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Articles, adjectives and age of onset: the acquisition of Dutch grammatical gender

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A comparison of the error profiles of monolingual (child L1) learners of Dutch, Moroccan children (child L2) and Moroccan adults (adult L2) learning Dutch as their L2 shows that participants in all groups massively overgeneralize [–neuter] articles to [+neuter] contexts. In all groups, the reverse gender mistake infrequently occurs. Gender expressed by Dutch attributive adjectives reveals an age-related asymmetry between the three groups, however. Whereas participants in the child groups overgeneralize one particular suffix (namely the schwa), adult participants use both adjectival forms, the schwa-adjective and the bare adjective, incorrectly. It is argued that the asymmetry observed in adjectives reflects that adult learners exploit an input-based, lexical learning route, whereas children rely on grammar-based representations. The similarity in article selection between all groups follows from the assumption that adults, like children, make use of lexical frames. Crucially, lexical frames can successfully describe the distribution of gender-marked articles, but they cannot account for gender in adjectives.

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I Introduction

There is a striking difference between the success of language acquisition by children and adults: children, starting from birth, uniformly reach a level of attainment that learners exposed to a new language at later ages hardly ever reach. Various explanations have been put forward to account for this contrast, among which the idea that there are maturational constraints that lead to a critical period for language acquisition (Penfield and Roberts, 1959; Lenneberg, 1967; Newport, 1990; Birdsong, 1999; for an overview, see Hyltenstam and Abrahamsson, 2003), multiple critical periods (Meisel, 2007) or to multiple critical periods that each affect different aspects of the language learning ability (Seliger, 1978; Scovel, 1988; Beck, 1998; Long, 1990; Schachter, 1996; Eubank and Gregg, 1999).

One specific proposal that attempts to pinpoint vulnerable domains in adult language acquisition is the Failed Formal Features Hypothesis or FFFH (Smith and Tsimpli, 1995; Hawkins and Chan, 1997). The FFFH advances the idea that uninterpretable formal features – which are features that do not substantially contribute to meaning (e.g. Tense) but that do induce morphosyntactic operations (e.g. Agreement) – are subject to critical period effects. Adult learners who have not activated a particular uninterpretable feature within a designated timeframe can reach a high level of attainment in a new language, but their attainment will either remain below native levels (Tsimpli and Rousseau, 1991; Franceschina, 2005), or their nativelike performance conceals non-native underlying competence (Hawkins, 2005).

Building on insights from linguistic theory, the FFFH assumes dissociation between the syntactic level of representation and the lexicon (Beard, 1982; 1995; Halle and Marantz, 1993; Noyer, 1997; Harley and Noyer, 1999). On this view, it is assumed that lexical items are inserted after the syntactic derivation has been completed. Post-syntactic lexical insertion paves the way for independent developmental trajectories, and for the dissociation between grammar and lexicon in terms of critical period effects. Hawkins and Franceschina (2004), for instance, observe that advanced late learners only learn the rules of 'grammatical gender' to the extent that these rules can be predicted by phonological

analogies, indicating that learning based on associative memory is fully available for adult learners, whereas grammar seems inaccessible.[1]

Recently, Ullman (2001a; 2001b; 2004) has proposed a new model, known as the Declarative/Procedural (DP) model, which gives a neurobiological explanation for the observation that it is grammar in particular that is affected by age of exposure. According to the DP model, two different neural systems – declarative and procedural memory – underlie different types of (linguistic) knowledge. Declarative memory is argued to be implicated in the knowledge about facts and events, it appears to be relevant for storing arbitrary related information, and it is used for conscious and explicit recollection. Linguistic information stored in declarative memory comprises all kinds of irregular, idiosyncratic word-specific information and idiom (lexicon). Procedural memory has been claimed to be involved in the learning and processing of motor, perceptual and cognitive skills, that is, the coordination of procedures in real time. Learning and remembering this kind of knowledge is unconscious and implicit. Computations that involve linguistic rules used for generating well-formed words and combining words into acceptable sentences are supported by procedural memory. The DP model claims that, for children, the learning and use of grammar depend largely upon procedural memory, whereas the memorization and use of words depend upon declarative memory. Use of the two memory systems is, however, critically affected by age:

> It is proposed that, because grammatical computations relying on procedural memory become relatively difficult to learn, whereas the learning ability of declarative memory function remains relatively strong, late learners of language, particularly those exposed after late childhood or puberty, may differ in crucial ways from earlier learners […] later learners tend to shift to declarative memory for the same 'grammatical' functions, which are moreover learned and processed differently than in the earlier learners. (Ullman, 2001b: 109)[2]

Grammatical gender provides an interesting case for the hypothesis that lexicon and grammar are dissociated with respect to the age factor: In many languages, the uninterpretable Gender feature, which operates at the level of grammar, has morphophonological correlates. French root

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[1] Others confirm the dissociation, but argue that late learners show native knowledge of syntax in combination with non-native lexical representations (Lardiere, 1998; Prévost and White, 2000; White, 2003).
[2] For a discussion of psycholinguistic evidence for this type of age effect, see Clahsen and Felser (2006).

nouns have, for instance, typical feminine endings (la baguette 'the bread', l'addition 'the bill') or typical masculine endings (le couteau 'the knife', le monument 'the monument'). Such morphophonological regularities are localized in the lexicon (see Bybee, 1995). For monolingual children learning French, it has been shown that morphophonological regularities are, in early stages, used quite successfully to assign gender to novel words. The use of syntactic cues in later stages indicates that these monolingual children do end up with a more abstract syntactic representation of grammatical gender, however (Karmiloff-Smith, 1979). Similar (developmental) observations are reported for other languages with morphophonological gender cues (on Spanish, see Pérez-Pereira, 1991; on Czech, see Polišenská, 2006; on Russian, see Rodina, 2005). Interestingly, morphophonological regularities enable adult learners with extensive immersion in the L2 to perform rather accurately with respect to grammatical gender. In contrast to children, an adult's knowledge of grammatical gender does not exceed the lexical level, however (Hawkins and Franceschina, 2004). By using lexicon-driven strategies to learn grammatical gender, late learners can thus show seemingly native behaviour, even though they lack a grammatical representation of grammatical gender. Note that the success of this non-native 'mimicking' of native behaviour is not only dependent on how advanced a late non-native learner is, but also on the amount of output overlap between the lexicon-driven and grammar-driven strategies, as will be explained in Section II.

In this article, we focus on effects of age in Dutch grammatical gender. Our aim is to further explore the hypothesis that biological age influences the more abstract grammar-driven gender representations, and does not have an effect on lexical gender representations. In order to do so, it is crucial to properly define the two types of representations, especially because, according to various models, the distinction between the two types of representations does not exist (compare the Past Tense debate on dual vs. single mechanism; see Rumelhart and McClelland, 1986; Pinker and Prince, 1988; Marcus *et al.*, 1992; Pinker, 1999; McClelland and Seidenberg, 2000). Next, we need to explain how the two levels of representation are relevant for understanding Dutch grammatical gender. For Romance or Slavic languages, which have transparent gender systems (that is, a predictable gender category based morphophonological patterning), this is more obvious than for Dutch,

which is generally assumed to have an opaque gender system. On the basis of single-mechanism models for learning in the lexicon, we show in Section II that grammatical gender encoded in Dutch definite articles can, in principle, be approached by lexicon-based representations. In contrast, lexicon-based rules fail to account for gender distinctions in Dutch attributive adjectives. Section III discusses some developmental implications of the lexicon–grammar distinction.

Following the FFFH and DP model, our premise is that age typically influences the grammatical level of representation. Our expectation is thus that language acquisition data, especially those of late learners, show dissociation between gender encoding in definite articles, on the one hand, and attributive adjectives, on the other (Section IV). Experimental data obtained from monolingual Dutch children, bilingual Moroccan-Dutch children who were not substantially exposed to Dutch before the age of 4, and bilingual Moroccan-Dutch adults who started to learn Dutch after puberty confirm this expectation (Sections V and VI). The discussion, conclusions and some final remarks are given in Sections VII and VIII.

II Gender encoding in Dutch articles and adjectives

What are the diagnostics that enable us to tease lexical and grammatical linguistic information apart? The mental lexicon is generally assumed to be the locus of arbitrary mappings of form and meaning, which are structured through phonological and semantic associations (Bybee, 1985; 1995; 2001; Pinker, 1999; Pinker and Prince, 1991; McClelland and Patterson, 2002). From this perspective, gender regularities like 'all words ending in -*a* are feminine' or 'all animals are masculine' are lexicon-based. Such generalizations can lead to productivity, because predictions for novel words can be derived on the basis of analogy to memorized words. We assume that generalizations based on memorization encompass not only words but also phrases and sentences (Fillmore *et al.*, 1988; Goldberg, 1995; 2006).[3] Associations between lists of memorized phrases and sentences can be formed through probabilities in the input between subsequent words, resulting in 'constructions' or

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[3] However, for a different view, according to which the lexicon is more limited, see Clahsen (1999: 992): 'Linguistically, morphological roots have lexical entries, but sentences typically do not (proverbs, clichés, etc., however, may be exceptions in this respect).'

'frames'. In monolingual acquisition, such input-based syntactic patterns have been shown to be powerful acquisition mechanisms (Mintz *et al.*, 2002; Mintz, 2003; Tomasello, 2003). Our criterion thus is that gender rules that can be covered by input-based phonological, semantic or syntactic patterns are lexical in nature, whereas those rules that cannot be captured via input-based analogies are part of the grammar.[4]

Let us now turn to the Dutch articles and adjectives, keeping the above distinction between lexicon and grammar in mind. Recall that Dutch has a two-way gender system that distinguishes between common and neuter nouns (see the introduction to this issue). Example (1) gives a short description of the Dutch system of definite articles:

> 1)   If a Dutch root noun is singular and neuter, the definite article *het* is selected; in all other cases the definite article *de* is selected.

Thus, the common noun *hond* 'dog' is preceded by the definite article *de*, whereas the neuter (singular) noun *paard* 'horse' is preceded by *het*. The plural form *paarden* 'horses' also selects for *de*. The skewed distribution of *het* and *de* suggested in (1) may lead to distributional differences between the two articles. Analyses of the CELEX database – compiled on the basis of two dictionaries and the most frequent lemmata from the text corpus of the Institute for Dutch Lexicology (160,000 lemmata) – indeed show that common nouns (which take *de*) outnumber neuter nouns (taking *het*) by a ratio of about 2:1 when type frequencies are counted and by a ratio 3:1 when the count is based on token frequencies (Van Berkum, 1996). Given these distributions, we conclude that the definite article *de* predominates in the language input. Based on the input and, more specifically, occurrences of *de* with a range of different nouns, learners of Dutch are thus likely to postulate the frame in (2a). As evidence for '*het*-words' mounts, learners start listing the exceptions to (2a) one by one, starting with the most frequent *het*-words; see (2b).

> 2)   a.   [de NOUN][5]
>   b.   [het huis], [het mes], [het been], etc.

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[4] A prototypical example of a rule of grammar is the so-called default or Elsewhere rule: 'the default [is] phonologically and lexically unrestricted, ceteris paribus' (Pinker and Prince, 1991: 346).

[5] We have chosen the category NOUN (which may initially be linked to the semantic primitive object), but make no claims whatsoever as regards the precise nature of this category, and the grammatical information related to it.

This developmental analysis is supported by observations from mono-lingual children learning Dutch: after a stage of article omission, Dutch children show use of the definite article *de* with common gender nouns (*de hond* 'the dog') as well as with neuter gender nouns (*de paard* instead of *het paard* 'the horse'). At the age of six, most Dutch children still overgeneralize the definite article *de*, although correct use of the definite article *het* gradually increases (De Houwer, 1987; Bol and Kuiken, 1988; Wijnen and Verrips, 1998; Van der Velde, 2003).

The Dutch definite article system, as well as developmental patterns observed in L1 Dutch, can be accurately described through lexicon-based rules. The Dutch system of attributive adjectival inflection is, however, different from the definite article system. Whereas Dutch adjectives in predicative position are not inflected, a suffix is visible in attributive posi-tion unless the article is indefinite and the adjective modifies a singular, neuter noun. Table 1 gives an overview (see also the introduction to this issue). The pattern in Table 1 is summarized in (3):

> 3) If a Dutch noun is singular and neuter and the article is indefinite, the attributive adjective is bare; in all other cases the attributive adjective ends with -*e*.

The results of a pilot study on the numbers of tokens of adjectives inflected with schwa and bare adjectives can shed light on the input dis-tributions and, hence, on the lexical frames that adult learners of Dutch will postulate. In this study, 20 high-frequency adjectives were included.[6] The counts are based on Dutch adult- and child-directed speech in three CHILDES corpora, that is, the Groningen corpus, the Van Kampen corpus, and the Bol and Kuiken corpus (MacWhinney, 2000). In these input data, 60% (506/825) of the attributive adjectives appears inflected with schwa and 40% (319/825) appears as a bare form. The ratio of schwa-adjectives and bare adjectives in the Dutch input is thus 1.8:1, whereas this is 3:1 for the definite articles *de* and *het* (Van Berkum, 1996). The asymmetry between the distributions of definite articles and attributive adjectives in the input predicts an asymmetry

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[6] The calculation of the 20 most frequently occurring adjectives in Dutch child language was based on the MacArthur Communicative Development Inventory (N-CDI: Zink and Lejaegere, 2002): *blauw* 'blue', *geel* 'yellow', *goed* 'good', *groot* 'big/large', *groen* 'green', *klein* 'little/small', *koud* 'cold', *lang* 'long', *moeilijk* 'difficult', *mooi* 'beautiful', *nat* 'wet', *rood* 'red', *vast* 'solid/fixed', *vol* 'full', *voorzichtig* 'careful', *vriendelijk* 'nice', *vuil* 'dirty', *vies* 'dirty', *heet* 'hot', *lief* 'sweet (nice)'.

Table 1 Attributive adjectival inflection in Dutch

Context	Suffix	Example
Definite, neuter, singular	-e	*Het mooie huis* 'The nice house'
Indefinite, neuter, singular	-ø	*Een mooi huis* 'A nice house'
Definite, common, singular	-e	*De mooie auto* 'The nice car'
Indefinite, common, singular	-e	*Een mooie auto* 'A nice car'
Definite, neuter, plural	-e	*De mooie huizen* 'The nice houses'
Indefinite, neuter, plural	-e	*Mooie huizen* 'Nice houses'
Definite, common, plural	-e	*De mooie auto's* 'The nice cars'
Indefinite, common, plural	-e	*Mooie auto's* 'Nice cars'

between definite articles and attributive adjectives in the output of adult learners, because their (lexical) representations are crucially dependent on input distributions. More specifically, the predominance of the [−neuter] form *de* in the input predicts that in the case of definite articles it is likely that the [−neuter] form *de* is used in [+neuter] contexts. The much more equal distributions of [−neuter] and [+neuter] adjectival forms predicts the alternating use of the two lexical frames in (4a) and (4b), in which 'ADJ-ə' refers to the adjective with schwa and 'ADJ' stands for the bare adjectival form. Since these frames are insensitive with respect to a noun's gender, this scenario would predict errors in both directions:

4) a. [ADJ-ə NOUN]
    b. [ADJ   NOUN]

A factor that may emphasize the relative weight of the bare adjective in the case of late learning is that adults seem to rely less on structural cues than children do and include also predicative adjectives in their calculations (Felser *et al.*, 2003; Marinis *et al.*, 2005; Blom *et al.*, 2007). Inclusion of predicative adjectives in the aforementioned counts leads to a percentage of bare adjectival forms in the input of 77% ($n = 27,251$). If structural cues are indeed less prominent to adults than to children, it is expected that adults show in the definite articles and adjectives opposite error profiles: Definite articles will show use of [–neuter] forms in [+neuter] contexts, while attributive adjectives will show [+neuter] forms in [–neuter] contexts.

The lexicon-based approach predicts that late learners make different types of errors in definite articles and attributive adjectives, respectively. Their errors with adjectives, which are determined by input

distributions, may also be different from the children's errors. Lexical learning, moreover, fails to account for the Dutch system of attributive adjectives, yielding the prediction that adult learners are unlikely to reach native levels of performance with respect to Dutch attributive adjectives. We illustrate this shortcoming by sketching a lexicon-based developmental trajectory.

Suppose that a learner postulates the two frames in (4). The frame in (4a) works well for a large number of contexts, but predicts the occurrence of errors in indefinite contexts with singular neuter nouns (*Een grote paard 'a big horse'). The frame in (4b) is relatively unsuccessful and predicts errors in more contexts. Mismatches between the output of (4b) and structures in the input will force the learner to narrow the scope of the frame containing a bare adjective. Based on the presence of the indefinite article *een* in indefinite singular contexts, a learner could, for instance, hypothesize (5).

5)   [een   ADJ   NOUN]

The frame in (5) predicts the occurrence of incorrect bare adjectives with common nouns (*Een groot fles 'a big bottle'). Only separate frames for each adjective–noun pair, as illustrated in (6), could solve this:

6)   [een   ADJ   huis],   [een   ADJ   konijn],
       a   ADJ   house,   a   ADJ   rabbit,

     [een   ADJ   potlood], etc.
       a   ADJ   pencil

An adequate description of the Dutch adjectival system is provided by the frame in (4a), combined with a list like in (6). This combination of frames fails to generalize over the class of neuter nouns, however: (6) does not capture the categorical nature of attributive adjectival inflection in indefinite, singular contexts. Crucially, this is not a disadvantage of this particular combination, but it applies to all descriptions of the Dutch adjectival system in terms of lexicon-based rules.

Does a description in terms of grammar provide a parsimonious alternative? We believe it does. Adopting the theoretical framework in which Hawkins and Franceschina (2004) embedded their model, we can formulate a set of lexical insertion rules that makes use of the (uninterpretable) grammatical feature [±gender], here instantiated as [±neuter]. The other

features [±attr], [±def] and [±plur] stand, respectively, for attributiveness, definiteness and plurality:[7]

7) /ø/   ↔   [+attr, –def, +neut, −plur]
    /ɘ/   ↔   [+attr]

Example (7) contains two rules for lexical insertion that together account for the Dutch system of attributive adjectives. Recall that lexical insertion is post-syntactic. It is, more specifically, the result of the interplay between the two principles of grammar in (8):

8) a. Subset Principle: The features of the inserted vocabulary item must be equal to or a subset of the features in the syntactic slot (Halle, 1997).
    b. Elsewhere Principle: A more specified vocabulary item has precedence over an underspecified vocabulary item (Kiparsky, 1973).

Amongst other things, interaction of the Subset Principle and the Elsewhere Principle prevents insertion of the schwa suffix if the noun is singular and neuter and the article indefinite. Conversely, the result of these principles will be that the underspecified form for attributive adjectives (the adjective ending with schwa) will be inserted in any attributive contexts except the one for the combination indefinite, neuter and singular. Assuming that monolingual children start with the general rule – and later on acquire the more specific, topmost, rule (7) – does seem to make the correct developmental prediction, that is, a phase characterized by across-the-board overuse of schwa followed by an increased use of bare adjectives. Rule (7) does not predict the insertion of bare adjectives in inappropriate contexts.

Note that it is also possible to give a grammar-based description for definite articles, as illustrated in (9):

9) /het/ ↔   [+def, +neut, −plur]
    /de/   ↔   [+def]

According to (9), *de* is inserted in all definite contexts, unless the context is definite and the noun is neuter and singular; in this particular case, *het* must be inserted. The rules in (9) have the same empirical coverage as the lexicon-based constructions in (2), but are more parsimonious than the (most simple set of) lexical rules.

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[7] We have no reason to choose for this particular set of binary features, other than that they provide an adequate description for the Dutch adjectival system.

Building on recent ideas of properties of the lexicon, we argued that grammatical gender in Dutch could have a lexical level of representation as well as a grammatical level of representation. In terms of empirical coverage, the two types of representations are equally successful for definite articles, whereas in the case of attributive adjectives the grammatical representation is more adequate than the lexical representation. In terms of parsimony, the grammatical representation is favoured in both cases. However, in our view, effects of age overrule parsimony and predict that late learners rely on lexical representations, even though the grammatical representation is the more parsimonious. Children, in contrast, are expected to depend on grammatical representations. On the basis of input distributions, which are commonly assumed to be the basis of lexicon-based learning, we derived a number of specific predictions with respect to the adult error profiles for definite articles and attributive adjectives.

III Lexical and grammatical representations in language development

Before summarizing the specific predictions of our analysis, we briefly discuss the relation between lexical and grammatical representations from a developmental perspective. Previous literature raised the important question as to how a learner can acquire grammatical features such as [±neuter], given that these features do not flag themselves in the input. To bridge the gap between information contained in the input stream and grammatical information, it has been proposed that learners follow a bootstrapping procedure that allows them to map accessible, statistical information onto (innate) grammatical features (Maratsos and Chalkley, 1980; Pinker, 1989; Mintz *et al.*, 2002; Mintz, 2003). According to this view, an input-driven, bottom-up procedure results in patterned lexical information (e.g. frames). Subsequently, high correlations between lexical patterns and grammatical features certify successful mapping and, consequently, the acquisition of the grammatical feature.

From a developmental perspective, it is plausible that the lexical representations of Dutch grammatical gender precede the grammatical representations. High correlations between the lexical patterns and grammatical features in the case of definite articles (as shown in the

previous section), suggest that definite articles are bootstraps for [±neuter].[8] The 'law of parsimony' would predict that children will exploit the advantages of the grammatical representation and activate [±neuter] also in the case of attributive adjectives once they have done this for definite articles. Although definite articles are reliable bootstraps, they do not allow us to pinpoint the time of bootstrapping. In such cases, it may be useful to look at developments in other gender domains, which show less high correlations between the lexicon-based and grammar-based patterns (e.g. attributive adjectives).

This brings us to a developmental prediction. The merit of grammatical features is that they explain a range of different phenomena. The feature [±neuter], for instance, generalizes over Dutch definite articles, attributive adjectives, demonstratives, possessives, *wh*-pronouns and relative pronouns. By their very nature, lexical rules will not have such generalizing properties. If learners activate [±neuter], it is thus expected that this will influence their linguistic performance in all these gender domains. On the other hand, if grammatical gender is learned on the basis of lexical strategies only, isolated changes are expected to occur.

IV Predictions

Based on the premise that late learners have reduced abilities to access abstract grammatical rules and prefer using lexical learning mechanisms instead, our expectation is that Dutch grammatical gender will show selective effects of age of onset. Because grammar-based and lexicon-based representations make similar predictions for definite articles, we expect that equally proficient early and late learners will show in this gender domain similar profiles: Overuse of the [−neuter] definite article *de* in [+neuter] contexts. Input distributions predict that errors with adjectives go in two directions, however: [+neuter] bare adjectives in [−neuter] contexts and [−neuter] schwa-adjectives in [+neuter] contexts. Inconsistency between the types of errors in definite articles and attributive adjectives is not expected given grammar-based representations. Our expectation is therefore that early learners are expected to show consistency between the errors profile in definite

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[8] Diminutives, which do have morpho-phonological gender-marking on the noun may provide the very first step into the Dutch gender system (Cornips and Hulk, this issue).

articles and attributive adjectives, whereas late learners are expected to be inconsistent. This (in)consistency is expected to be visible in developmental trajectories as well: Children are expected to show parallel developments of definite articles and attributive adjectives, whereas adult learners are expected to show dissociation between definite articles and attributive adjectives.

V Experimental method

In order to test these predictions, language production data obtained in a controlled experimental setting is discussed.[9] Three groups of learners participated in the experiment: monolingual (child L1) learners of Dutch, Moroccan children learning Dutch as their L2, and Moroccan adults learning Dutch as their L2. The merit of this three-way comparison is that it potentially allows disentangling effects of age of onset and L1 vs. L2 acquisition (Schwartz, 1992; 2004; Unsworth, 2005).

1 Participants

The participants in all groups live in the western part of the Netherlands (Randstad). The monolingual (child L1) participants were attending regular elementary schools or day-care in predominantly Dutch monolingual surroundings and were reported by their teachers to be developing language normally. In total, 64 children were tested, divided over five age groups (ranging from 3–7 years old). Fifty-three L2 participants were tested, divided into two child L2 groups (with different levels of proficiency) and two adult groups (also with different levels of proficiency) (see Appendix 1).

We define an L2 child as a child whose initial substantial exposure to the non-native language is between ages 4 and 7 (based on Schwartz, 2004). Based on the teacher's responses on a shortened version of the *Anamnese meertaligheid* 'Questionnaire on the child's multilingual context' (Blumenthal and Julien, 1999), it was decided whether or not a child met the child L2 criterion. Selected child L2 learners were born

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[9] Our assumption is that performance data reflect underlying competence (Fromkin, 1980; 1983). We choose a performance/production test to be able to use the same test for all participants, including young children.

in the Netherlands, were raised by parents who did not communicate with them in Dutch (rather, they used Moroccan-Arabic and/or the Berber language Tarifit), showed little passive and active knowledge of Dutch when they entered school at the age of four, and lived in area's with a high percentage of Moroccan immigrants (ranging from 20–40.2%).[10] The children included in the study were reported to be developing normally, and did not visit a speech therapist. Selected adults immigrated to the Netherlands well after puberty (>15) and did not have any contact with Dutch before they immigrated to the Netherlands.

2 Level of proficiency

To ensure a valid comparison between the children and adults, a test to measure level of proficiency was included (Unsworth, 2005). For both L2 children and adults, sentence repetition is a standardized procedure (among other procedures) used to assess L2 proficiency. Assuming that adults meet the cognitive prerequisites to do a test developed for children – but that the reverse does not necessarily hold – we engaged both L2 children and L2 adults in a sentence-repetition test developed for L2 children: The selected sentence-repetition task is part of the *Taaltoets Alle Kinderen* 'Children language assessment' (TAK; Verhoeven and Vermeer, 2002), which is a standardized procedure for measuring proficiency in Dutch grammar in Turkish and Moroccan children aged 4–11 years. In this test, each sentence that has to be repeated contains a certain word-order property of Dutch and a function word. Only if both word-order and function word in a sentence were repeated correctly were two points assigned for that particular sentence. The test contained 20 items, resulting in a maximum score of 40.

Participants were assigned to either group I or group II on the basis of their TAK scores. Group I has a score below 20 points and participants in group II have scored 20 points or higher. For the children, the proficiency score correlates strongly with age and, thus, with length of exposure to Dutch: Nearly all children in the child L2 I groups are under the age of 7, whereas there is hardly any child in the child L2 II

[10] Wijkenmonitor (2007): http://www2.utrecht.nl/images/Secretarie/Bestuursinformatie/Publicaties2007/ WM2007/wijkenmonitor2007.pdf (March 2008)

group that is under the age of 7. Four L2 children were excluded because they did not finish the TAK proficiency test. To compare L1 and L2 children, we used length of systematic exposure to Dutch (in years) as a criterion. For the child groups this measure may work well because there is much less variation with respect to length of exposure than in the adult group. Given that systematic exposure begins for the L2 children at approximately age four, we assume that the youngest monolingual group, that is, the 3-year-olds, are comparable to the child L2 II group, which has a mean age of 7;3.[11] For the complete picture, this may imply that the child L1–3, child L2 II and adult L2 II groups provide the optimal comparison, although we immediately stress that this rather indirect comparison between child L1 and adult L2 groups should be treated with considerable caution.

3 L1 background

All participants speak Moroccan-Arabic, the Berber language Tarifit, or both these languages as their first language. Moroccan-Arabic makes a distinction between feminine and masculine gender. Feminine nouns tend to end in *-a*. Adjectives agree in gender with the noun, in contrast to definite articles. Example (10) gives examples of a masculine and feminine noun–adjective pair, respectively (Harrel, 1962; examples from Hoogland, 1996):

10) a. ražel   ax•r
        man-indef   different
     b. mʁa   xʁa
        woman-indef different

The Berber language Tarifit also has a masculine–feminine gender system. Singular nouns that end on *-t* or *-a* are nearly always feminine, whereas singular nouns that begin with a vowel tend to be masculine. Feminine demonstratives and adjectives have a *-t* in the onset. Moroccan-Arabic and Tarifit have, according to Hawkins and Franceschina (2004), the underlying grammatical feature [± feminine]. This does not map onto the Dutch [± neuter] feature, which makes positive transfer improbable, also in terms of abstract features. Two adult

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[11] The youngest L1 group (3 year olds) was too young for the TAK.

participants had learned French as a non-native language, as well as Dutch. Because French is also [± feminine], like Moroccan-Arabic/Tarifit, it is not expected that additional knowledge of French influences the acquisition of the Dutch gender system in a particular direction (Sabourin and Stowe, this issue).

4 Experimental design and materials

Knowledge of both gender encoding in definite determiners and attributive adjectival inflection was tested by means of a sentence completion task in which participants described (contrasts between) pictures. The target nouns comprised fairly frequent common nouns and an equal number of neuter nouns. For child L1 learners, who were youngest in age, the test contained fewer items per category because of the children's short concentration span. In the adjective test, the pictures depicted a minimally contrasting pair to force the participant to use an adjective for describing the difference. The indefinite condition preceded the definite condition to introduce the object in the discourse, and to create a felicitous context for definite articles. As fillers, items on verb placement and verbal inflection have been included. The items on articles, adjectives and verbs were presented in pseudo-randomized order. In the definite article test each noun was tested twice (with considerable time and other test items in between). Additionally, the adjectival inflection test elicited a definite article in the definite condition (for examples of text item, see Orgassa and Weerman, this issue).

VI Results

1 Definite articles

We predicted that between-group comparisons would show no differences between monolingual children, child L2 learners and adult L2 learners of Dutch. Learners from the same level of proficiency in these three groups are expected to make the same number and types of errors. Both the lexical and grammatical route predict that *de* will be used in contexts requiring *het* and that correct use of the neuter definite article *het* is expected to increase with growing proficiency in Dutch in all groups. The percentages in Table 2 show the proportions of errors in

Table 2 Errors of commission definite articles (% *het* with common nouns and *de* with neuter root nouns), child L1–3, child L2 and adult L2 groups

Group	Common nouns (definite article error = *het* > *de*)		Neuter nouns (definite article error = *de* > *het*)	
Child L1: 3	0%	0/33	88%	37/42
Child L2 I	0%	0/164	97%	170/176
Child L2 II	10%	26/251	85%	212/248
Adult L2 I	2%	2/85	96%	106/110
Adult L2 II	6%	6/105	71%	84/119

common and neuter noun conditions, respectively. The types of errors involve using *het* instead of *de* (common noun conditions) and *de* instead of *het* (neuter noun conditions). Omission errors were excluded for two reasons. First, they do not inform us about grammatical gender, but on (in)definiteness. Second, article omission may be unrelated to representational deficits and, hence, does not concern the questions addressed in this article (Baauw *et al.*, 2002). Responses in which a participant used a different noun than targeted were excluded. (This criterion applies to all further analyses in this article.) Both definite articles produced in the definite article test and definite articles in the adjectival inflection test were taken into account, because the two tests did not reveal differences in types of errors.

Between-group comparisons do not indicate differences in types of errors: Participants in all groups make few errors with common nouns (0–10%) and frequently err on neuter nouns (71–97%). Thus, use of *de* instead of *het* can be identified as an error profile that is neither influenced by age of onset nor by the factor nativeness. A comparison of proficiency levels suggests that more proficient L2 learners perform better with respect to neuter nouns than less proficient L2 learners. This development seems to go hand in hand with a slight increase of errors in the common noun conditions. Individual data, however, show that both developmental effects in the child L2 group are influenced by one particular child, who shows an across-the-board use of *het*. Exclusion of this level II participant (outlier) weakens any developmental effects in the child L2 sample: The percentage of errors in the common noun condition becomes 2% (5/227), in the neuter noun condition 93% (209/224). Statistical testing shows that in the adult L2 group the developments are not significant either (Mann–Whitney (exact) tests neuter condition $z = -.503$, $p = 0.703$; common condition $z = -.391$,

$p = 0.796$). The observed patterns are generally consistent between participants. Only the results of the adult L2 group in the neuter condition show a considerable degree of individual variation (M correct use = .28; range correct use .00−.88; SD correct use = .30).

The developmental pattern of the monolingual children is given in Table 3. The monolingual children show a statistically significant development in their correct use of neuter gender between ages 3 and 5 ($z = -2.057$, $p = .040$), which is represented by a clear decline of errors (from 88% to 31%). Despite this development, monolingual children aged 7 perform clearly above chance level, but are still below Brown's (1973) criterion, which states that a grammatical morpheme is acquired once it appears in at least 90% of the obligatory contexts. Responses in the common noun conditions suggest a slight increase of errors. Although this effect is not statistically reliable, it might be a trend, which indicates that the development observed in the neuter noun conditions has a marginal influence on common nouns. In fact, the monolingual children that do use *het* with common nouns are those children that frequently use *het* in the neuter noun conditions, which would be expected if use of *het* in the neuter noun conditions spreads to the common noun conditions (Unsworth, this issue).

To summarize, child L1, child L2 and adult L2 learners of Dutch with a comparable level of proficiency make a similar number of errors in their use of definite articles. Their errors are, moreover, of the same quality: '*de* instead of *het*' frequently occurred, whereas '*het* instead of *de*' was infrequent in all groups. A cross-sectional comparison of monolingual children from different ages showed that older children used *het* correctly more often than younger children; the older children also showed a slight tendency to use *het* incorrectly more often

Table 3 Errors of commission definite articles (% *het* with common and *de* with neuter root nouns), monolingual children aged 3–7 years

Group	Common nouns (definite article error = *het* > *de*)		Neuter nouns (definite article error = *de* > *het*)	
Child L1: 3	0%	0/33	88%	37/42
Child L1: 4	2%	2/98	56%	54/93
Child L1: 5	14%	12/88	31%	27/87
Child L1: 6	18%	19/103	29%	31/108
Child L1: 7	7%	8/119	24%	29/122

than the younger children. The L2 groups did not show statistically significant developments either in the common or in the neuter noun conditions. The experimental L1 data confirmed findings from previous, spontaneous speech studies: Mastery of the Dutch definite article system requires considerable time and/or input. This lengthy development is also expected to hold for non-native learners. Therefore, only data from L2 learners with more/longer exposure to Dutch can indicate whether or not the absence of any (statistically significant) developments in our L2 data differentiate between native and non-native learner groups.

2 Attributive adjectives

Dutch adjectives encode gender in the indefinite singular condition only. In this condition, learners can make two types of errors: They can either use the bare adjective incorrectly with common gender nouns (*een bruine/*bruin hond-common* 'a brown dog' = ø > ə) or use the adjective ending on schwa incorrectly with neuter gender nouns (*een *bruine/bruin paard-neuter* 'a brown horse' = ə > ø). Table 4 gives the error profiles for monolingual children, child L2 learners and adult L2 learners.

The child L1 and child L2 groups make hardly any errors with adjectives modifying common nouns (0–8%), and make many errors with adjectives modifying neuter nouns (81–84%). Both observations reflect a preference for the adjective with schwa in the child groups. In contrast, the adult learners make many errors with common nouns (77–71%) and fewer errors with neuter nouns (20–44%). The difference between child L2 and adult L2 learners is statistically significant (level I

Table 4 Errors adjectival inflection (% bare adjectives with common nouns and adjectives with schwa with neuter root nouns in the indefinite singular condition), child L1–3, child L2 and adult L2 groups

Group	Common nouns (adjectival inflection error = ø > ə)		Neuter nouns (adjectival inflection error = ə > ø)	
Child L1: 3	0%	0/16	84%	16/19
Child L2 I	8%	14/171	81%	134/165
Child L2 II	6%	10/169	81%	127/157
Adult L2 I	77%	34/44	20%	9/44
Adult L2 II	71%	49/69	44%	34/77

and II collapsed: $z = -4.594$, $p = .000$ and for neuter nouns $z = -4.064$, $p = .000$). In particular, the less advanced adults show an across-the-board preference for the bare adjective. The absence of a statistically significant difference between level I and level II adults in the neuter condition ($z = -1.226$, $p = .252$) may be due to the individual differences in the adult level II group in this condition: Two participants show across-the-board use of the bare adjective, two other participants overuse the schwa-adjective in all cases, and the rest of the participants fall in between these two extremes.

A comparison of the non-native level I and level II groups does not reveal any developments. A comparison of the different monolingual age groups suggests a clear developmental pattern, however (Table 5). Statistical testing confirms the decline of errors in adjectival inflection with neuter nouns: Spearman's *rho* non-parametric test of correlation reveals a significant negative correlation between age and number of errors in the adjectival conditions with neuter nouns ($rho = -.329$, $n = 62$, $p < .01$, one-tailed).

The above results indicate that a learner's age influences the production of attributive adjectives: Child L2 learners have the same error profile as monolingual children, whereas the error profile of adult L2 learners (with the same L1 as the child L2 learners) is clearly different.[12] The adult profile is compatible with the expectations given input

Table 5 Errors adjectival inflection (% bare adjectives with common nouns and adjectives with schwa with neuter root nouns in the indefinite singular condition), monolingual children aged 3–7 years

Group	Common nouns (adjectival inflection error = ø > ǝ)		Neuter nouns (adjectival inflection error = ǝ > ø)	
Child L1: 3	0%	0/16	84%	16/19
Child L1: 4	0%	0/49	54%	21/39
Child L1: 5	0%	0/45	30%	13/44
Child L1: 6	0%	0/49	36%	19/53
Child L1: 7	0%	0/62	25%	15/60

[12] The situation is potentially complicated by the observation that in Moroccan-Arabic, word-final (unstressed) vowels are sometimes elided. This could contribute to the preference to use the bare form rather than the schwa. However, given that it is as yet unclear how this process of elision in Moroccan-Arabic would be transferred to Dutch, it remains uncertain to what extent this could contribute to the L2 adults' behaviour. It is expected that this influence is rather marginal, because studies on adjectival inflection in adult Dutch that include participants from other L1 backgrounds also report overuse of the bare form (Weerman *et al.*, 2006; Blom *et al.*, 2007).

distributions of bare adjectives and adjectives ending with schwa. The observed difference between children and adults might be superficial, however. If the adults incorrectly assume that the nouns they modify with a bare adjective are neuter nouns, they would make a mistake in gender attribution, but their choice of the adjectival form would not be different from that of the children. In this case, the adult 'errors' with adjectival forms would, in fact, be correct forms in terms of gender agreement. In order to correct for incorrect gender attribution, we correlated the responses in the article and adjective tests per noun. At most three definite article responses were collected per noun. A noun was classified 'de' (or common) if a participant used *de* either two or three times with this noun. A noun was classified 'het' (or neuter) in cases where a participant used *het* either two or three times with this noun. A noun was classified 'inconsistent' if a participant used a combination of *de/het*, *de/de/het* or *de/het/het* with this noun. The adjectives were analysed using a similar model, leading to the response categories 'schwa', 'bare' and 'inconsistent'. After excluding inconsistent nouns, we related choice of definite articles to choice of the adjectival form per noun (consistency analysis). The results are listed in Appendix 2. The consistency analysis shows that the children are consistent, using *de* in combination with the adjective on schwa. In terms of grammatical gender, this is compatible with the claim that the children overattribute [–neuter] to nouns stored in their lexicon. In the adult groups, the inconsistent pattern predominates: a noun that consistently appears with the definite article *de* is used in combination with the bare adjectival form.[13]

An analysis of the individual patterns shows that the children's consistency, on the one hand, and the adult's inconsistency, on the other, cannot be attributed to individual differences. From a group of 33 L2 children, 25 children are more often consistent than inconsistent (range of consistent responses $= 71$–100%; $n = 5$–15 per participant); four children are excluded because their results did not allow for a consistency analysis (due to lack of consistently classified nouns on the basis of definite articles). The absence of a difference in the data of three children is probably due to the low number of responses per participant

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[13] Although this consistency analysis is important, we stress that it only gives an indication, because we unfortunately had to exclude many responses.

(consistent responses = 50%; *n* responses = two per participant), and one participant was classified as an outlier. From a group of 20 L2 adults, four are more often consistent than inconsistent (range consistent responses = 63–100%; *n* = 3–9 per participant), and in 10 participants the inconsistent pattern predominates (range consistent responses = 0–33%; *n* = 1–9 per participant)[14]; four participants are excluded because their results did not allow for a consistency analysis (due to lack of consistently classified nouns on the basis of definite articles), and two participants did not show a difference (consistent responses = 50%; *n* responses = 4).

In sum, the results discussed in this section reveal a difference between children and adults. At first sight, both children and adults make a considerable number of errors with adjectival forms. However, consistency analyses show the children's errors can be interpreted as overgeneralizations of [–neuter], whereas this does not explain the adult errors. As a consequence, children and adults have different error profiles with respect to attributive adjectives: children overuse the schwa-adjective while adults, by contrast, also overuse the bare adjective. It was shown that these differences can neither be explained by individual variation, nor do they follow from L1 transfer. The adult error profile (that is, errors in two directions and inconsistency between definite articles and attributive adjectives) is compatible with a lexicon-based input-driven learning procedure, whereas the children's profile (consistency between definite articles and attributive adjectives) is compatible with a grammar-based representation.

3 Developments across gender domains

We argued in Section II that Dutch definite articles and attributive adjectives can be accounted for with a restricted set of grammatical features. In this analysis grammatical gender is represented by the binary feature [±neuter]. As [±neuter] is assumed to be relevant for both definite articles and attributive adjectives, it is expected that activation of this feature will influence both gender domains (Section III). In other words, parallel development in the two different gender domains may

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[14] There is one adult participant with only one consistent response.

be indicative of a unifying factor and hence may provide support for [±neuter]. Dissimilar developments, in contrast, are compatible with the frame-based lexical approach.

If an increase of the neuter definite article *het* goes hand in hand with an increase of the bare adjective in indefinite, singular, neuter contexts, it is likely that [±neuter] has been activated. Given the rather lengthy development of the monolingual children, both L2 adults and children in our study may be in a relatively early developmental stage, which would explain the absence of statistically significant developments in the L2 groups. As regards the developmental pattern of the bilingual children,[15] production data reported in three other studies are relevant. Hulk and Cornips (2006) studied the acquisition of definite articles in Dutch bilingual children from a wide range of L1 backgrounds (Moroccan Arabic/Berber, Sranan, French, Akan/Ewe, Russian-Sranan, Turkish). The neuter noun results of Hulk and Cornips' oldest group, aged 9;3–10;5, show that although the bilingual children did not catch up with their age matches (90% correct), they did outperform our oldest child L2 group (39% correct use of *het*). Cornips *et al.* (2006) tested Moroccan and Turkish bilinguals in the age range 10;5–12;11 and found 42% (121/288) correct use of *het*, whereas 26.9% (155/576) of the (indefinite) adjectives were correct (that is, bare). Laloi *et al.* (2005) tested a group of 15–16-year-old Moroccan child L2 learners of Dutch (*n* = 9) with a test similar to ours. These authors found that the neuter definite article *het* was used correctly in 64% (36/56) of the obligatory contexts, and that the schwa-adjective was massively overused (only 9% i.e. 10/111 of the adjectives in the indefinite, neuter, singular condition were bare).

Based on a comparison of our youngest bilingual group, the child L2 I group (mean age: 5;10, *n* = 17), our oldest bilingual group, the child L2 II group (mean age: 7;3, *n* = 16), Hulk and Cornips' (2006) oldest bilingual group (age range: 9;3–10;5, *n* = 3) and the Cornips *et al.* (2006) results (age range: 10;5–12;11, *n* = 24), we deduce that the bilingual children show a gradual development from 3% (6/176), 15% (36/248), 39% (16/41), 42% (121/288) to 64% (36/56) correct use of

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[15] We will use the more general distinction between monolingual and bilingual children here (instead of L1 and L2 children), because the other studies may include simultaneous and sequential bilingual children.

het. This development suggests that the bilingual children are delayed, but do not fossilize. This observation is particularly interesting in the light of the attributive adjectives. Recall that our data showed no development; the data collected by Laloi *et al.* (2005) and Cornips *et al.* (2006) confirm persistent overuse of the schwa-adjective (for a similar observation, see Weerman *et al.*, 2006). Figures 1 and 2 illustrate the contrast between monolingual and bilingual children.

Developmental patterns across gender domains suggest a difference between monolingual and bilingual children. The parallel development of the monolingual children is consistent with activation of an abstract underlying representation that influences different types of gender encoding. The bilingual children, however, show dissimilar developments in two different gender domains.
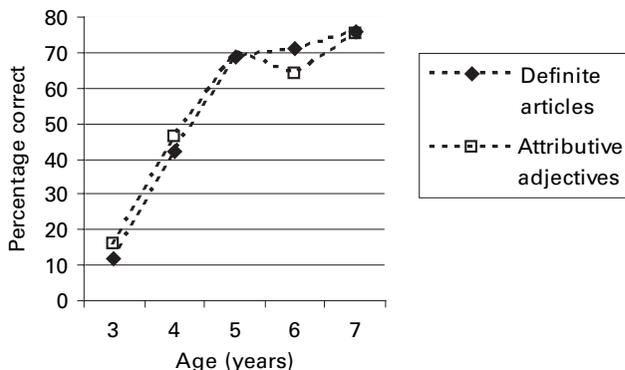

Figure 1   Development of neuter gender (definite articles and attributive adjectives), monolingual children
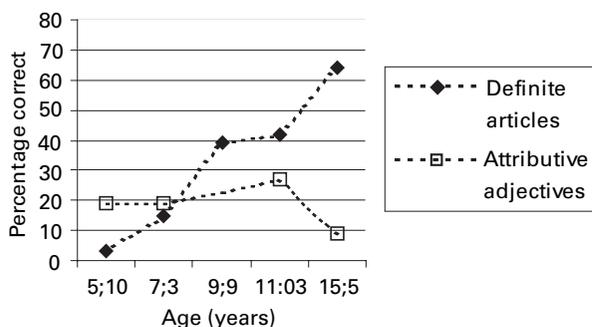

Figure 2   Development of neuter gender (definite articles and attributive adjectives), bilingual children

Strikingly, the longitudinal behaviour of the bilingual children appears to be consistent with our prediction for late learners of Dutch. This could imply that the bilingual/L2 children do not activate [±neuter], and rely on lexical representations only. An alternative explanation would be that the bilingual/L2 children can access [±neuter] but are unable to detect the relevance of this feature for the adjectival system, because the indefinite article is not gender-marked in Dutch. In effect, the children fail to deduce the topmost rule in (7), repeated in (11) below, and use the least specific, default, rule instead, resulting in overuse of the schwa-adjective:

11) /ø/ ↔ [+attr, –def, +neut, –plur]
    /ǝ/ ↔ [+attr]

A method to determine whether or not bilingual/L2 children activate [±neuter] would be to test them not only on definite articles and attributive adjectives, but to also collect data on gender-marking in demonstratives, possessives, *wh*-pronouns and/or relative pronouns. If the developmental pattern in these domains resembles that of the definite articles, it is likely that the bilingual/L2 children activate [±neuter]. In this case, attributive adjectives constitute a special, because vulnerable, gender domain in Dutch. If gender-marking turns out to be problematic in the other domains, it is plausible that the bilingual/L2 children have not accessed [±neuter].

VII Discussion

Two recent theories on effects of age on language acquisition draw a distinction between lexicon and grammar: the Failed Functional Features Hypothesis (FFFH) and the Declarative/Procedural (DP) model (Ullman, 2001a; 2001b; Hawkins and Franceschina, 2004; Ullman, 2004). It has been argued that the lexicon – and the neural system that subserves the mental lexicon (declarative memory) – is fully operational at later ages. Grammar was claimed to pose difficulties for adult learners, possibly as an effect of reduced availability of its subserving neural devices (procedural memory). In this contribution, we explored this hypothesis on the basis of Dutch grammatical gender.

First, we showed that grammatical gender in Dutch definite articles can be captured by input-driven lexicon-based rules as well as by

grammar-based representations. However, in order to account for the Dutch adjectival system, an abstract grammatical gender feature is required ([±neuter]). Second, on the basis of input distributions we determined lexical frames for definite articles and attributive adjectives, and derived error profiles for late learners on the basis of these frames. Subsequently, we pointed out in which aspects the adult error profiles are expected to be different from the error profiles of children, assuming that children are not dependent on input-based frames but have access to grammar-based representations. Our expectation was that types of errors in attributive adjectives and (in)consistencies between definite articles and attributive adjectives revealed differences between early and late learners.

Experimental results from monolingual Dutch children, Moroccan child L2 learners of Dutch and Moroccan adult L2 learners of Dutch confirmed our predictions. With respect to Dutch definite articles, one particular error profile predominated in all groups, that is, use of the common definite article in neuter contexts. The attributive adjectives revealed different error profiles for L1 and L2 children, on the one hand, and L2 adults, on the other hand. The vast majority of the children's errors could be interpreted as use of the common form (i.e. schwa-adjective) in neuter contexts, and were in this respect consistent with the errors in definite articles. Adult learners overused both the schwa-adjective and the bare adjective. The adult error profiles with respect to definite articles and attributive adjectives are inconsistent from a grammar-based perspective, but were fully compatible with input distributions, and hence with a lexicon-based perspective. Only the monolingual children in our sample underwent developmental changes: Between ages three and seven they showed an increased accuracy of definite article and attributive adjectives. The two gender domains developed in parallel, which is expected if both are represented by [±neuter]. In combination with results from other studies on bilingual/child L2 children, our results showed that in bilingual/child L2 development definite articles do show a (prolonged) development, whereas attributive adjectives seem to fossilize.

The observed three-way distinction between monolingual children, bilingual/L2 children and L2 adults is reminiscent of Newport's (1990) work on native, early and late learners of American Sign Language, and

it may allow us to formulate more refined hypotheses on effects of age. Our developmental results might, for instance, be indicative of age effects that occur even earlier than age six/seven; and this is compatible with the hypothesis proposed by Meisel (2007), according to which crucial changes have an onset between ages three and four and further changes take place around age six/seven. Perhaps the special case of attributive adjectives – the topmost rule in (11), or more generally the feature [±neuter] – has to be activated before age four. Alternatively, the results may plead for a critical period until age six/seven that takes input distributions into account. The crucial premise of such an account would be that activation of [±neuter], or deducing the lexical insertion rules of the Dutch adjectival system, only happens if relevant information in the input exceeds a certain threshold or critical mass (Marchman and Bates, 1994). In the case of Dutch grammatical gender or adjectival inflection, a lengthy period of substantial exposure could compensate for weak statistical properties of the input. Monolingual children who start from birth can therefore reach native levels of performance, but bilingual/L2 children who receive less input in the same period and/or start later might not reach the critical mass on time.

VIII Conclusions

Based on the results of speech production experiments on Dutch grammatical gender conducted with Dutch monolingual children, Moroccan child L2 learners of Dutch and Moroccan adult L2 learners of Dutch, we conclude that adult learners rely on lexicon-based learning whereas children apply grammar-based learning strategies. Whether or not there are also early effects of age remains uncertain: A comparison of error-profiles showed that the monolingual children and child L2 learners pattern similarly (and differ from the adult L2 learners), whereas developmental analyses indicated a difference between the monolingual children and child L2 learners.

In this article, we provided an answer to the questions as to how and why early and late learners differ from each other in their acquisition of Dutch grammatical gender. Our theoretical approach and data shed light on some aspects, but raised new questions as well. Future research should point out to what extent the critical period and input distributions interact in bilingual children. It is important to compare developmental

patterns in a range of gender domains and, ideally, conduct this type of research on different populations that vary in age of onset. In addition, studies looking at the ultimate attainment of Dutch grammatical gender – in particularly looking at the ultimate attainment of the Dutch adjectival system – should indicate whether or not [±neuter] can eventually be accessed by late learners. If late learners can reach a native level of performance with respect to Dutch attributive adjectives, this would plead for the Declarative/Procedural model. If they are unable to do so, this would support the Failed Functional Features Hypothesis.

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Appendix 1   Information about participants is given in Tables 6 and 7

Table 6   Overview of child L1 participants

Group	Age range	*n*
Child L1: 3	3;2–3;10	7
Child L1: 4	4;0–4;11	17
Child L1: 5	5;1–5;11	15
Child L1: 6	6;2–6;11	11
Child L1: 7	7;1–7;10	14

Table 7   Overview of child L2 and adult L2 participants

Group	Age at time of testing (range)	Age of onset	Proficiency score (range)	*n*
Child L2 I	5;10 (4;2–8;3)	≈4	14.8 (7–19)	17
Child L2 II	7;3 (6;2–8;4)	≈4	28.1 (20–35)	16
Adult L2 I	31.7 (25–44)	>15	6.2 (0–19)	10
Adult L2 II	28.2 (21–39)	>15	26.4 (21–40)	10

Appendix 2   Consistency analysis

If a participant used the definite article *de* with a noun (*de appel* 'the apple'), and also said *een groene appel* 'a green apple', this noun received the label 'common consistent': the choice of *de* suggests that 'apple' has for this participant common gender, and use of the schwa adjective is consistent with this classification. If he or she said *het appel* in combination with *een groene appel*, the label 'neuter inconsistent' has been attributed: use of the definite article *het* is inconsistent with use of the schwa adjective in the indefinite condition. The model used for scoring consistent and inconsistent responses is illustrated in Table 8. The Tables 9 and 10 give the collapsed results for common and neuter nouns.

Table 8   Model for scoring consistent and inconsistent responses

Definite article test	Indefinite attributive adjective test	Consistency label
De appel 'the apple'	*Een groene appel* 'a green apple'	common consistent
De appel 'the apple'	*Een groen appel* 'a green apple'	common inconsistent
Het appel 'the apple'	*Een groene appel* 'a green apple'	neuter inconsistent
Het appel 'the apple'	*Een groen appel* 'a green apple'	neuter consistent

Table 9   Results of consistency analysis in child L2 and adult L2 groups (percentages)

Group	n	Common		Neuter		Excluded*
		consistent	inconsistent	inconsistent	consistent	
Child L2 I	196	55	4	0	0	41
Child L2 II	236	54	5	2	1	39
Adult L2 I	154	8	16	0	0	76
Adult L2 II	112	11	21	2	4	63

Notes: Some totals do not add up to 100% due to rounding. *Inconsistent article and adjective use, omissions of articles and use of nouns that were not targeted were excluded.

Table 10   Results of consistency analysis in child L1 groups (percentages)

Group	n	Common		Neuter		Excluded*
		consistent	inconsistent	inconsistent	consistent	
Child L1: 3	37	70.0	0	5	0.0	25.0
Child L1: 4	102	71.5	0	3	13.0	13.0
Child L1: 5	90	45.5	0	8	15.5	31.0
Child L1: 6	110	43.0	0	8	25.5	23.5
Child L1: 7	140	42.0	2	2	22.0	31.0

Notes: Some totals do not add up to 100% due to rounding. *Inconsistent article and adjective use, omissions of articles and use of nouns that were not targeted were excluded.