Spelling patterns of plural marking and learning trajectories in French taught as a foreign language

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Abstract

Although French plural spelling has been studied extensively, the complexity of factors affecting the learning of French plural spelling are not yet fully explained, namely on the level of adjectival and verbal plural. This study investigates spelling profiles of French plural markers of 228 multilingual grade 5 pupils with French taught as a foreign language.

Three analyses on the learner performances of plural spelling in nouns, verbs and pre- and postnominal attributive adjectives were conducted (1) to detect the pupils' spelling profiles of plural marking on the basis of the performances in the pretest, (2) to test the profiles against two psycholinguistic theories, and (3) to evaluate the impact of the training on each spelling profile in the posttest.

The first analysis confirms the existing literature that pupils' learning of French plural is not random but ordered and emphasizes the role of the position for adjectives (pre- or postnominal) on correct plural spelling. The second analysis reveals the theoretical difficulties of predicting spelling of adjectival and verbal plural. The third analysis shows that strong and poor spellers both benefit from a morphosyntactic training and provides transparency and traceability of the learning trajectories.

Together, the descriptive analyses reveal clear patterns of intra-individual spelling profiles. They point to a need for further research in those areas that have empirically provided the most inconsistent results to date and that are not supported by the theories: verbs and adjectives.

Key words:

French; spelling; written plural; silent orthographic marker; syntactic marker; Processability Theory; cognitive Learning Based Theory

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1. **French plural markers without correspondence in phonology**

Learning to spell is a complex linguistic activity that follows specific learning trajectories (Bahr, Silliman, Berninger, & Dow, 2012). In the initial stages of spelling, children mainly use their knowledge of phonology to spell words. During the later learning stages, they refine their spelling knowledge, learn more about the complexities of the phonological, orthographic, and morphological characteristics of words as well as syntactic information above word level, and use this knowledge when writing (Bahr et al., 2012; Nunes, Bryant, & Bindman, 1997; Silliman, Bahr, Nagy, & Berninger, 2018; Sprenger-Charolles, Siegel, Béchennec, & Serniclaes, 2003; Treiman & Bourassa, 2000). Spelling is particularly challenging when orthography does not have any correspondence in phonology. The difficulties increase when spelling represents syntactic information (Bryant, Nunes, & Bindman, 1997; Sandra, 2012; Weth, n.d.). In English, syntactic markers distinguish for example plural and genitive such as in *the friends drink* vs. *the friend's drink* (Arciuli & Monaghan, 2009; Funke & Sieger, 2012; Kemp, Nilsson, & Arciuli, 2009). They are particularly challenging in the writing process, as writers need to process the syntactic information and take into consideration the syntactic function of the words that agree with each other. Interestingly, although young spellers already identify - and may correctly produce - syntactic markers, spelling difficulties with the same markers may persist throughout school (Betzel, 2015; Bryant, Nunes, & Bindman, 2000; Totereau, Brissaud, Reilhac, & Bosse, 2013; Totereau, Thevenin, & Fayol, 1997; Turnbull, Deacon, & Kay-Raining Bird, 2011). Even literate adults show spelling difficulties in some contexts (Blondel, Brissaud, & Rinck, 2016; Largy, Fayol, & Lemaire, 1996). Poor spellers show particular difficulty with syntactic spelling (St-Pierre & Béland, 2010).

Silent markers that represent syntactic structures are characteristic for the French writing system (Catach, 1980; Dubois, 1965). They visually highlight syntactic information above the word level that is not or barely present in phonology. An example is the plural marking in French.

Very few written plural forms also have different phonological forms for singular and plural, apart from a few nouns (e.g., *œil / yeux,* [œj] / [jø], 'eye/eyes'), the forms of the frequent verbs *to be, to have, to make* and *to go* ending on *-ont* [ɔ̃] and verbs including an additional affix (e.g., *-iss-*) located between the stem and the plural morpheme. This interfix signals the plural orally (*il finit / ils finissent*, [il fini] / [il finis], 'he finishes' / 'they finish').

Crucially however, the written plural morphemes *-s* and *-nt* always remain inaudible on the word level and in most sentential contexts. The only context in which the plural ending becomes audible is the context of a *liaison*, a process by which a word-final consonant is pronounced at the beginning of the following word if the latter is vowel-initial (Encrevé, 1988). The main scope of liaison are the words within the nominal phrase, i.e. (*de bons amis,*

[də bɔ̃zami], 'good friends'). As soon as the plural marker is audible, spelling errors decrease (Brissaud & Fayol, 2018; Gunnarsson & Soum-Favaro, 2008; Manesse & Cogis, 2007; Totereau et al., 2013).

In general, the only oral indication for plural in a clause is the determiner, more precisely the article and most but not all other determiners. Children mainly encounter plural markers when they are exposed to print. The following singular and plural sentences sound almost identical but differ in writing: *Le grand chat noir mange* [lə gʁɑ̃ ʃa mɑ̃ʒ] vs. *Les grands chats noirs mangent* [le gʁɑ̃ ʃa mɑ̃ʒ] (literally: 'The big cat black eats' vs. 'The big black cats eat'). In oral French, the utterances remain the same, except for the article. Note that other determiners, such as pronouns might not distinguish number or not do so clearly (e.g. leur/leurs [lœʁ] 'their').

In written French, the plural marker *-s* must be added to each word within the plural noun phrase (NP), and *-nt* must be added at the inflected verb form representing the agreement with the plural-NP-subject. As the plural markers indicate phrase structure and subject-verb-agreement, this redundancy helps readers to deduce the meaning of a sentence.

1.1 Plural spelling development in French in L1 and L2 learners

While written plural is a challenge for French L1 learners even after they have learned French oral plural, learners of French as a foreign language (hereinafter referred to as L2) learn written plural right from the beginning, as a part of the language learning process.

In addition, foreign language teaching often focuses on verbal conjugation and the inflection forms present only in spelling. The regular plural markers *-s* (noun, adjective) and *-nt* (verb) are therefore often spelled correctly, especially for verbs (Granget, 2005; Gunnarsson, 2006, but not Granget, 2017), and subject-verb agreement is produced even earlier than adjective agreement (Ågren, 2009). Additionally, the L2 learners' spelling shows variance in stem alternations and morphological forms, which cannot be deduced from the rule stem plus suffix and must be learned as vocabulary (i.e., to *teach, taught*) (Ågren, 2009; Gunnarsson, 2006).

The variable of language input provides more insights into the differences between L1 and L2 French learners, assuming that monolingual L1 learners have more input in the target language compared to bilingual and foreign language learners, who also receive (dominant) input in another language (Ellis, 2008). Comparing the production of plural marking in oral and written French narratives, Ågren and van deWeijer (2013) confirm the hypothesis that L1 learners produce oral plural more accurately than bilingual and foreign language learners. In written narratives, however, L1 and L2 learners did not differ in the production of number agreement.

The body of research on plural spelling development in French is impressive and has identified bundles of factors that might influence the production of the respective markers (for an overview, cf. Brissaud & Fayol, 2018; Guyon, 2003). Overall, studies on L1 and L2 French indicate that learning grammatical spelling is laborious for all learners. They need to

become aware of grammatical structures that differ substantially from the oral structures that might be already available to them (L1) or not yet (L2). The acquisition of written plural might be even more difficult, as a corpus study shows that singular forms outnumbers plural in oral and written French (Ågren & Van De Weijer, 2013).

All studies agree that plural on nouns is acquired earlier as plural on verbs (Guyon, 2003; Totereau et al., 2013). A reason for the early acquisition on nouns may be the semantic grounding of nominal plural and the high frequency of the plural markers -*s* (M. Fayol, Totereau, & Barrouillet, 2006).

After the discovery of the plural marker -*s*, pupils tend to overgeneralize it to other word categories such as adjective, verb, and adverb (Guyon, 2003; cf. Fayol et al., 2006). In fact, younger pupils tested in grades 1 to 3 achieved higher correct spelling scores for adjectives than for verbs (Thévenin, Totereau, Fayol, & Jarousse, 1999). While the generalization on the adjective is inconspicuous and seems a subsequent step in the course of development (i.e., *Les vélos blancs*), the generalization on verbs as well as the marking of non-inflecting adverbials is striking (i.e., *Les vélos *roules *vites* instead of *Les vélos roulent vite.*). The learners' overuse of a plural markers on all words that are in a plural context suggests a generalized, semantically based understanding of plurality.

Only with the discovery of a second plural marker, -*nt* for verbs, an analysis of the grammatical word category becomes relevant and so does the distinction between nouns and verbs. This discovery is decisive for the learning process as the learners have to refine their processing strategy (Michel Fayol, Hupet, & Largy, 1999; Guyon, 2003). The acquisition is particularly difficult, however, since the subject can take many forms and may consist in a simple NP (*les chiens*), a subordinate clause (*les chiens de ma voisine/qui aime(nt) courir*) or a pronoun (*ils*). The correct marking of the verbs hence depends not only on the verb in the respective sentence but also on the NP-subject.

Several researchers have studied individual spelling profiles across different syntactic contexts, including regular (inaudible plural) and irregular (audible plural) verbs with dictation (amongst other tasks) in pupils throughout primary school until grade 6 in French majority or minority contexts (M. Fayol et al., 2006; Geoffre & Brissaud, 2012; Lefrançois, 2009; Thévenin et al., 1999; Thibeault, 2017; Totereau et al., 2013). These studies show the variability of spelling among the learners in general and their not yet stabilized understanding of plural marking. However, the score of correct plural spelling for a given word class (nominal, adjectival or verbal plural) correlates with the spelling score of another word class. In a study with 341 grade 6 pupils, Totereau et al. (2013) showed that pupils with a very high spelling score for plural nouns (n=135, 3/3 or 100% correct nouns) also have the highest spelling score for verbs (73%) and adjectives (36%). In contrast, among those pupils who do not spell nominal plural correctly (n=123, 0 or 33% correct nouns), 72% fail with verbs and 100% with adjectives. Beyond this, those pupils who achieve a good score on adjectives (n=57), spell all the nouns and almost all the verbs correctly (Totereau et al., 2013, p. 167). The findings in Totereau et al. (2013) confirm earlier experiments that show

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the acquisition of nouns before verbs and adjectives (M. Fayol et al., 2006; Totereau et al., 1997). The better performance on verbs over adjectives in the study with grade 6 pupils (Totereau et al., 2013) might be partially explained by the curriculum's focus on verb conjugation in the curriculum. Moreover, it seems that the target adjectives were not always identified as adjectives. At least the discovery and acquisition of verbal plural seems to be crucial for the acquisition of the number paradigm in written French. A rapid development of verbal plural marking between grade 3 and 5 has been observed in the experiments conducted by Fayol et al. (2006).

1.2 The particularities of adjective plural

In additional to the plural spelling of the word class, Fayol et al. (2006) report that adjectives placed between determiner and noun (prenominal adjectives) are more often accurately marked with the plural marker *-s* than postnominal adjectives (i.e., DAN: *les petits chiens* versus DNA: *les chiens noirs*) by L1 learners. A possible interpretation is that the lower frequency of plural agreement in postnominal adjectives in comparison to prenominal adjectives is a consequence of the longer distance to the determiner, the only audible signal for plural in a sentence.

Two studies in foreign language contexts have distinguished the position of adjectives and its influence on plural spelling. The first of these, conducted in a foreign language context in Luxembourg (Bîlici, Ugen, Fayol, & Weth, 2018), analyzed data of grade 5 pupils who had received 3 years of French at school. Spelling was tested with a cloze test dictation. The target words were presented in the respective sentence contexts. The studied syntactic contexts DNV, DANV and DNAV distinguished the pre- and postnominal position of the adjective. The order of correct spellings scores was highest for nouns, followed by verbs and prenominal adjectives, followed by postnominal adjectives, which provided by far the most difficult category for the pupils.

Ågren (2009) distinguished between (1) attributive adjectives that hold, pre- or postnominal position and are part of the NP, and (2) predicative adjectives that are not. She observes that the agreement of attributive adjectives, being part of the NP, is spelled correctly less often than that of predicative adjectives, which are not part of the NP. Her study mentions no difference between pre- and postnominal adjectives, however. In respect to Processability Theory (PT) (Pienemann, 1998) described in detail later, Ågren (2009) confirms that plural nouns appear very early (stage 2), but concludes that, concerning plural agreement, other factors alongside the processing constraints considered by PT might intervene.

1.3 Teaching French plural spelling

Beyond development, many researchers have studied the impact of training methods that might foster plural spelling (Arseneau & Nadeau, 2018; Boivin, 2018; Brissaud & Cogis, 2011; Brissaud & Fayol, 2018; Cogis, 2004; Elalouf, Cogis, & Gourdet, 2011; Fisher & Nadeau, 2014;

Gauvin & Thibeault, 2016; Geoffre, 2013). These innovative trainings have given rise to a new teaching paradigm, which is distinct from 'traditional' teaching methods based on grammar rules, memorization and long dictation as assessment tool to more learner-centered methods. The new training methods differentiate between rule knowledge and its application, and offer regularly short and well-adapted exercises that mobilize the learners' syntactic analyses during discussions of specific observations in spelling and their relation to grammar (Brissaud & Cogis, 2011; Cogis, 2004; Geoffre, 2013; Mortamet, 2019; Thibeault, 2017). Among many qualitative examples, two experimental intervention studies confirm the positive effects of the systematic teaching of plural markers (Bîlici et al., 2018; Thévenin et al., 1999).

2. The present study

The heterogeneous observations in plural spelling of verbs and adjectives and the different patterns in L1 and L2 settings lead to the present study with an experimental paradigm including two test points, before and after a training. The pre- and posttests assessed plural spelling across the word categories nouns, verbs and adjectives, and distinguished between the position of pre- and postnominal adjectives. The study is based on the spelling profiles of French L1 pupils (Totereau et al., 2013) as well as on the research on spelling development in L2 learners (Ågren, 2005, 2009).

The aim of the study is to reveal spelling profiles of plural markers of 228 multilingual grade 5 pupils in Luxembourg that have been taught French as foreign language (L2) for three years. The study includes three analyses: (1) the spelling profiles of plural marking on the basis of the performances in the pretest, (2) the testing of two psycholinguistic theories against these empirical observations, and (3) the impact of the training on pupils' spelling profiles.

While the first analysis, the pretest results, give insights into the spelling acquisition of grade 5 pupils in a foreign language setting, the second analysis sharpens the question of learning plural markers and (perhaps) identifies the theory that best predicts this learning of multilingual fifth graders as they learn French. The two learning theories have been extracted from the literature review. The third analysis exhibits how learners with different levels of plural spelling benefit from the training.

2.1 Learning theory 1: Learning Based Theory (LBT)

The first theory refers to the theoretical framework the research of Fayol and colleagues is based on (M. Fayol et al., 2006; Totereau et al., 1997) in a L1 French context. The here called Learning Based Theory (LBT) predominantly studied and interpreted the learning of French plural morphology in the framework of Anderson's cognitive learning theory (Anderson, 1983, 1993, cf. Fayol et al. 2006). The theory claims that the acquisition and the use of plural in written French constitute procedural learning that involves rules of the Condition(s)-Action(s) type. Procedural learning is first related to the pluralization of word categories. At

an early learning stage, children rely on semantics and establish a production rule R1: if plurality then add -*s*. As the semantic foundation of nouns (which often refer to countable entities) is different from the purely formal plurals of verbs and adjectives, the acquisition of the nominal plural occurs first. Further, because nouns and adjectives receive the same marker, the R1 rule can be generalized to adjectives. The frequency of the marker -*s* (i.e., for adjectives) leads to the overgeneralization of -*s* to verbs. In the phase when pupils produce -*s* as a plural marker, they still need to acquire restrictions on their use of the R1 rule. When children become aware of the second plural marker -*nt*, they learn to refine the initial rule. Indeed, they must identify nouns, adjectives, and verbs within the sentence and add the corresponding inflection marker. The rule is adapted to R1.1: If plural and noun or adjective, then add -*s*; R1.2: if plural and verb, then add -*nt*. The authors assume that this learning is very likely based on the practice of reading and writing (i.e., exposure to a written corpus enabling children to extract the conditions of rule application).

To these rules, Fayol and colleagues (2006) added the factor of the word position. It has been identified that the distance between the word that needs to be pluralized and the determiner, the only word with an audible plural, influences pluralization. The position was found to be especially important for the category of attributive adjectives, being more correctly inflected in prenominal position as in postnominal position (Fayol et al., 2006). The position farther away from the determiner within the NP is assumed to be the reason that postnominal adjectives are more prone to marker omissions (Fayol et al., 2006). However, despite the differences between the pre- and postnominal adjectives, the acquisition order observed for French plurals by word categories is first nouns, then adjectives, and finally verbs for L1 pupils in the three first years of schooling.

This paper reformulates the three distinct factors that can influence the spelling of plurals into predictions.

First, in accordance with the semantic grounding of nominal plural, prediction 1 says that no pupil would learn adjectival or verbal plurals before the nominal plural.

Second, according to the high frequency effects of final -*s*, prediction 2 says that no pupil would spell the verbal plural without also having marked nominal and adjectival plurals.

Third, in line with the impact of the proximity to the determiner and therefore the position of a word within the NP, prediction 3 says that no pupil would spell the plural of postnominal adjectives without also having marked the plural of prenominal adjectives.

2.2 Learning theory 2: Processability Theory (PT)

The Processability Theory (PT) (Pienemann, 1998) is anchored in the generative grammar framework where syntactic rules are interdependent (Bartning & Schlyter, 2004; Pienemann, 1998, 2005) and based on linguistic processing principles. It presents natural second language learning from a linguistic non-linear perspective that represents the transfer of grammatical information within the syntactic constituent structure. The PT predicts specific learning sequences according to the level of grammatical processing

achieved by the learner. More precisely, plural on lexical level with bare nouns appears first, followed by the agreement of words within the syntactic constituent structure such as the NP. On this intra-phrasal level, learners should mark agreement in the contexts DN, DAN and DNA. This stage would be followed by the interphrasal level including the agreement of predicative adjectives and the agreement between the subject NP and the verb. PT predicts that, whatever the language, the order of grammatical learning is determined by learners' ability to process grammatical structures (Pienemann, 2005; Pienemann, Keßler, & Itani-Adams, 2011). Therefore, in a specific learning stage, learners can produce and understand only those linguistic forms that they can recognize and process within the phrase and within the sentence. The PT was originally designed for natural spoken second language acquisition but has been adapted to account for plural spelling (Ågren, 2005, 2009; Ågren, Granfeld, & Schlyter, 2012; Granfeld, 2005). Ågren (2009) tested its theoretical predictions for French as a foreign language with Swedish adults learning (oral and written) French in Sweden. She hypothesized and critically discussed that, according to the PT, number agreement should be produced in the following order of stages (ibid. p. 128):

1) Bare words, invariant forms, such as *fille* ('girl')
2) Plural on nouns (lexical agreement), such as *fille / filles* (girl/girls)
3) Plural agreement with the NP between nouns, determiner and attributive adjectives (phrasal agreement), such as *les filles, les grandes filles, les filles grandes* ('the girls, the big girls, the girls big')
4) Plural SV-agreement (inter-phrasal), agreement on predicative adjectives, such as *les filles sont grandes* ('the girls are big').

This paper reformulates these stages into predictions. First, to measure plural on nouns and adjectives, the first two stages of lexical access and the phrasal procedure (stage 3) are merged into one category. The category corresponds to the prediction 1: no pupil would mark the verbal plural but not the nominal plural. Second, in accordance with stage 3, the intra-phrasal plural agreement between nouns, determiners and attributive adjectives, prediction 2 says that there would be no spelling differences between plural spelling of the pre- and postnominal adjectives.

Third, in line with the inter-phrasal plural agreement between subject and verb, prediction 3 says that no pupil would mark the verbal plural but not the nominal and adjectival plural.

3. Method

As the main effects of a morphosyntactic training on multilingual fifth graders' spelling have already been reported in a previous paper (Bîlici et al., 2018) including a thorough description of the sample and the intervention program, this method section will mainly focus on the original and additional analyses performed for this paper whilst only briefly sketching out the main characteristics of the participants, intervention program and spelling test allowing to follow the procedure without the necessity to read to other paper. The sub-

section on spelling patterns explains how the data is analyzed in a perspective of intra-individual learning patters of French plural spelling.

Participants

Overall, two hundred twenty-eight fifth graders (54% girls) with a mean age of 11 years participated in this study. All 228 pupils had been exposed to the same amount of (written) French language at school because they had all entered the Luxembourgish school system at least by the first grade. The pupils scored over 50% on an adapted version of a standardized French grammar reception test (Lecoq, 1996), and thus, demonstrated a sufficient command of French syntax for participating in this study. On the basis of the performances in the spelling pretest (see below), the pupils were quasi-randomly assigned to an intervention (n = 137) or a control group (n = 91). The groups were comparable in terms of socio-economic status, age and distribution of different home languages. We obtained parental permission for each child to participate in the study. The National Research Ethics Committee was informed and did not object to this study.

The fifth graders in our study had a multilingual background with several first languages, and 38.6% of them were growing up with two or more family languages. They had been using oral Luxembourgish in school for at least 7 years at the time of the study. They began to learn to read and write in German in Grade 1. French is taught as a foreign language, starting in Grade 2 with oral French and in Grade 3 with written French. The pupils can be described as foreign language learners.

Materials and procedure

The training program. Both groups participated in six training sessions that lasted about 20 min each. They were trained in small groups of four to five children. They were trained during normal school hours but by external instructors. To ensure the equal administration of training and high treatment fidelity, all instructors were trained by the research team and were provided with a script that they had to follow precisely. The pupils in the intervention group followed an explicit training program based on tools developed for French monolingual students including observation of words in different syntactical contexts, de- and recomposition, comparison and application in other contexts (Boivin, 2018; Cogis, 2004; Fisher & Nadeau, 2014) designed to foster syntactic processing and to improve the spelling of French plurals. Within the sessions, pupils explored the plurals of different word categories, beginning with the nominal and adjectival plurals and thus with agreement within NPs before learning and training verbal plural and the agreement between the NP and the verb. The pupils in the control group were trained in French listening comprehension. They were exposed to short texts orally and discussed the stories afterward. The control group merely served to exclude the potential impact of a Hawthorne effect on the test scores of the intervention group.

The pretest and posttest. Both groups of pupils participated in a pre- and posttest session (4 months apart). The pretest was composed of an experimentally designed French spelling cloze test (dictation). The posttest was conducted six weeks after the last intervention session. It included a parallel version of this spelling test, i.e. different items controlled for length and frequency within the same design. All tests were administered as group tests by the means of an audio CD.

Test design. In the following, we describe the design of the spelling test in detail because the analysis of spelling patterns related to the marking of plural is based on this test design. The spelling design included three grammatical categories (i.e., nouns, verbs, and adjectives), and the adjectives could take one of two positions (i.e., prenominal or postnominal). For the ease of reading, in what follows, we speak about four grammatical word categories: (1) nouns (*Les <u>chiens</u> sautent,* 'The <u>dogs</u> jump), (2) verbs (*Les chiens sautent*, 'The dogs <u>jump</u>), (3) prenominal adjectives (*Les <u>grands</u> chiens sautent,* 'The <u>big</u> dogs jump), and (4) postnominal adjectives (*Les chiens <u>noirs</u> sautent,* 'The <u>black</u> dogs jump'). The cloze spelling test included 24 plural target items across the four grammatical word categories (six nouns, six verbs, six prenominal adjectives, six postnominal adjectives) and 12 singular filler items. The items used on the pretest and the posttest are presented in the Appendix. For the analyses, only the spellings of the plural endings of the words were scored.

Spelling patterns. For the current analysis, the spelling patterns were designed to provide information about how accurately pupils spelled the plural within the four grammatical categories that are represented throughout the paper in the following order: (1) nouns, (2) verbs, (3) prenominal adjectives, and (4) postnominal adjectives. As the focus of this paper is on learning of spelling of categories above chance level, a grammatical category was considered to be learned and given a score of 1 if a participant spelled the plurals of at least two thirds of its items correctly (4 out of 6 items) analogous to statistical methods in large-scale studies in which performance estimates are based on the chance that students have a 62% chance of getting a typical item of given scale correct. If a pupil pluralized fewer than two thirds of the items, the word category was considered not yet achieved and given a score of 0. For instance, a pupil who correctly pluralized at least two thirds of all the nouns and verbs but fewer than two thirds of the pre- and postnominal adjectives was assigned the spelling pattern 1100. The application of this method aims to take random and emergent spellings out of the focus.

4. Results

4.1 Individual spelling patterns of plural agreement (prior to training, pretest)

To obtain a first overview of the distribution of the spelling patterns, we calculated frequencies for the 16 possible pattern combinations (see Table 2). The answers of a total of 212 pupils (93%) were represented by six of the patterns. Only 16 pupils' answers fit the

other 10 patterns, which were therefore discarded from further analyses. In this way, we identified the six most frequent plural spelling patterns.

Insert table 1 with the information on frequencies of the 16 spelling patterns across word categories of the plural marking in French on the pretest about here.

As Table 1 shows, a large proportion of the pupils showed the spelling patterns 1110 and 1111. Indeed, 25.9% of the pupils correctly inflected the nouns, verbs, and prenominal adjectives but not the postnominal adjectives (1110), and 24.6% of the pupils succeeded in all four grammatical categories (1111). A total of 14% of the pupils showed the spelling pattern 1100 (correctly inflecting nouns and verbs), and 7.5% of the pupils showed the spelling pattern 1010 (correctly inflecting nouns and prenominal adjectives). On the basis of the conflicting results from the literature concerning the order of acquisition of the plural of verbs and adjectives, it is noteworthy that twice as many pupils correctly spelled nouns and verbs (pattern 1100) as nouns and prenominal adjectives (pattern 1010). Only those pupils who spelled correctly nouns, verbs and prenominal adjectives, also marked correctly postnominal adjectives. A series of supplementary analyses of variance (ANOVAs) with language background as within-subjects factors and group (training or control) as a between-subjects factor were computed and showed that the reason the pupils produced one of these patterns (1100 vs. 1010) could not be explained by their language background. Further, 7% of the pupils inflected nouns only (spelling pattern 1000), and 14% of the pupils did not pluralize any of the tested categories (spelling pattern 0000).

4.2 Compatibility of the plural spelling patterns with the learning theories LBT and PT
To address the second research question about the typical spelling patterns in relation to the theoretical approaches of the LBT and PT, in a first step, we summarized the predictions of these two approaches. In a second step, we indicated the numbers of pupils who violated these predictions on the pretest according to the data from the pupils who showed one of the six most frequent spelling patterns defined above (*n* = 212). This information is summarized in Table 2.

Insert table 2 with the information on the empirical verification of the theoretical predictions set in the Learning Based Theory (LBT) and in the Processability Theory (PT) related to the acquisition of written plural in French on the basis of the pretest (n = 212) about here.

According to the LBT, the semantically grounded nominal plural is acquired before the, not semantically grounded, adjectival or verbal plural. Of the total of 212 pupils distributed across the six spelling patterns, no pupil violated this prediction as no pupil marked adjectival or verbal plural but not nominal plural. The LBT also predicts that the nominal and

adjectival plural will be acquired before the verbal plural because of the high frequency of the *-s* marker (*-s* before *-nt*). The verification of this prediction showed that no pupil marked verbal plural who did not mark nominal plural. However, 91 pupils violated the prediction of marker frequency by inflecting verbs but not adjectives: Among them, 32 pupils inflected verbs but neither prenominal nor postnominal adjectives, and 59 pupils inflected verbs but not postnominal adjectives. No pupil violated the third prediction that distance to the determiner influences plural marking, i.e. words closer to the determiner such as prenominal adjectives compared to postnominal adjectives further from the determiner.

As for the PT, the prediction that the head of a constituent structure is learned before its extensions was confirmed as all pupils who marked adjectival plural had marked nominal plural as well. The prediction that the agreement within the NP, the constituent structure, is learned before subject-verb-agreement, the grammatical function structure, was violated by 91 pupils altogether. These pupils are the same who violated the marker frequency prediction of the LBT. Accordingly, among these learners, 32 inflected verbs but neither prenominal nor postnominal adjectives, and 59 learners inflected verbs but not postnominal adjectives.

4.3 Impact of the training: Intra-individual spelling patterns of plural agreement

The overall effects of the training were already reported in Bîlici et al. (2018). Beyond this, the analyses on the level of individual spelling patterns adds which learners profited most from the training.

The learning trajectories were defined as stable, improving, or declining in accordance with the differences between the pretest and posttest in the patterns in spelling performance. As the spelling profiles in the pretest have shown a very structured development, a learning trajectory was considered stable when a pupil pluralized the same number of categories on the posttest as on the pretest (e.g., 1100 on the pretest and 1100 or 1010 on the posttest). Alternatively, a learning trajectory was identified as improving when a pupil had success on at least one more category on the posttest than on the pretest (e.g., 1100 on the pretest and 1110 or 1111 on the posttest). Possible emergent spellings as well as possible improvement within category were not taken into account. A learning trajectory was identified as declining when a pupil pluralized fewer categories on the posttest than on the pretest (e.g., 1100 on the pretest and 1000 or 0000 on the posttest). Figure 1 shows the individual spelling profiles and individual learning trajectories from pre- to posttest.

Insert figure 1 with the information on the spelling patterns and trajectories of participants from the intervention (n = 128) and the control group (n =84) at the pre- and posttest for each word category and position about here.

The more descriptive perspective on the learning trajectories is in line with the significant effect of training on average performances (Bîlici et al., 2018). However, both analyses are

complementary as the current analyses show that beneath the main effects of training, the individual spelling patterns and the individual learning trajectories vary considerably.

In the intervention group, the number of pupils who increased performance between pre- and posttest by at least one category was 52.3% (n=67), compared to 29.8% (n=25) in the control group. Furthermore, 38.3% of the pupils in the intervention and 52.4% in the control group remained stable, and 9.4% of the pupils in the intervention and 17.9% in the control group decreased their spelling performance. In summary, the distributions within the different learning trajectories differed significantly by group, χ^2 = 11.123, p = .004, ɸ = 0.221. Looking into the development within the spelling profiles the learning effect becomes striking as pupils of the intervention group who succeeded in pluralizing all four grammatical categories doubled on the posttest, increasing from 24.8% (n=34) to 50% (n=69). The number of pupils in the control group who spelled all four categories correctly remained almost stable, increasing from 24.2% (n=22) to 28.6% (n=26). Looking into the profiles of the rather poor spellers, pupils of the intervention group who did not mark any plural (0000) decreased from 17 to 6 pupils, compared to the control group with a decrease from 15 to 8 pupils. Moreover, out of the 10 pupils of the intervention group who did only mark nouns in the pretest (1000), 8 pupils achieved at least one more category, compared to 2 out of 6 pupils in the control group. Indeed, within each spelling profile, more pupils in the intervention group progressed, whereas more pupils in the control group remained stable during the 4-month period between pre- and posttest.

Concerning the stability of learning, it is essential to note that the learning trajectories (see Figure 1) remained within the six most frequent patterns identified in the pretest data (see Table 2) for both groups. Only one pupil, out of the control group, resulted in a deviant pattern in the posttest.

5. Discussion

The first aim of our study was first to analyze individual spelling patterns related to the plural marking in French across four grammatical categories (nouns, verbs, prenominal, and postnominal adjectives). Secondly, we considered the compatibility of the established spelling patterns with two learning theories explaining the plural acquisition from a procedural learning perspective (the Learning Based Theory, LBT) and from a generative grammatical perspective (Processability Theory, PT). Thirdly, we explored the impact of morphosyntactic training on the intra-individual learning trajectories of pupils regarding French spelling patterns in the Luxembourgish context, learning French as a foreign language.

5.1 Individual spelling patterns of plural agreement

Our findings confirm the prevalent view that pupils' learning of the plurals of word categories is ordered rather than random. In our sample of 228 multilingual fifth graders

learning French as a second written language in a foreign language context, 212 pupils (93%) produced one of six spelling patterns out of 16 possible plural marking patterns across four grammatical categories (nouns, verbs, prenominal and postnominal adjectives). These patterns are assumed to be in developmental order, as other patterns are almost nonexistent. The findings also corroborate previous work regarding early plural marking of nouns, as a total of 79% of the pupils have achieved at least this category after three years of French teaching (cf. table 1).

The literature is not as conclusive on the learning sequence of adjectival or verbal plural. While Thévenin et al. (1999) observed in a French L1 context with young children (grade 1-3) that adjectival plural was spelled correctly before verbal plural, the results in Totereau et al. (2013) with grade 6 pupils showed a reversed pattern compared to the beginning of schooling. The literature on French as a foreign language reports an early plural marking on verbs that precedes the plural spelling of attribute adjectives (Ågren, 2009; Granget, 2005; Gunnarsson, 2006). Our data confirms that subject-verb agreement is learned rather early in a foreign language context, as half of the pupils spell verbal plural correctly. The spelling patterns 1100 and 1010 in this study indicate the existence of two different groups of pupils in an intermediary phase of learning the plural of a second word category (i.e., adjectives or verbs). The group exhibiting the spelling pattern 1100 seems to follow the learning path reported by Ågren (2009) for foreign language learners, whereas the group showing the spelling pattern 1010 seems to follow the learning path of young L1 learners (M. Fayol et al., 2006; Thévenin et al., 1999). As these parallel learning patterns could not be explained by their language background, we assume that foreign language learners of French might be twice as likely to learn verbal plural before adjectival plural and, hence, follow the spelling pattern 1100 rather than the pattern 1010 as an intermediate learning step. Following the majority of literature in this field, we suggest that the identification of verbal plural, i.e. the identification of the second plural marker *-nt*, is decisive for the developmental process.

Concerning the spelling performance in relation to the position of attributive adjectives, i.e. pre- or postnominal, the individual spelling profiles demonstrate that pupils correctly spell postnominal adjectives only when they have acquired all other categories. These results are in line with the hypothesis proposed by Fayol et al. (2006), in an L1 French context, i.e. that the proximity or distance of the determiner might have an effect on the plural marking of adjectives.

5.2 Compatibility of the plural spelling patterns with the learning theories

In order to link the spelling patterns to theoretical models, we related the observations in our data to the predictions of two distinct learning theories: cognitive Learning Based Theory (LBT) vs. Processability Theory (PT) based on linguistic processing principles. We scrutinized the numbers of pupils who violated the predictions of both learning theories. Overall, our data supports most of the predictions but is not compatible with one prediction

of each theory. Our data supported LBT's predictions of semantical groundedness and word position. Semantically grounded plural (nouns) is clearly learned before plural that is not semantically grounded (adjectives, verbs). The prediction of LBT that the distance to the determiner influences the learning order of plural marking on, first, prenominal, then postnominal adjectives is also confirmed by our data. Indeed, plural marking on prenominal adjectives that are closer to the determiner which is the only audible marker of the plural is learned before postnominal adjectives that are farther away from the determiner. However, the LBT's prediction on marker frequency, claiming that the more frequent marker *-s* is learned before the lesser frequent marker *-nt* is only partially confirmed. This prediction was only confirmed for the nominal plural (*-s*) when contrasted with the verbal plural (*-nt*). In contrast, 91 pupils inflected verbs (*-nt*) more accurately than they inflected adjectives (*-s*), an empirical observation that does not support the marker frequency prediction.

Concerning the PT, our data supported the prediction regarding the constituent structure according to which the head of the NP (noun) is acquired before the agreement within the phrase is learned. Nominal plural is clearly learned before adjectival plural. The prediction, i.e. that intraphrasal agreement (within the NP) precedes interphrasal agreement (subject-verb agreement) is only partially confirmed. Although our data confirms that all pupils who marked verbal plural also marked nominal plural, no less than 91 pupils altogether marked verbal plural but not the agreement within the constituent structure.

Taken together, neither LBT's marker frequency prediction nor PT's prediction that constituent structure is acquired before grammatical function structure is borne out by empirical observation.

A reason for lack of evidence supporting the LBT and PT predictions concerning the order of adjectival and verbal plural marking might be the difference between the learning conditions upon which the theories and studies are based: the first language context in spelling acquisition (LBT) and the natural oral second language learning (PT). Indeed, marker frequency (in LBT), and intra- vs. interphrasal agreement (in PT) are certainly important factors in the contexts in which the theories were originally applied.

The learning patterns analyzed here are situated in a context of foreign language and spelling instruction at school that intensively trains verbal morphology for about two years. Pupils seem to have become aware of the consistent presence of the *-nt* ending for the third-person plural. Moreover, the Luxembourgish schoolbooks used to teach French, introduce verbs from the beginning, whereas adjectives are introduced only one year later. The results of the Luxembourgish learners, however, also match the paradigm of foreign language learners and French L1 pupils at the end of primary school or beginning of secondary school: They all share a strong confrontation with the orthographic markers in the school curriculum, namely verbal conjugation.

Another aspect requires further discussion. According to the syntactic constituent structure described in PT, both pre- and postnominal adjectives belong to the same level of

processing because they are both parts of the NP. Thus, PT does not predict explicit performance differences related to the plural of pre- and postnominal adjectives. However, our data showed that pupils' performance regarding the plural of postnominal adjectives was much lower than for prenominal adjectives. This indicates that it might not be the exchange of grammatical information within the NP as such that causes problems for the plural spelling of postnominal adjectives. Most likely a multitude of influencing factors comes together here.

Firstly, although only few prenominal adjectives occur in French, these adjectives are short, highly frequent, and occur most often in pupils' written input.

To this, LBT theory would add that prenominal adjectives are easier to mark as they have a direct cue to plurality just in front of them: the determiner. Postnominal adjectives, on the contrary, are farther from the determiner, and the concept of plurality might be less active in pupils' minds as they spell these words.

Thirdly, attributive adjectives are canonically positioned after the noun, in general at the third position (determiner-noun-adjective). Yet, in prototypical French sentences this position is canonically also occupied by the verb (determiner-noun-verb). This might sometimes lead to a positional conflict in spelling the correct marker.

Last but not least, the role of vocabulary and access to the lexicon was not considered in any of the studies discussed here. However, vocabulary is certainly an important factor in the L2 learners' context (Hudson, 2008). As teaching French in Luxembourg does not focus as much on adjectives as on verbs, pupils might have more difficulty in activating semantics and the orthographic lexicon of some verbs and adjectives (Ouellette, 2010). In consequence, they might have less capacity to access the word's grammatical category (Brehm & Bock, 2013).

5.3 Impact of the training: Intra-individual spelling patterns of plural agreement (posttest)

The third part of the paper discusses how explicit instruction affects the learning of plural morphology and initial spelling patterns. The statistical mean group comparisons showed that explicit instruction had a strong positive effect on pupils spelling performance (see Author et al. 2018). The present in-depth analyses of the learning trajectories studied the performance of the pupils in the intervention versus control group in accordance with the spelling profiles identified in the pretest. Indeed, the number of pupils who improved their performance between pre- and posttest by at least one grammatical word category or who succeeded in spelling all four categories correctly almost doubled. Within the control group, only 27.5% of the pupils improved their spelling by at least one category and the pupils who spelled all four categories correctly remained almost stable. Despite the strong effect of the training, the spelling patterns of all pupils on the posttest remained within the range and type of the six spelling patterns identified on the pretest.

Notably, the more fine-grained analyses of the individual spelling patterns and the subsequent intra-individual learning trajectories show that both strong and poor spellers

benefitted from the training as a strong increase appears in each of the six spelling categories. Instead of reporting means and standard deviation, the spelling profiles have the advantage of providing transparency and traceability for the learning trajectories.

The fact that the learner performances follow a very clear learner trajectory out of six empirical and theoretically plausible spelling patterns makes an important contribution to the existing literature on French plural spelling. Furthermore, the insights into the spelling trajectories through which the pupils seem to navigate at different improvement rates are findings that are especially relevant for teaching.

5.4 Theoretical and practical implications

Our study adds important knowledge to previous studies on French plural spelling in L1 and L2 contexts. We identified the existence of specific spelling patterns suggesting that plural agreement in French is learned in an organized way. Examining learning of written number morphology in French from the perspective of two learning theories, our study shows that some predictions of cognitive Learning Based Theory (LBT), developed in a first written French context, and linguistic Processability Theory (PT), developed for second language learning, can be applied to the learning of written plural morphology in a foreign language learning setting. However, it became evident that the area that shows the least clear empirical results, i.e. the order of spelling development of verbs and adjectives, as well as performance differences in pre- and postnominal adjectives, cannot be explained by either of the two theories. This review of the two theories, both used in the current literature on French plural spelling, indicates that additional factors have to be taken into consideration to explain the performance differences, such as the concurrent positions of verbs and adjectives as well as, most probably, vocabulary.

Moreover, the analysis of the spelling patterns begs the question of the order of learning adjectival and verbal plural in French in a context where French is instructed as a foreign language. This applies in particular to the positions of the attributive adjectives. Finally, our study highlights the complexity of factors affecting the learning of syntactic spelling in the domain of French plural.

From a practical perspective, our study has some implications that are relevant to the teaching of French as a foreign language. First, the results reflect a pedagogical insight that cannot be repeated often enough: that a group of pupils of the same age and with the same exposure to written language at school might be at very heterogeneous learning phases of plural spelling. Second, the findings are fully in line with the actual discourse of teaching syntactic spelling (Brissaud & Fayol, 2018; Mortamet, 2019), claiming that the plural of some grammatical categories develops earlier than that of others, and that the corresponding grammatical reflection needs to be activated when teaching French spelling. Beyond previous studies, our results suggest that the plural of postnominal adjectives is particularly difficult to learn. Thus, pupils might need a more consolidated vocabulary and prior

understanding of the plural of nouns, verbs, and prenominal adjectives before they can learn the plural of postnominal adjectives.

5.5. Limitations and perspectives of the present study

One of our study's limitations is that it provides insights into a brief and limited part of the learning process, because we observed pupils' spelling within a time frame of 4 months in the context of an intervention study. As the study analyzed the profiles on the basis of one dictation with cloze tests (the pretest) and interpreted the learning trajectories from the spelling scores in the pre- and posttest, caution is advised for causal interpretations of the results. However, we were able to observe an entire spectrum of learning that confirms former studies and, in the case of adjectival position, raises further questions. Additional research is necessary to provide information with more data, and from multiple writing contexts, as well as about a longer trajectory in the process of learning French plural spelling.

Another limitation is the linguistically highly heterogeneous sample of Luxembourgish pupils. Our data did not explain different learning patterns by way of the pupils' language background. However, all the pupils are multilingual and learn to read and write in German with French as the second language of literacy, taught as foreign language. It is not always easy in Luxembourg to determine to what extent French really is a foreign language for the pupils or whether they have already grown up with French. This variance in relation to French as well as possible influences of the pupils' first languages might impact their spelling profiles and learning trajectories. A follow-up study should scrutinize these language differences.

Although the study controlled that the pupils knew the vocabulary in the tests, the role of vocabulary in the spelling profiles remains unclear, especially concerning adjectives. Further experiments on plural spelling should therefore include vocabulary tasks and control for orthographic and semantic representations of the test items.

The role of syntactic spelling for other literacy skills, such as sentence construction and syntactic reading, would be a further important aspect to investigate in future studies on plural spelling.

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