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Source- and product-oriented strategies in L2 acquisition of plural marking in German

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Abstract This article deals with the acquisition of the German plural system. It raises the question how morphologically complex words are represented in the mental grammar and in the lexicon of children and how this representation emerges.

There are several theoretical accounts dealing with this question. These accounts are basically of two kinds. One approach models the German number system as rule-based; i.e. source-oriented rules are postulated that operate on the singular form of the noun. The second approach is schema-based. Essential to this approach is the idea that speakers form the plural of a given noun according to prototypical plural shapes. Empirical evidence can be found for both approaches, but neither of them seems to be able to fully explain acquisitional paths on its own.

On the basis of the analysis of acquisitional data, this article argues for an expanded schema account that embraces both source- and product-oriented mechanisms. We propose an acquisition model according to which learners start out with storing plural forms holistically in an associative network; then they abstract product-oriented schemas from these stored forms that focus on the typical gestalts of German plural forms. In a last step, they establish source-oriented schemas that relate singular schemas with plural schemas.

The data for this study were gathered in a nonce word elicitation experiment from children aged 6 to 10 learning German either as their native or second language. In the latter case, the children's L1 was either Russian or Turkish.

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1 Models of inflectional morphology

In a traditional morphological analysis, a morphological complex word is viewed as being put together by its component parts, which, in the case of German plural morphology, are the nominal word stem and the plural marker. This approach can be illustrated with the German plural form *Hunde* ('dogs'). This form can easily be analyzed into the stem *Hund* ('dog') and the plural marker *-e*. However, this analysis seems to be less obvious with German plural forms like *Gärten* ('gardens'), where the plural is marked by an umlaut that cannot be separated from the stem. Or, take a singular-plural pair like *das Messer* ('knife')–*die Messer* ('knives'), where the plural is not marked overtly on the noun. These facts constitute problems for any structuralist or generative item-and-process (IP) based analysis in morphology. In IP models, the distribution of plural markers on noun stems is described as a complex system of rules with long lists of exceptions (cf. for example Mugdan 1977 for plural marking in German). Bybee (2003:126) refers to these rules as source-oriented, as they "act on a specific input to change it in well-defined ways into an output of a certain form." The source-oriented view thus implies that there is a base or underlying form, in our case, the nominative singular of a noun, from which the other word forms, in our case, the nominative plural, are generated. This can be illustrated with one of the rules that Mugdan (1977:87) establishes for the German plural system: "Bei Stämmen auf /ə/ steht {//ɐn//}": Noun stems ending in schwa take the plural marker *-n*.[1]

These descriptions of the German plural morphology have in common that the gender and the final phonetic/phonological shape of the singular form are the relevant factors on which the rules are based, e.g. feminine nouns ending in schwa take the plural marker *-n* (for a more detailed description of the German number system cf. the following section). From a psycholinguistic perspective, i.e. the mental representation and acquisition of inflectional morphology, the symbolic account corresponds largely to this morphological model. In the symbolic account, it is assumed that speakers take the singular stem and change it according to specific rules to derive the desired plural form. Irregular plural forms that cannot be derived by a rule are stored holistically (cf. Günther 2004).

With regard to learning-processes, it is more or less explicitly assumed that learners would first have to analyze a given plural form into a stem and a plural marker and then learn the rules for the distribution of the plural markers relative to the noun stems to which they can be attached (cf. Wegener 1995). Those plural forms that cannot be captured by these rules have to be stored as exceptions. Due to this different treatment of regular and irregular forms, these models are also known as dual-system approaches (cf. Gor 2010). A prominent instance of this approach is the dual-mechanism model (Clahsen et al. 1992; Clahsen 1999; Pinker 1999; Sonnenstuhl-Henning 2003), which postulates one regular default plural marker (*-s*)

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[1]IP rules might also be regarded as not being source-oriented when a rule such as N[pl] → N[sg] + *-e* is read as "the plural form consists of the singular form plus *-e*". Still, even under this interpretation of the rule, the plural is analyzed as a singular form that has been changed in certain ways.

and long lists of exceptions to account for the German number system.[2] As Gor (2010) observes, this view has been challenged by the connectionist modelling of neural networks which have been able to simulate rule-like behavior without integrating rules into the model. From a linguistic perspective, the IP-model has been criticized because it reduces the morphological system to the relation between stem (singular) and derived form (plural), where the latter is not thought of as having an independent representation (e.g. Bybee 1985, 1988; Köpcke 1993).

An alternative to rule-based treatments of inflectional morphology are linguistic models that assume that the speaker and his individual linguistic experience influence his construction of the structure of grammatical systems in crucial ways. These approaches can be subsumed under the label of usage-based linguistics. Bybee (2006:711) summarizes the difference as follows: "While all linguists are likely to agree that grammar is the cognitive organization of language, a usage-based theorist would make the more specific proposal that grammar is the cognitive organization of one's experience with language." The grammatical organization emerges as a result of the storage of concrete word forms. Through the recognition of phonological and semantic similarities between the stored words speakers are able to abstract schemas.[3] In Bybee's (1988:135) words a schema is "an abstraction from existing lexical forms which share one or more semantic properties. The schema contains the features most strongly represented (i.e., represented most often) in existing forms in the position of their occurrence." Applied to the German number system, Bybee's conception of schema means that speakers abstract from the different plural forms (e.g. *die Blumen* ('flowers'), *die Hunde* ('dogs'), *die Autos* ('cars'), etc.) different phonological schemas that convey the meaning of plurality. The abstracted schemas contain the article *die* and the ending of the word form since these are the features that are identical for German plural forms. A more detailed description of the existing plural schemas in German is given in the following section.

While morphological rules, as stated in IP-based models, are source-oriented as explained above (i.e. they operate on the singular form of a noun), a schema is product-oriented, in the sense that it generalizes over many forms that belong to a specific grammatical category (in our case, plural). Consequently, in a schema approach no specification is necessary as to how a category (e.g. plural) is derived from some other category (e.g. singular), cf. Bybee (2003:126).

The different conceptions of inflectional morphology have led to an ongoing debate about the adequacy of the concepts *rule* and *schema*. As already pointed out above, one fundamental difference between a schema and a rule is that the latter is source-oriented, in the sense that it operates on a base form, which, in this case, is the singular of a noun accompanied by its grammatical information, i.e. gender, and

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[2]The definition of -*s* as default-plural is based on the claim that -*s* is used without restrictions with nouns of every gender, mono- or bisyllabic roots, roots ending in a consonant or a vowel, nominalized conjunctions, eponyms and product names, and with nominalized verb phrases (Clahsen 1999:995). However, it has been shown that -*s* is not used as a default, but, on the contrary, only in specific contexts (for nouns ending in an unstressed full vowel or pragmatically marked nouns like proper names, and those named above), which holds for all the other plural markers as well (cf. Stemberger 1999; Laaha et al. 2006:278).

[3]Cf. Tomasello (2005) and Behrens (2009) for more detailed description of the acquisition process in the usage-based model.

phonotactic structure. Schemas, on the other hand, are product-oriented in the sense that they represent characteristics of the target form, i.e. in our case the plural of a noun. According to this conception, the paradigmatic relations between singular and plural are not necessarily analyzed. Other important characteristics of product-oriented schemas in comparison to source-oriented rules are that the former do not exist independently of the concrete word forms from which they emerge, and that they are highly affected by the number of participants that share the same properties: A schema that applies to a large number of words is more productive than one that applies only to a few examples. Furthermore, schemas are organized around a prototype. This means that there is a prototypical schema associated with a certain grammatical function. Schemas that do not display all elements of the prototype are still associated with the grammatical function, but to a lesser degree; as a result, they are gradient rather than discrete entities and there is no clear-cut difference between regular and irregular elements.[4]

As already pointed out above, these models of inflectional morphology find their psycholinguistic counterpart in connectionist models of language acquisition or mental representation (Rumelhart and McClelland 1986). As these models can simulate rule-like behavior without the notion of rules, there is no need for assuming two mechanisms as in dual-mechanism models, where one deals with regular elements and the other one with irregular elements. Rather, in these single-route models (Bybee 1995; Elman et al. 1996; Seidenberg and Elman 1999), all elements are processed in the same way, i.e. by associative patterning (cf. Gor 2010). As Gor (2010) observes, the controversial issue of dual- vs. single-system accounts that has dominated the discussion about the learning of inflectional morphology has come to a standstill without reaching a solution.

In this study, we would like to shift the focus from the single- or dual-system debate to the question whether learners follow source-oriented rules to form a German plural or whether they aim to produce a plural form that conforms to a typical plural schema without considering the paradigmatic fitting of singular and plural form.

2 German plural system

2.1 Source-oriented rules

Plural formation in German is a fairly complex grammatical system, since, different from English, several distinct forms mark plurality on the noun (cf. Mugdan 1977; Augst 1975; Köpcke 1993; Wegener 1995). Table 1 gives an overview of the plural markers.

The first four plural markers are suffixes; the fifth is phonetically zero, and is analysed as a zero morpheme, since it occurs in plural contexts completely parallel to the other plural suffixes. The sixth is an umlaut mutation in the stem vowel of the singular form of the noun, for example the change from [u] to [y] in *Bruder–Brüder*

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[4]The question which of the plural schemas in German represents the prototype will also be answered in Sect. 2.2 where an analysis of the frequency of nouns instantiating a specific plural schema in the children's productive lexicon is presented.

Table 1 Native plural markers in German (cf. Köpcke 1993:36)

Plural marker	Examples		
	Masc.	Fem.	Neut.
-e	Fisch/Fische ('fish')	Kenntnis/-nisse ('knowledge')	Jahr/Jahre ('year')
-(e)n	Bauer/Bauern ('farmer')	Tür/Türen ('door')	Auge/Augen ('eye')
-er	Geist/Geister ('ghost')	–	Kind/Kinder ('child')
-s	Park/Parks ('park')	Mutti/Muttis ('mom')	Auto/Autos ('car')
-ø	Adler/Adler ('eagle')	–	Fenster/Fenster ('window')
Umlaut (*UL*)	Vater/Väter ('father')	_[a]	_[b]
UL + *-e*	Sohn/Söhne ('son')	Kuh/Kühe ('cow')	_[c]
UL + *-er*	Wald/Wälder ('wood')	–	Volk/Völker ('people')
def. article	der SG/die PL	die SG/die PL	das SG/die PL

[a]In the entire lexicon there are only two instances, namely *Mutter–Mütter* 'mother–mothers' and *Tochter–Töchter* 'daughter–daughters'

[b]Only one instance, namely *Kloster–Klöster* 'monastery–monasteries'

[c]Only one instance, namely *Floß–Flöße* 'raft–rafts'

'brother'–'brothers'. *Umlaut* is the only morpheme that can combine with others, namely *-ø*, *-e*, and *-er*.[5] Some of the morphemes are limited to two of the three gender classes. Thus, while gender does not predict the plural morpheme, it does constrain its selection. Although in structural analyses determiners are not viewed as plural markers, they are included in the present analysis, since, from a perceptual point of view, they are an additional source of information in the NP regarding grammatical number, and when they co-occur with the zero suffix, they are the only source of information, e.g. *der Wagen–die Wagen* 'car'–'cars'. There have been attempts to reduce the number of plural markers. From a structural point of view, Wegener (1995) suggests that, due to phonological regularities, the number of plural markers can be reduced to a set of five forms, namely *-(e)n*, *-(e)*, *-s*, *(UL +) -er*, *UL + -(e)*. The relatively small number of German plural markers correlates with the prosodic fact that German plural forms exhibit almost exclusively a trochaic pattern except for the small number of monosyllabic native German nouns that form their plural with *-s*. Thus, if the singular form already displays a trochee, no schwa is added in the plural (e.g. *der Wagen–die Wagen* 'car'–'cars'). But, if the singular form does not display a trochee, schwa is added to obtain the typical trochaic word structure (e.g. *der Hund–die Hunde* 'dog'–'dogs'). Bittner (1991:39), however, argues, that *-ø* and *-e* should not be analyzed as allomorphs as there is no complementary distribution in the sense that every time *-e* does not appear, *-ø* is chosen instead. For this paper, the actual number of plural markers is not of central importance since in this article word forms are thought of as holistic gestalts that are not segmented into a root and an ending (cf. the Sect. 2.2).

The distribution of these markers can be described on the basis of gender: masculine and neuter nouns form their plural predominantly with the suffix *-e* and feminine

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[5]In the following data analyses, we focus on the endings and leave the *Umlaut* aside.

Table 2 Mapping of schemas to the functions *singular* and *plural* in German

	Schemas[a]				
	$'\sigma\ \sigma$	$'\sigma\ \sigma$	$'\sigma\ \sigma$	$'\sigma\ \sigma$	$'\sigma\ \sigma$
	| |	| |	| |	| |	| |
	X ən	X ə	X Vs	X ɐ	X əl
Plural	*Blumen* ('flowers')	*Hunde* ('dogs')	*Autos* ('cars')	*Kinder* ('children')	*Sessel* ('armchairs')
Singular	*Wagen* ('car')	*Blume* ('flower')	*Atlas* ('atlas')	*Messer* ('knife')	*Sessel* ('armchair')

[a]The syllable structure $['\sigma\sigma]$ illustrates the trochaic structure of the schemas. This notation is not intended to mark syllable boundaries

nouns with the suffix -(*e*)*n*. Furthermore, there are preferences in choice based on the phonological structure of the noun, e.g. nouns ending in an unstressed full vowel (-*v* in the following) form their plural with -*s*, e.g. *Auto*, *Kino*, *Taxi* etc. Nouns ending in -*e* form their plural with -(*e*)*n*, independently of gender. Finally, there are preferences based on a combination of gender and phonological shape: masculine and neuter nouns ending in a closed schwa-syllable (-*el*, -*er*, -*en*), with rare exceptions, form their plural with -*ø*.

Some studies provide evidence for the assumption that learners do indeed follow these source-oriented rules when producing German plural forms. For example, in their study of the acquisition of German plural morphology by monolingual German speaking children, Laaha et al. (2006:297) find that "already in the youngest age group of our study (2;6–3;0), children must have identified the relevance of the gender distinction between feminine and non-feminine and of word-final phonology".

2.2 Product-oriented schemas

As Köpcke (1993) notes, none of the plural formations in German can be exclusively associated with the semantic notion of plurality. For example, a schema that ends in schwa can be associated with a singular meaning as well as with a plural meaning. This holds for almost all schemas that can be abstracted from German plural forms as Table 2 illustrates.[6]

As Table 2 illustrates, nearly all plural schemas display a trochaic structure with the exception of the few monosyllabic nouns forming their plural with -*s* (*Park–Parks*) which are not mentioned in Table 2. Furthermore, nearly all plural schemas end with a reduced schwa syllable. Again, only those nouns that end in an unstressed vowel and which form their plural with -*s* do not display this structure. The different plural schemas differ greatly concerning the reliability with which the various schemas signal plural. According to Köpcke (1993), the crucial criteria for the reliability of plural schemas are a joint effects of type- and token frequency, saliency, iconicity, and validity of the relevant schema components. Type frequency refers to

[6]We focus on schemas for the nominative only.

Table 3 Evaluation of plural markers (cf. Köpcke 1993:85)

Plural marker	Saliency	Type frequency	Token frequency	Validity	Iconicity
-(e)n	+	+	+	+	+/−
-s	+	−	−	+	−
-e	+	+/−	−	−	+
-er	+	−	−	−	+

the number of nouns that take a certain plural marker. For example, the plural marker -(e)n is far more frequent than the other markers. Token frequency measures how frequently nouns occur in language use. The term *saliency* refers to the acoustic perceptibility of the different plural markers: A marker that adds phonetic material to the noun is more salient than an *Umlaut*, which does not add phonetic material to the noun. A marker that adds a syllable to the noun stem is more iconic than a marker that does not, e.g. -*e* vs. -*s*. Finally, the parameter of validity specifies the frequency with which a phonetic shape appears in the plural vs. singular. For example, nouns ending in -(e)n are quite often plural nouns, but there are also a few singular nouns ending in -(e)n. Table 3 lists the plural endings and assigns the above-mentioned criteria to them. The basis for Köpcke's evaluation is Mater's (1970) reverse dictionary.

Wecker (2016) argues that it would be more appropriate for a schema-based approach to analyze the whole schema, not isolated features (i.e. the plural markers). This means that one needs to analyze the frequency with which a certain phonological shape as a whole appears in singular and plural contexts. The criteria of saliency and iconicity are not considered as they can only be evaluated by contrasting the singular and the plural form, which, methodologically, amounts to a source-oriented analysis. In her study, Wecker analyzes the children's productive vocabulary based on the corpus compiled by Pregel and Rickheit (1987)[7] and evaluates the possible schemas with regard to their frequency and validity. Wecker finds that bisyllabic schemas containing the features definite article *die* and the endings -(e)n[8] > -*s* > -*er* > -*el*[9] > -*e* > -*ø* [10] are, from left to right, decreasingly reliable for signalling the function of plurality (cf. Table 4). This means that, taking the children's lexicon as the basis, a noun ending in -(e)n displays a high reliability for denoting the function of plurality and can be described as the prototypical plural schema, whereas a noun ending in -*e* displays a very low reliability for this function. A monosyllabic noun does not display any reliability at all for the function of plurality.

Evidence for the assumption that learners do not simply follow source-oriented rules when producing a German plural form comes from several studies. For example, acquisition studies show that children learning German as their first or second

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[7]Pregel's and Rickheit's corpus of monolingual German speaking children is based on word production from the age of 6 to 10 years.

[8]This unit comprises all plurals ending in a schwa syllable plus -*n*: -*en*, -*ern*, -*eln*.

[9]As a matter of fact, -*el* is not a plural marker in German, but, since this ending occurs frequently in plural contexts, we assume that children designate a plural schema to nouns with that shape.

[10]-*ø* here stands for a monosyllabic noun without a specific ending.

**Table 4** Noun endings in singular and plural contexts in the learner's lexicon

Noun endings	Plural	Singular
-ø	0	7.5 %
-el	3 %	0.9 %
-s	5.5 %	0.5 %
-er	21 %	0.9 %
-e	31 %	20.6 %
-(e)n	39.5 %	0

language especially overgeneralize the plural marker that is considered to be most typical for signalling the plural, i.e. *-(e)n* (cf. Behrens 2002; Bittner and Köpcke 2001; Köpcke 1998; Szagun 2001; Wegener 2008). Also, Köpcke (1998) shows in a reanalysis of acquisitional data in Mugdan (1977) that the learners tend to repeat the stimulus item (i.e. the singular form) the more the item resembles a prototypical plural schema.

3 Proposal for a combined model

So far we have seen that there are two main theoretical approaches to inflectional morphology and its acquisition and processing: The rule-based approach (including dual-mechanism) that assumes source-oriented rules in order to describe the system and the schema approach that describes product-oriented schemas. With regard to the acquisition and processing of inflectional morphology, the former assumes that learners abstract the rules for the regular elements of the German number system and store the irregular plural forms holistically. The latter approach describes the acquisition process as the abstraction of product-oriented schemas that are associated with the function *plural*. Speakers thus produce a plural by matching a form with stored plural schemas rather than deriving it from the singular form. Empirical evidence can be found for both approaches. To our mind, neither of them is fully satisfactory for two reasons: First, neither a rule-based model nor a schema model can explain all acquisitional data. In studies that take a rule-based perspective, a relevant number of data is discarded as being not explicable (cf. Mugdan 1977; Laaha et al. 2006; Wegener 1995). Studies that take the schema perspective mostly focus on the explanation of these otherwise inexplicable data without taking into account data that can be accounted for by rules (cf. Köpcke 1998). Second, neither the rule- nor the schema-based models can explain the developmental phases in the acquisition process, i.e. the steps the learners go through on their way to mastering the German plural morphology. To our mind, these problems can be solved in an expanded schema model that comprises both, source- and product-oriented mechanisms. In this regard, we follow Nesset (2008), who argues in favor of a differentiation between first-order- and second-order schemas. In our model, a first-order schema corresponds to what we have described so far as a schema, i.e. a generalization about word forms, that is mapped to a certain grammatical function (in our case the nominative plural). The first-order schemas are product-oriented in that they describe characteristics of the

Fig. 1 First- and second-order schemas
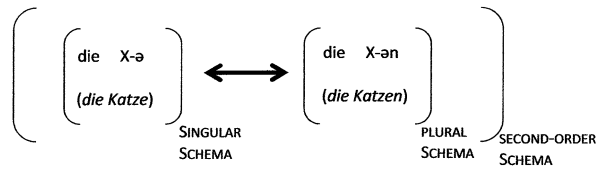
form without relating it to other forms of the paradigm. An example is the schema that contains the definite article *die* and the ending *-en* and is mapped to the function of plurality (cf. the schemas listed in Table 2). A second-order schema accounts for the paradigmatic relations between different first-order schemas. A second-order schema is thus a kind of a "super"-schema that relates two first-order schemas to each other. As shown in Table 2, there are (first-order) schemas that are mapped to the function *singular* and (first-order) schemas mapped to the function *plural*. The relation between those two functions was not considered but there are preferences for the matching of schemas from both functions. For example, nouns instantiating the first-order schema that contains the article *die*, the ending schwa and is mapped to the function singular (e.g. *die Katze* 'cat') are paradigmatically related to nouns instantiating the first-order schema that contains the article *die*, the ending *-en* and is mapped to the function plural (e.g. *die Katzen* 'cats'). This paradigmatic relation can be captured by the second-order schema that expresses the fact that singular schemas with the article *die* and the ending schwa are connected to plural schemas with the article *die* and the ending *-en*, cf. Fig. 1.

We contend that speakers abstract not only (first-order) schemas for certain grammatical functions but also (second-order) schemas for the paradigmatic relations among different first-order schemas. These second-order schemas are still considered as schemas (and not rules) as they are abstractions over occurring word forms (and thus sensitive to frequency effects) and organized around a prototype. This point can be illustrated by the following example: The second-order schema described above in Fig. 1 is very strong as there is a large amount of singular and plural forms that correspond to the described first-order schemas and that are paradigmatically related. There are however other nouns, not ending in schwa and of neuter or masculine gender that also have plural forms ending in *-en*, as for example *der Bär–die Bären* ('bear'–'bears').[11] These are instantiations of a relatively weak second-order schema as there are only few instantiations of this schema. The assumption of second-order schemas would predict that the two first-order schemas that define the reliable second-order schema strive for being paradigmatically related whereas instantiations of two first-order schemas that are paradigmatically related but do not belong to a strong second-order schema tend to change their form in order to fit the stronger second-order schema. Evidence for this process can indeed be found by looking at diachronic data, e.g. the change of the masculine monosyllabic noun *der Perl* ('pearl') to the feminine noun ending in schwa *die Perle*. To our mind, this change of gender and form of the base form can be explained by the fact that the former nominative plural *die Perle* was reinterpreted by the speakers as the nominative singular

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[11]Those nouns follow the weak declension schema. As Köpcke (2000) shows, those masculine nouns that do not dispose of all the characteristics of prototypical weak inflecting masculine nouns (schwa ending, trochaic structure, animate) tend to change the declension class.

form, since the plural form (*die Perle*, 'pearls') occurred more frequently than the singular form (*der Perl*, 'pearl'). As a consequence of this reinterpretation, the new plural form in *-en* evolved, i.e. *die Perlen* which is without any exception chosen for feminine nouns ending in schwa. At that point the pair *die Perle–die Perlen* matched a strong second order schema.

One difference between first-order and second-order schemas is, of course, that second-order schemas are source-oriented as they capture generalisations about paradigmatically related forms or first-order schemas. The assumption of these two different kinds of schemas makes it possible to account for both source- and product-oriented mechanisms within the schema model: While generalizations about the product (in this case, the plural form) are captured in first-order schemas, generalizations about the paradigmatic relation between source and product (in this case, the singular and the plural form) are captured in second-order schemas. It is thus preferable to a theoretical account that comprises only (source-based) rules or (product-oriented) schemas or to an account that operates with two different mechanisms (rules and schemas).

With this theoretical background, the acquisition process can be modeled as follows: Learners start by storing nouns holistically in their mental lexicon. These stored nouns are matched with each other by phonological and semantic similarities. In a first step, learners abstract first-order schemas from these stored word forms and map phonological schemas onto a grammatical function. After this first step source-oriented second-order schemas emerge, since they are based on first-order schemas. This means that first, learners acquire typical shapes for singulars and plurals and, in a second step, establish paradigmatic relations between these two functions. In other words, we assume that learners at first follow a product-oriented strategy when marking the plural on a noun, i.e. they compare the concrete form to their stored plural schemas. Later, the source-oriented strategy will become more predominant, i.e. learners will mark the plural according to specific characteristics of the singular form (gender and final sounding).

As in this study we examine the acquisition process of three different learner groups (German as L1, German as L2, Russian as L1 and German as L2, Turkish as L1), we need to keep in mind that one dominant question in the research on (early) second language acquisition is whether, and if so, in what way the L2 acquisition process differs from the L1 acquisition process and whether the learner's first language influences the acquisition process of the target language. Whereas in the early days of second language research the first language was seen as the crucial factor that determines the acquisition process in the second language (Lado 1957), researchers later put forward the hypothesis that the L2 acquisition process proceeds independently of the learner's L1 (Dulay and Burt 1974). In contemporary approaches, independently of their theoretical orientation, it is assumed that the learner's L1 is a crucial factor, among others, in second language acquisition (White 2007; Bybee 2008; MacWhinney 2001; Gass and Selinker 2008). With respect to the acquisition of morphology, however, this assumption is not uncontroversial, since some studies show no influence of L1 at all (e.g. Parodi et al. 2004). On the other hand, in Wegener's (1994) study of the second language acquisition of the German plural system by children with Turkish, Russian, or Polish as L1, it is shown that the first language does

indeed indirectly influence the acquisitional process. It is assumed that the prior linguistic knowledge serves as a background against which the target system is analyzed and processed. Since the present article deals with Russian and Turkish learners, we provide a brief description of the plural system of these two languages.

Russian, like German, is a fusional language, whose inflectional paradigms are characterized by numerous syncretisms. As in German, there are several endings to mark the plural on the noun (*-y*, *-i*, *-a*, *-ja*). The distribution of these plural markings can be described on the basis of the gender or inflectional class of the noun; nevertheless, the specific plural marker cannot be predicted in all cases. In this respect, the Russian plural system is parallel to the German plural system. Turkish, which does not have the category of grammatical gender, is an agglutinative language, where the relation between grammatical functions and forms is usually transparent and regular. There is only one marker, which expresses the plural on the noun, i.e. *-ler*, with the phonological variant *-lar*. Which of these allomorphs is chosen, depends entirely on the phonological structure of the noun (vowel harmony). It is important to note, that the plural marker, contrary to Russian and German, is not obligatory in all contexts, in particular, it does not have to occur when a number word precedes the noun. In sum then, the Turkish plural system is much more regular and less complex than the German and the Russian systems. The decision for choosing these two typologically very different languages is important in light of our theoretical argument: The typological differences allowed us to test whether participants show different acquisitional strategies due to their first languages.

4 Hypotheses

In light of the expanded schema-approach to language acquisition, our general assumption is that L2-learners, as well as monolingual German speaking children, will not only pursue a source-oriented strategy to form a plural, i.e. they will not exclusively rely on specific characteristics of the singular, such as the ending and the gender of a given noun in order to produce a plural form on the basis of source-oriented-rules. Rather, L2-learners will, in addition to a source-oriented strategy, follow a product-oriented strategy. Since the abstraction of schemas from concrete word forms in the input relies on language-independent cognitive abilities, we assume that the aforementioned strategies can be observed for both L1 and L2-learners. This general assumption can be fleshed out into the following more specific hypotheses H1–H4[12]:

H1: Even though masculine and neuter nouns ending in *-el, -er*, or *-en* mark their plural in almost all cases with -ø, we expect to find striking differences in the use of -ø. Given our assumptions about the different degrees of reliability of plural schemas, we predict that -ø will be used most frequently with nouns ending in *-en*, less so with nouns ending in *-er*, and least with nouns ending in *-el*. For noun stems ending in *-e*, learners will also use -ø, since this is a potential

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[12]Prior to our data analyses, we have spelled out these hypotheses in terms of more specific statistically verifiable hypotheses. The results of the statistical analysis are listed in the Appendix.

plural schema. Note, that in the target language, nouns ending in their singular in schwa always add an overt plural marker. A word form, which does not display any of the endings listed in Table 4 should not be associated with the function of plurality at all, i.e. monosyllabic nouns.

H2: If learners produce plural forms that differ from the singular, they will preferentially rely on forms ending in -(*e*)*n*, since this form represents the prototypical plural schema, cf. Sect. 2.2.

H3: With regard to the acquisition process, we assume that learners in an earlier acquisitional stage rely more dominantly on the product-oriented strategy when building a new plural form and that the source-oriented strategy becomes more important at an advanced acquisitional level.

H4: Since our general hypothesis only relies on language independent cognitive abilities and not so much on prior linguistic knowledge, we assume that there will be only marginal differences between learners with Russian or Turkish as their L1. In other words, learners will make use of schematic representations independently of their first language. Knowledge from the L1 will serve only partially as a background against which the new linguistic system is analyzed and processed, e.g. it might be quite possible that learners with Turkish as their L1 tend to omit plural markers more frequently than learners with a Russian background, since the omission of plural markers occurs frequently in Turkish but rarely in Russian.

5 Method and participants

The participants of this study were 65 children with Turkish or Russian as their first languages from grade one to four from five different schools in North Rhine-Westphalia, Germany, as well as a control group of 20 monolingual German speaking children of the same age range and the same schools.

The participants were subdivided into four groups according to their status as first or second language learners of German and age (grade). For grade one and two, 25 children with Turkish or Russian as L1, and ten monolingual German speaking children participated in the study. For grade three and four, 40 children with L1 Turkish or Russian, and ten monolingual German speaking children participated. As the age of onset of acquisition for most participants with L2 German was around age three to four, the older participants had a longer exposure to the German language.[13]

In our study we conducted nonce word tests to elicit plural forms. Similar to the Berko (1958) tests, an image of a made-up object was shown to the children on a computer screen along with a fantasy name. For example, the interviewer said: *Das ist die Trunt* ('That is the FEM Trunt'). The images depicted animate and inanimate objects. Since the test sentences contained the definite article, the children obtained information about the gender of the noun. The nonce word and its definite article were also presented in written form above the image of the artefact. The interviewer

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[13]Most of the participants were born in Germany and visited kindergarten. In a questionnaire most of the children specified that Turkish or Russian is the dominant language spoken at home. We thus concluded that the age of onset of acquisition must have been around three to four.

Table 5 Test items

Gender	Word-structure					
	Monosyll.	X-*e*	X-*el*	X-*er*	X-*en*	X-*v*
M	Schlass, Troch	Manke, Fulke	Trunkel, Knaffel	Knuker, Grutter	Trauken, Stossen	Trunta, Treifa
N	Gocht, Knolk	Flunde, Knumpe	Trolchel, Spauchel	Zorfer, Knauker	Gratten, Trunten	Siero, Wiero
F	Trunt, Procht	Duhre, Mafte	Knussel, Wontel	Wuhrer, Bachter	–	Kafti, Kaftu

repeated each nonce word together with its definite article. Next, an image of several of these objects was shown on the computer screen and the children were asked how they would refer to several of these objects using the given nonce word. The children gave answers such as: *die Trunten* ('the.$_{PL}$ Trunt.$_{PL}$'), or *die Trunte* ('the.$_{PL}$ Trunt.$_{PL}$'), or *die Trunts* ('the.$_{PL}$ Trunt.$_{PL}$'), for example. In this way, plural forms for the nonce words were elicited.

To make the test situation more natural, the interviewer told the participants that she was writing a children's fantasy story, in which a lot of new creatures or objects are introduced, and that she needed help from the children for how these creatures/objects should be named. One test session took about five minutes. The interviewer made sure that each session contained two to three breaks in order to avoid overfatigue and lack of concentration on the part of the children, which would have resulted in unreliable responses. During these breaks, the children were asked questions about their everyday lives.

In using artificial nouns that conformed to the phonological structure of real German nouns, we made sure that the children had never heard the items before. The test items were artificial nouns that instantiate the basic regularities of the German plural system. Two sets of test items were used: The first set was taken for the first and third session, the second was taken for the second session. The time interval left between sessions was eight weeks, which made it possible for us to check for developmental progress. Table 5 shows the test items and the structure they display.[14]

6 Results and discussion

As the data points for each test are quite small and no consistent development in the time span of the three tests (four months) could be detected, the answers to the three tests were collapsed. To account for multiple testings, we applied Bonferroni corrections. Since there were no clear differences between the participants' answers for masculine and neuter items, the results for masculines and neuters were analyzed

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[14]The items were mostly taken from Köpcke (1993). To assure that no homogenous associations with existing German, Turkish or Russian nouns would be evoked, the items were previously tested for the associations they evoke with a group of students with German, Russian, or Turkish as first languages, respectively.

as one. Table 6 shows the results in percentages.[15] In the left column, the word-structures of the test items are listed.[16] In the columns to the right, the numbers before the slash indicate the frequency of use of the respective plural marker by the younger children. The numbers after the slash refer to the older children. For example, 30.8 % of the younger children with L1 Turkish used the plural marker -(*e*)*n* with the monosyllabic feminine items. The remaining percentages were: -*ø*: 46.2 %, -*e*: 15.4 %, -*er*: 0 %, -*s*: 7.7 %.

For statistical analysis, we conducted a series of independent Wilcoxon tests. For the comparison within language groups, we used a Chi-squared test or an independent Wilcoxon test. We assessed the influence of item type, gender and participant group on the use of zero marking, and the influence of gender and participant group on the use of the plural marker -(*e*)*n*. We would like to emphasize, though, that we regard our study as, at least in part, exploratory. We have included many variables and different conditions of these variables, such that we now have at our disposal a collection of potentially relevant effects. This comes at the cost of a complex data structure. We hope that our results could serve as a basis for other quantitative studies that could further explore aspects of our data.

The discussion of the results is divided into two parts: We will first discuss those cases where the participants did not change the input item, i.e., where they seemed to use zero-marking. In the second part we will deal with those cases where the subjects made use of an overt plural marker.

6.1 No overt plural marking

As can be seen in Table 6, the participants mostly used -*ø* more often for items for which this would be predicted in a rule-based approach (non-feminine nouns ending in -*el*, -*er*, -*en*). At first sight, it seems that the participants tended to use -*ø* according to the regularities in the system. They thus seemed to apply a source-oriented strategy by choosing the plural marker, which is triggered by the relevant characteristics (gender and ending) of the singular form. At second sight, however, it becomes apparent, that our subjects also applied a product-oriented strategy. This becomes evident in the case of items that, from a structural point of view, require -*ø*-marking, i.e. the masc./neut. nouns ending in -*el*, -*er*, or -*en*. Figure 2 shows how often -*ø* was used for these items. As there are no remarkable differences between participants with Turkish or Russian as L1, the results for those groups are summarized.

Most importantly, Fig. 2 shows that the participants did not use -*ø*-marking to the same degree for the three item types ending in -*el*, -*er*, and -*en*. They rather used -*ø* most frequently for items ending in -*en*, less so for items ending in -*er* and even less for items ending in -*el*. This is in accordance with H1. These differences between the item groups are statistically significant when the answers of all participants are

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[15]In cases where the sum of the plural markers does not make 100 %, this is due to other forms the participants produced (e.g. *Trunti* etc.). We will concentrate in our analysis on the plural suffixes and not consider the use of *Umlaut*.

[16]For items ending in a full vowel, the answers for non-feminine and feminine items were not analyzed separately, since they do not behave differently in the target language.

Table 6 Results of the experiments

Section a: Turkish 1–2/3–4

Test item	Chosen plural marker (in %)				
	-(e)n	-ø	-e	-er	-s
Monosyll. F (N = 13/34)	30.8/32.4	46.2/2.9	15.4/38.2	0/8.8	7.7/17.6
Monosyll. –F (N = 26/68)	19.2/25	34.6/5.9	26.9/30.9	0/25	19.2/11.8
X-e F (N = 13/34)	46.2/67.6	38.5/20.6	0/0	7.7/5.9	7.7/5.9
X-e –F (N = 26/68)	65.4/52.9	55.8/26.5	0/1.5	3.8/10.3	7.7/8.8
X-el F (N = 13/34)	61.5/47.1	23.1/41.2	7.7/5.9	0/0	7.7/5.9
X-el –F (N = 26/68)	38.5/50	46.2/29.4	0/1.5	0/4.4	15.4/14.7
X-er F (N = 13/34)	46.2/44.1	30.8/26.5	0/2.9	0/2.9	23.1/23.5
X-er –F (N = 26/68)	11.5/35.3	53.8/32.4	0/4.4	0/0	30.8/27.9
X-en –F (N = 26/68)	0/4.4	76.9/73.5	0/7.4	3.8/5.9	15.4/8.8
X-v F/–F (N = 39/102)	17.9/22.5	28.2/9.8	2.6/2.9	5.1/7.8	46.2/55.9

Section b: Russian 1–2/3–4

Test item	Chosen plural marker (in %)				
	-(e)n	-ø	-e	-er	-s
Monosyll. F (N = 27/59)	18.5/55.9	18.5/1.7	37/37.3	3.7/1.7	22.2/1.7
Monosyll. –F (N = 54/118)	18.5/28	14.8/2.5	38.9/48.3	11.1/14.4	14.8/5.1
X-e F (N = 27/59)	44.4/78	37/11.9	0/1.7	0/1.7	14.8/6.8
X-e –F (N = 54/118)	40.7/61.9	44.4/20.3	0/1.7	0/4.2	5.6/8.5
X-el F (N = 27/59)	44.4/61	33.3/10.2	3.7/6.8	3.7/1.7	11.1/20.3
X-el –F (N = 54/118)	31.5/45.8	46.3/27.1	7.4/5.1	1.9/3.4	13/18.6
X-er F (N = 27/59)	22.2/40.7	51.9/23.7	0/10.2	0/0	22.2/25.4
X-er –F (N = 54/118)	16.7/23.7	51.9/37.3	1.9/4.2	0/0	27.8/33.9
X-en –F (N = 54/118)	0/5.9	83.3/72.9	1.9/4.2	1.9/1.7	7.4/11.9
X-v F/–F (N = 81/177)	13.6/20.9	28.4/6.2	11.1/4.5	3.7/5.1	38.3/53.1

Section c: German 1–2/3–4

Test item	Chosen plural marker (in %)				
	-(e)n	-ø	-e	-er	-s
Monosyll. F (N = 13/17)	69.2/47.1	7.7/0	15.4/52.9	7.7/0	0/0
Monosyll. –F (N = 26/34)	38.5/20.6	15.4/8.8	26.9/52.9	11.5/0	3.8/17.6
X-e F (N = 13/17)	76.9/64.7	15.4/17.6	0/0	7.7/5.9	0/11.8
X-e –F (N = 26/34)	61.5/55.9	15.4/23.5	0/2.9	11.5/0	11.5/8.8
X-el F (N = 13/17)	61.5/35.3	15.4/58.8	0/0	0/0	0/0
X-el –F (N = 26/34)	46.2/23.5	30.8/58.8	7.7/11.8	3.8/0	11.5/5.9
X-er F (N = 13/17)	53.8/11.8	30.8/47.1	0/11.8	0/5.9	0/11.8
X-er –F (N = 26/34)	26.9/2.9	46.2/67.6	0/5.9	0/0	26.9/23.5
X-en –F (N = 26/34)	3.8/0	84.6/88.2	3.8/2.9	0/0	3.8/8.8
X-v F/–F (N = 39/51)	23.1/7.8	15.4/19.6	2.6/7.8	10.3/11.8	48.7/43.1

Fig. 2 Use of *-ø* for
non-feminine items ending in
-el, -er, -en

Use of -ø for non-feminine items ending in -el, -er, -en
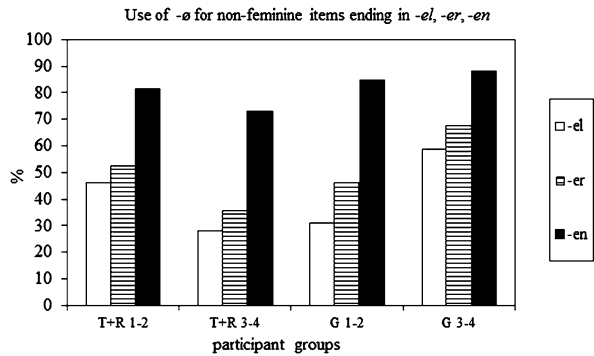
aggregated (*-el* < *-er*: $W = 263$, $p = 0.018$; *-er* < *-en*: $W = 1438$, $p < 0.001$; *-el* < *-en*: $W = 9$, $p < 0.001$).[17]

Keep in mind, that these results cannot be explained by assuming a rule-based mechanism, since all of these nouns regularly form their plural with *-ø* and therefore should be treated equally. But, if we analyze the products, i.e. the different plural forms that are obtained by applying zero-marking, we find that the plural schemas vary largely with regard to their reliability for representing the function of plurality (cf. the analyses of the children's productive vocabulary summarized in Sect. 2.2): forms ending in *-el* display very low reliability for conveying this function. Consequently, these items are often marked overtly (mostly by *-n* or *-s*, cf. Table 6) instead of *-ø*. Thus, the participants produce forms with higher reliability for plurality than the regular forms would exhibit. A noun ending in *-er* displays a higher reliability for plurality than a noun ending in *-el*. Consequently, the participants use *-ø* more frequently. But, since the reliability of this schema is rather low, the participants again frequently mark the plural overtly and produce thus plural forms that represent a schema with higher reliability. Forms ending in *-en* represent a schema with the highest reliability for plurality. Accordingly, the participants use *-ø* to up to 90 %. In sum then, the higher the reliability for plurality of the stimulus item, the stronger the tendency of the participants to use zero-marking on the noun.[18]

The plural formation for non-feminine items ending in *-el, -er*, or *-en* thus provides strong evidence in favor of the hypothesis that the participants tried to produce a form that communicates the function of plurality most clearly. Their strategy is thus not only source-oriented, but also product-oriented.

By comparing the different participant groups, one can also conclude that this product-oriented strategy is not a temporary phenomenon that vanishes with an increasing degree of proficiency of children with a Russian and Turkish L1 background

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[17]When a paired Wilcoxon test was run separately for the different participant groups, its outcome was significant for only some of them, presumably due to small group sizes. The detailed results are given in the Appendix.

[18]The fact that the participants did not add the marker *-(e)n* to a word form already ending in *-en* can be explained by the desire to avoid double marking. But, if they had wanted to mark the plural overtly, they still could have chosen *-s* which would have preserved the trochaic structure of the noun. The fact that they did not add *-s* but left the stimulus item unchanged speaks in favor of our hypothesis.

Fig. 3 Use of -ϕ for monosyllabic nouns, nouns ending in a full unstressed vowel (-v), and nouns ending in schwa
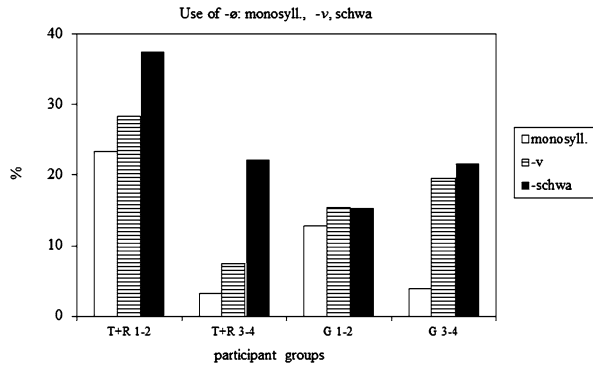
in German. Rather, the pattern is also manifested in the German control group in grades 3–4, the most advanced learners.[19]

In what follows we will have a closer look at items that, from a structural point of view, require an overt plural marker. Figure 3 shows the use of -ϕ for monosyllabic nouns, nouns ending in a full unstressed vowel (-v), and nouns ending in schwa.

Again, we can see that ϕ-marking is used to different degrees. It is used least frequently with monosyllabic items, slightly more often with items ending in an unstressed full vowel, and most frequently with items ending in schwa. These differences between the item groups are again statistically significant when the answers of all participants are added up (-ϕ < -e: $W = 856.5$, $p < 0.001$; -ϕ < -v: $W = 407.5$, $p = 0.027$; -v < -e: $W = 759$, $p = 0.011$).[20] These results cannot be explained by a rule-based mechanism. If such a mechanism were at work, the participants would have used -ϕ with equal frequency for all three item-types. But note that the items again show differences in their reliability for plurality. A monosyllabic item does not display any cue for plurality. Items ending in an unstressed full vowel are bisyllabic and thus show at least some similarity to a plural form. Finally, items ending in -e display the highest reliability for plurality as they represent a possible plural schema. Again these cases show that the participants did not solely follow a source-oriented strategy, but also applied a product-oriented strategy in producing a plural form.

If one compares the Russian and Turkish learners with regard to the use of -ϕ, one finds differences, since Turkish learners tend to omit the plural marking more frequently than Russian learners, cf. Table 6. It is thus important to point out that this fact does not contradict our general hypothesis H4 since Turkish learners indeed omit the plural marking more frequently than Russian learners but they also do so as a function of the form of the stimulus item: they omit the plural marker more often to the extent that the stimulus item already resembles a prototypical plural schema.

Finally, Fig. 4 shows how frequently -ϕ is used for feminine items ending in -el or -er. In light of our argument, two results are of interest: First, -ϕ is used less frequently for feminine items than for masc./neut. ones. This result is statistically significant

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[19]Even for adult speakers of German, this distribution has been demonstrated in earlier studies (Köpcke 1993).

[20]When a paired Wilcoxon test was run separately for the different participant groups, it came out significant for only some of them. The detailed results are given in the Appendix.

Fig. 4 Use of -∅ for feminine nouns ending in -*el* or -*er*
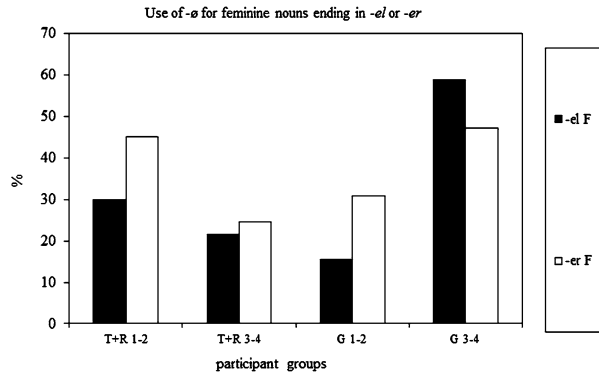
when the answers of all participants are taken together ($W = 939.5$, $p < 0.001$).[21] This conforms to the gender-based regularities and shows that the participants produce a plural form according to specific characteristics of the singular (source-oriented). Interestingly, this not only holds for learners from a gender language (Russian) but also for learners from a language without gender (Turkish). Secondly, feminine nouns ending in -*er* tend to be left unchanged more often than feminine nouns ending in -*el*. Again, this difference between the item types are statistically significant when the answers of all participants are taken together ($W = 639$, $p = 0.007$).[22]

This again cannot be explained by a rule-based mechanism alone. Once again we can conclude that the majority of the participant groups used -∅ more often for those items that display a higher reliability (in this case feminine items ending in -*er*) than for those items with a comparatively lower reliability for plurality (feminine items ending in -*el*). [23]

To sum up, the analysis of the use of the zero-marking shows that, on the one hand, the participants followed a source-oriented strategy in producing plural forms. They formed the plural according to the gender and the ending of the singular. This strategy becomes clear when the participants use -∅ more often for items that regularly take -∅ than for items that regularly mark the plural overtly. On the other hand, however, the analysis shows that the participants pursued product-oriented strategies. They did not use -∅ according to the regularities of the system alone, but they used it the more frequently the more the singular resembles a typical plural schema.

6.2 Overt plural marking

In this section we will have a closer look at overt plural markings by the participants of this study and at the kind of plural markers they used. Again, we will show that

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[21]When a paired Wilcoxon test was run separately for the different participant groups, it came out significant for the participant group R 3–4 ($p = 0.002$) and marginally significant for the group T 1–2 ($p = 0.076$).

[22]When a paired Wilcoxon test was run separately for the different participant groups, it came out significant for the participant group R 3–4 ($p = 0.003$) and marginally significant for the group R 1–2 ($p = 0.093$).

[23]Only the results of the participant group G 3–4 do not fit this interpretation. Apparently, this group did not differentiate between feminine and non-feminine nouns, which would also explain the high number of (ungrammatical) zero-markings for these feminine nouns.

Fig. 5 Overt plural marking for non-feminine monosyllabic items

Overt plural marking for non-feminine monosyllabic items
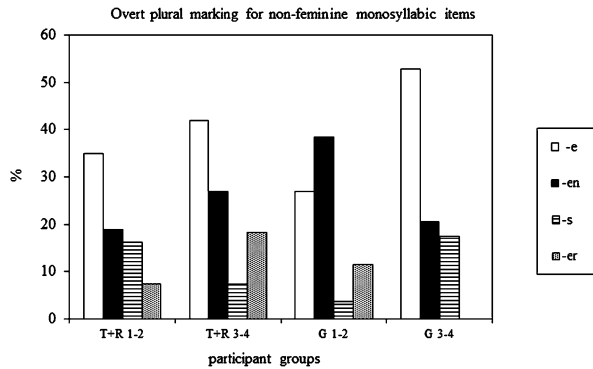
there is evidence that the subjects of all groups pursued a product-oriented strategy to a certain degree.

We start with non-feminine monosyllabic nouns. In traditional IP- or rule-based accounts, the plural marker *-e* is analyzed as the regular form for monosyllabic non-feminine nouns. An analysis of the children's productive vocabulary on the basis of a corpus from Pregel and Rickheit (1987) shows that this is indeed the plural marker that next to *-er* appears most frequently for these nouns. In the case of *-er* this is not in line with the adults' lexicon. Here, *-er* is rather the exception. The endings *-s* and *-en* for monosyllabic non-feminine nouns are very infrequent in the children's as well as in the adults' lexicon. Figure 5 shows the plural forms that were produced by the participants for masc./neut. items.

The plural morpheme *-e* is, in comparison to the other markers, the form that is chosen most often by most of the participant groups. At first sight then, the children seemed to apply a source-oriented strategy. But, it is also noteworthy that this *-e* is hardly ever chosen for more than 40 % of the items. As Fig. 5 shows, the plural form *-en* was in strong competition with *-e*. This is remarkable since *-en* is very infrequent for non-feminine monosyllabic nouns, both in the children's and adults' lexicon. The plural *-er*, on the contrary, was used quite rarely, which is astonishing since a lot of non-feminine monosyllabic nouns in the children's vocabulary take this plural marker. Both results thus show that the participants did not form the plural forms solely on the basis of the source-based regularities. Rather, a product-oriented strategy was pursued: By choosing the plural form *-en*, the participants produced plurals that are very infrequent for this noun type, but which display very high reliability for plurality in general. This is in accordance with our hypothesis H2. By avoiding the plural form *-er*, on the other hand, the participants avoided a form, which has only low reliability for plurality.[24]

We will now discuss the feminine monosyllabic nouns. In rule-based accounts, the plural marker *-en* is analyzed as the regular form for monosyllabic feminine nouns.

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[24] As can be seen in Table 6, there are slight differences between participants with L1 Turkish and Russian. The participant group T 3–4 uses *-er* clearly more often than the participants with L1 Russian or German (the results of the statistical analysis for this difference are given in the Appendix). This can be interpreted as an influence from the L1: In Turkish, plurals are formed by suffixing *-ler* or *-lar* to the stem. The German plural *-er* is thus the form that shows the highest similarity to a Turkish plural, at least in written language. It is thus possible that this triggers the preference of this plural form by participants with L1 Turkish.

Fig. 6 Overt plural marking for monosyllabic feminine items
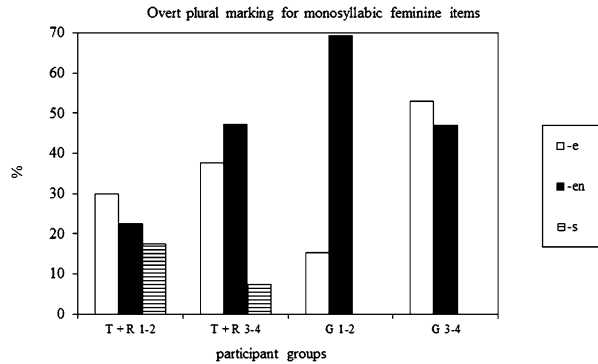
But, in the children's vocabulary, one finds quite a number of monosyllabic feminines that take the plural marker *-e* instead (*die Kuh–die Kühe* ('cow') or *die Wand–die Wände* ('wall')). As Fig. 6 shows, this tendency is reflected in the plural forms, the participants made use of.

The preferred use of the plural marker *-en* can be interpreted as a sign for the product-oriented strategy as well as for the source-oriented strategy: A plural ending in *-en* displays the highest reliability but it is also the form that preferably appears for these nouns. The fact that *-en* is used more often for feminine than for non-feminine nouns points to a source-oriented strategy. Again, this result is statistically significant when the answers of all participants are totaled ($W = 960$, $p < 0.001$).[25] Also, the high frequency of the marker *-e* for monosyllabic feminines points to this conclusion as plurals in *-e* appear quite often in the case of monosyllabic feminines in the children's lexicon.

Finally, we turn to items ending in an unstressed full vowel. In general, nouns of this shape affix *-s* for marking the plural. In the children's lexicon, *-s* is the only plural form that is used for these nouns. Against this background, the high percentage of *-en* in all participant groups is remarkable. Participants substituted in up to 20 % the full vowel with the ending *-en* (e.g. *Siero–Sieren*) and, in this way, created a plural form that meets the prosodic requirements (trochee structure) and displays high reliability for plurality. This again provides evidence for our argument that speakers pursue a product-oriented strategy to form a plural.

6.3 Differences between the participant groups

As stated above, source- and product-oriented strategies for plural formation can be detected for all participant groups. Apart from that, slight differences of the predominance of the different strategies can be observed according to age or time of exposure. As Figs. 2, 5, and 6 show, the product-oriented strategy for plural formation seems to be more dominant in the older participant group of L2-learners than in the younger group. Older participants used zero-marking less frequently for non-feminine nouns

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[25]When a paired Wilcoxon test was run separately for the different participant groups, its outcome was significant for only some of them, presumably due to small group sizes. The detailed results are given in the Appendix.

ending in *-el* or *-er* than the younger children.[26] This finding contradicts the regularities of the system but leads the children to produce forms with higher reliability. Furthermore, they produced plurals ending in *-en* more frequently for non-feminine and feminine monosyllabic items and for items ending in an unstressed full vowel than the younger participants.[27] Again, this shows that the product-oriented strategy is slightly more dominant in the older participant group that was exposed to German for a longer time period.[28]

For the monolingual German-speaking control groups, the development goes in the opposite direction: As Fig. 2 shows, the older participants used *-ø* more frequently for non-feminine items ending in *-el* or *-er* than the younger participants. This difference was significant for items ending in *-el* ($\chi^2(1) = 4.659$, $p = 0.031$) and marginally significant for items ending in *-er* ($\chi^2(1) = 2.800$, $p = 0.094$). They thus produced plural forms with rather low reliability but which conform to the regularities of the system. The product-oriented strategy thus seems to be more dominant in the younger participant group, whereas the older participants prefer the source-oriented strategy of plural formation. This developmental order is in accordance with our hypothesis H3. Our interpretation is supported by the results depicted in Figs. 5 and 6 and by the results discussed for the items ending in a full vowel. The older participants form plurals ending in *-en* less frequently than the younger participants. Instead, the most frequent plural markers for the respective item structure are chosen more often. This difference was not significant.

We assume that the differences between the groups of the second language learners and the group of monolingual German speaking children can be explained by their different time of exposure to the target language: The second language learners were first confronted with a relevant amount of German input at age three to four, when they started to go to kindergarten. Some of the participants did not even attend a kindergarten in Germany so that their acquisition process presumably started even later. This means that participants with German as second language belong to a different acquisitional stage than the monolingual participants.

7 Conclusion

In sum then, the results of the study show that neither a source-oriented rule-based nor a product-oriented schema approach alone is sufficient to explain the participants' behavior in forming plurals. Instead of pursuing a source-oriented or product-oriented strategy exclusively, the data show that learners make use of both strategies. As a

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[26]This difference was significant for the Russian participant group for the items ending in *-el* ($\chi^2(1) = 6.149$, $p = 0.013$) and marginally so for the items ending in *-er* ($\chi^2(1) = 3.229$, $p = 0.072$). For the Turkish participant group this difference was marginally significant for the items ending in *-er* ($\chi^2(1) = 3.677$, $p = 0.055$) but not significant for the items ending in *-el* ($\chi^2(1) = 2.348$, $p = 0.125$).

[27]This difference was only significant for the Russian participant group for monosyllabic items ($W = 69$, $p = 0.018$) and not significant for the other groups and items.

[28]The younger L2-learners do not dispose of the same abstract schemas yet as their lexicon encompasses fewer nouns and is structured differently. This is why the product-oriented strategy is not as dominant as in the older L2-learners.

matter of fact, recent psycholinguistic studies support the idea that learners do not exclusively follow source-oriented (IP) rules in the production of morphologically complex words (cf. Kapatsinski 2012, 2013).

Both strategies can be integrated in a usage-based model for language acquisition, where it is assumed that learners build connections between plural forms and thus abstract schemas with differing reliability for the function plurality (first-order schemas) and between the singular and plural forms of one paradigm (second-order schemas). The comparison between the different participant groups showed that these strategies are pursued independently of the speakers' duration of language exposure. It could be demonstrated that in different acquisitional stages both strategies are visible. In hypothesis H4 we assumed only marginal differences between learners according to their L1. As a matter of fact, only very slight differences between the participants with Turkish or Russian as their L1 could be observed. Obviously, prior linguistic knowledge serves only partially as a background against which the new linguistic system is analyzed and processed. In our study this result was only found with regard to the omission of plural markers. Since our general hypothesis only relies on language independent cognitive abilities, it is plausible that learners will make use of schematic representations independently of their first language.

Appendix

In what follows, we give an overview of the statistical hypotheses that were established in order to operationalize our general hypotheses.

Statistical hypotheses testing the product-oriented approach

H(a): *-ø* will be used for non-feminine items ending in *-el*, *-er* or *-en* to an increasing amount.

Confirmed when the answers of all participants are aggregated:

-el < -en: $W = 9$, $p < 0.001$
-er < -en: $W = 1438$, $p < 0.001$
-el < -er: $W = 263$, $p = 0.018$

Within the participant groups, the results were significant only for some experimental groups:

Use of *-ø* for items ending in *-el*, *-er*, *-en*				
	Friedman	*-el < -en*	*-er < -en*	*-el < -er*
G 1–2	0.03	0.093	0.102	0.471
G 3–4	0.029	0.087	0.171	0.762
T 1–2	0.204	0.384	0.564	1
T 3–4	<0.001	0.003	0.015	0.882
R 1–2	0.01	0.021	0.039	0.87
R 3–4	<.001	<.001	<.001	0.183

H(b): -ø will be used in increasing number for items of all genders ending in -ø (monosyllabic), unstressed full vowel (-v), or -e.

Confirmed when the answers of all participants are aggregated:

-e > -v: $W = 759$, $p = 0.011$
-v > -ø: $W = 407.5$, $p = 0.027$
-e > -ø: $W = 856.5$, $p < 0.001$

Within the participant groups, the results were significant only for some of the experimental groups:

Use of -ø for monosyllabic items, items ending in -e and -v				
	Friedman	-v < -e	-ø < -v	-ø < -e
G 1–2	0.926	1	1	1
G 3–4	0.108	1	0.186	0.171
T 1–2	0.385	1	1	1
T 3–4	0.002	0.012	0.543	0.006
R 1–2	0.042	1	0.075	0.162
R 3–4	<0.001	0.009	0.354	<0.001

H(c): -ø will be used for feminine items ending in -el or -er in increasing number.

Confirmed when the answers of all participants are aggregated:

$W = 639$, $p = 0.007$

Within the participant groups, the results were significant only for some of the experimental groups:

Use of -ø for feminine items ending in -el and -er	
G 1–2	0.251
G 3–4	0.746
T 1–2	0.38
T 3–4	0.89
R 1–2	0.093
R 3–4	0.003

Statistical hypotheses testing the source-oriented approach:

H(d): -ø will be used more frequently for non-feminine items ending in -el or -er than for feminine items ending in -el or -er.

Confirmed when the answers of all participants are aggregated:

$W = 939.5$, $p < 0.001$

Within the participant groups, the results were significant only for some of the experimental groups:

Use of *-ø* for feminine items ending in *-el* and *-er* and non-feminine items ending in *-el* and *-er*	
G 1–2	0.129
G 3–4	0.103
T 1–2	0.076
T 3–4	0.805
R 1–2	0.129
R 3–4	0.002

H(e): *-en* will be used more frequently for feminine monosyllabic items than for non-feminine monosyllabic items.

Confirmed when the answers of all participants are aggregated:

$W = 960$, $p < 0.001$

Within the participant groups, the results were significant only for some of the experimental groups:

Use of *-en* for non-feminine < feminine	
G 1–2	0.047
G 3–4	0.057
T 1–2	0.246
T 3–4	0.332
R 1–2	0.816
R 3–4	<0.001

Statistical hypotheses testing the influence of age:

H(f): The older L2-learner groups will use *-ø* less frequently for non-feminine items ending in *-el* or *-er* than the younger L2-learner groups.

Partly confirmed:

Use of *-ø* for non-feminine items in *-el* or *-er*		
	R 1–2 > R 3–4	T 1–2 > T 3–4
-el	$\chi^2(1) = 6.149$, $p = 0.013$	$\chi^2(1) = 2.348$, $p = 0.125$
-er	$\chi^2(1) = 3.229$, $p = 0.072$	$\chi^2(1) = 3.677$, $p = 0.055$

H(g): The older L1-learner groups will use *-ø* more frequently for non-feminine items ending in *-el* or *-er* than the younger L1-learner groups.

Partly confirmed:

Use of *-ø* for non-feminine items in *-el* or *-er*	
G 1–2 < G 3–4	
-el	$\chi^2(1) = 4.659, p = 0.031$
-er	$\chi^2(1) = 2.800, p = 0.094$

H(h): The older L2-learner groups will use *-en* more frequently for monosyllabic items and items ending in an unstressed full vowel than the younger L2-learner groups.

Partly confirmed:

Use of *-en* for monosyllabic items and items ending in an unstressed vowel (*-v*)		
	T 1–2 < T 3–4	R 1–2 < R 3–4
-ø	$p = 0.342$	$p = 0.018$
-v	$p = 0.654$	$p = 0.206$

H(i): The older L1-learner groups will use *-en* less frequently for monosyllabic items and items ending in an unstressed full vowel than the younger L1-learner groups.

Not confirmed:

Use of *-en* for monosyllabic items and items ending in an unstressed full vowel (*-v*)	
	G 1–2 > G 3–4
-ø	$p = 0.278$
-v	$p = 0.160$

Statistical hypothesis testing the influence of L1

H(j): The older L2-learners with L1 Turkish will use *-er* more frequently for monosyllabic non-feminine nouns than learners of the same age with L1 Russian or German.

Partly confirmed:

Use of *-er* for monosyllabic non-feminine items	
G 3–4 vs. R 3–4	$p = 0.063$
R 3–4 vs. T 3–4	$p = 0.008$
G 3–4 vs. T 3–4	$P = 0.408$

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