Title: Bilinguals’ sensitivity to specificity and genericity: evidence from implicit and explicit knowledge\textsuperscript{1}

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Abstract

The present paper investigates whether school-aged French-English bilingual children’s implicit and explicit knowledge is affected by cross-linguistic influence (CLI) during online and offline sentence comprehension. The studies focus on the encoding of plural and mass nouns in specific and generic contexts. We also explore whether individual measures of oral proficiency, language exposure and age play a role on the children’s performance. Forty-three 8-to-10-year-old French-English children took part in a Self-Paced Reading task, a Grammaticality Judgement task and a Cloze test in their two languages. While the bilinguals’ performance was vulnerable to CLI in the French offline task, their online comprehension and production were affected in English. These findings suggest that CLI can occur in opposite directions at the level of implicit and explicit representations during sentence comprehension. The data also makes a new contribution to our understanding of the relative amount of language exposure, oral proficiency and age on CLI.
Introduction

This study investigates whether 8-to-10-year-old bilingual and monolingual children’s implicit and explicit linguistic representations affect their interpretation of specific and generic subject noun phrases (NPs) in English and French. The morphosyntactic differences between Romance (e.g. Italian, French, Spanish) and Germanic (e.g. English, German) languages in the encoding of specificity and genericity are an interesting case to consider cross-linguistic influence (CLI), i.e. language interaction, in the context of the bilingual development. In Romance languages, plural and mass NPs in argument position (i.e. subject vs. object) occur with a definite article regardless of the semantic context. In Germanic languages, plural and mass NPs occur as bare nouns (BNs) in generic context and with a definite article in specific context.

To-date, offline experimental studies report that school-aged bilinguals’ metalinguistic judgements in their Romance language (i.e. Italian) were affected by the Germanic (i.e. English/German) semantic of plural NPs (Kupisch & Pierantozzi, 2010; Serratrice, Sorace, Filiaci & Baldo, 2009). Corpus studies on pre-school children observed that CLI has an effect on the rate of determiner development in bilinguals as a function of language dominance (Hervé & Serratrice, 2018; Kupisch, 2003; 2007). However, it is still not known whether bilinguals’ comprehension of local markers of genericity and specificity in Romance and Germanic languages is vulnerable to CLI during online sentence processing.

The aims of the present study are to assess to what extent 8-to-10-year-old French-English bilingual and monolingual children, being educated in bilingual vs. monolingual schools respectively, differ in their acquisition of specificity and genericity. We specifically explored whether the nature of the children’s linguistic representations (i.e. implicit vs. explicit knowledge) is affected similarly, by testing the children’s sensitivity to grammatical violation both offline and online. Finally, we considered the role of individual measures of language exposure, proficiency and age on the children’s linguistic performance.
Cross-linguistic influence

Bilingual children’s linguistic development largely follows the path of monolinguals (De Houwer, 2009). However, bilinguals’ linguistic behaviours may occasionally differ quantitatively and/or qualitatively from that of monolingual children. In comprehension and production, bilinguals may rely on features from Language A while processing Language B, a phenomenon known as cross-linguistic influence (see review in Nicoladis, 2016; Serratrice, 2013). CLI is evidenced in three different ways: as transfer of a linguistic property from Language A into Language B (e.g. Yip & Matthews, 2007), as facilitating (e.g. Kupisch, 2007) or as delaying (e.g. Hervé & Serratrice, 2018) the acquisition of particular linguistic feature.

Although CLI has been reported at all linguistic levels, an extensive part of the literature has focused primarily on the interface between syntax and pragmatics. In this line of research, Hulk & Müller’s (2000) seminal hypothesis characterised CLI in terms of an epiphenomenon whereby if a structure at the interface between syntax and pragmatics has two grammatical analyses in Language A and only one in Language B, then the analysis shared by Language A and B will occasionally be overgeneralized in Language A regardless of the discourse-pragmatic context. This hypothesis considers CLI as a unidirectional phenomenon whereby the “least complex” system (one structure) is overgeneralised in the language that has a “more complex” system (two structures) regardless of pragmatic optimality. However, the validity of this hypothesis has been controverted by the significant number of studies reporting (i) bi-directional CLI (e.g. van der Linden & Blok-Boas, 2005), (ii) CLI outside of the interface between syntax and pragmatics (e.g. syntax-semantics interface: Fernández Fuertes & Liceras, 2010; narrow-syntax structures: Argyri & Sorace, 2007), (iii) CLI in absence of structural overlap (e.g. Hsin, Legendre, Omaki, 2013), and also (iv) an absence of CLI when actually predicted by Hulk & Müller’s own hypothesis (e.g. Zwanziger, Allen, & Genesee, 2007).
Processing mechanisms

Adopting a psycholinguistic approach, Nicoladis (2006) proposed to characterise CLI as an epiphenomenon arising from the co-activation of bilingual speakers’ two languages at the lemma and/or at the phonological levels. In speech production models, speakers first access the concepts related to the message they want to formulate (the conceptual level), then select the lexical entries with the relevant grammatical features (i.e. gender, word class) and associate them with the corresponding syntactic frame (the lemma level), then activate the phonological forms. Nicoladis’ proposal suggests that competition between bilinguals’ two linguistic systems will lead to CLI. For example, a Welsh-English bilingual wishing to talk about a ‘striped dinosaur’ would access the English words (*dinosaur, striped*) which will activate the English ADJ-N syntactic frame. Co-activation between bilinguals’ linguistic systems will lead to the activation - to a lesser extent – of the Welsh equivalents (*Deinosor, streipiog*) and the Welsh N-ADJ syntactic frame (Nicoladis & Gavrila, 2015). The discourse context will affect the degree of co-activation leading to occasional CLI. Nicoladis’ proposal also predicts an absence of CLI for structures that have different underlying conceptualization across languages (i.e. Slobin’s (1991) *thinking for speaking* formulation). For instance, in English, descriptions of moving figures focus both on the action and on the ongoingness of the action (‘dancing cow’ - V_ing-N in English). In French, the focus is drawn to the figure with some attention to the action (*vache qui danse* - N-qui-V in French). When describing moving figures, French-English bilingual children’s descriptions do not display CLI. This would be due to the fundamental difference in the way moving figures are conceptualised in both languages which only triggered the activation of the language-specific constructions at the lemma level (Nicoladis, Rose, Foursha-Stevenson, 2010).
One of the predictions arising from Nicoladis’ processing account is that prior exposure and/or use of a given structure will facilitate CLI (Nicoladis, 2006; Serratrice, 2007; 2016). The recent priming literature has shown that bilingual children’s linguistic systems are to some extent constantly co-activated during sentence processing for structures that have comparable form-function mapping across languages (e.g. Vasilyeva, Waterfall, Gamez, Gomez, Bowers & Shimpi, 2010: passives in English and Spanish; Wolleb, Sorace & Westergaard, 2018: dative alternation in English and Norwegian) but also for structures that do not have a parallel in the other language (Hsin, et al., 2013: English Adj-N/Spanish N-Adj word order) as well as for discourse-pragmatically sub-optimal structures (Hervé, Serratrice, & Corley, 2016: French dislocations in English). This complementary line of research indicates that competition between the co-activated language-specific form-function mapping give rise to possible CLI both in production and comprehension.

Overall, the processing account of CLI allows the presence of bi-directional CLI in any language combination due to competition between bilinguals’ two linguistic systems. Extra-linguistic factors such as input quantity, proficiency, or discourse context would govern the degree of co-activation. This model successfully accounts for previous instances of CLI regardless of structural overlap or interface phenomena.

Language dominance

Bilingual children are typically more proficient in one language (dominant language) than in their other language (weaker language) depending on the social and discourse context (Döpke, 1992; Genesee, Nicoladis, & Paradis, 1995). Language dominance is a multidimensional construct that includes proficiency, exposure and use (Unsworth, Chondrogianni, Skarabela, 2018). Yet, our current understanding of the relationship between these three features is fairly limited (see Montrul, 2016). Bilingual children’s linguistic performance and development is in part mediated by input
quantity and quality (see Unsworth 2016 for a recent overview). With regard to CLI, the prevailing assumption is that the dominant language is more likely to affect the weaker language (Yip & Matthews, 2007). However, a few studies challenge this claim (e.g. Nicoladis, 2006; Unsworth, 2012). These contrastive findings are fuelled by the lack of a uniform definition of language dominance and by the use of a multiplicity of measures (e.g. percentage of language exposure (Paradis, Nicoladis, & Crago, 2007), proficiency rating (Pirvulescu, Pérez-Leroux, & Roberge, 2012), language of the immediate environment (Serratrice, et al., 2009), Mean Length of Utterance (MLU) in each language (Yip & Matthews, 2007).

Typically, researchers have examined this concept by focusing either on performance-based (e.g. MLU, lexical diversity, morphosyntactic/semantics development tests) or experiential-based (e.g. amount of exposure, language of the wider-community, language use) measures (Unsworth, 2016). An alternative dichotomy can be established between measures of production (e.g. oral proficiency scores, MLU, total number of utterances in a sample, direction of mixing) or comprehension (e.g. receptive vocabulary test, input quantity). Rare are the studies that have included a variety of measures (Döpke, 1992; Kupisch, 2007; Hervé & Serratrice, 2018). Clearly, the current state of research calls for a more systematic definition of language dominance that would include controlling for individual and group measures of bilinguals’ performance and experience in both languages to better understand the relationship between language dominance and CLI.

**Implicit and explicit knowledge**

A variable that has largely been ignored in the study of school-aged bilinguals is the notion of the children’s implicit and explicit linguistic representations, constructs that are highly debated in the literature on L2 processing. The growing interest on the role of simultaneous bilinguals’ processing on CLI (Nicoladis, 2006; Serratrice, 2007; 2016) emphasises the need to consider the impact of school-aged bilingual children’s implicit and explicit knowledge on processing mechanisms.
Implicit knowledge refers to intuitive knowledge about underlying structures, arrived at by a process which takes place naturally, simply and without conscious operations such as learners’ sensitivity to form frequency. Implicit knowledge is typically measured through on-line tasks such as Self-Paced Reading (SPR), eye-tracking, electrophysiological measures (ERPs) or timed off-line tasks such as timed Grammaticality Judgement Tasks (GJT) (Jegerski, 2014). Explicit knowledge refers to consciously available knowledge about language and about its use. It is available through controlled processing such as being aware of L1-L2 similarities and learning explicit grammar rules. It is measured through untimed GJTs and other off-line metalinguistic knowledge tests (N. Ellis, 2015; R. Ellis, 2005; Godfroid, A., Loewen, S., Jung, S., Park, J. H., Gass, S., & Ellis, R., 2015). In this paper, we adopt the weak interface account which holds that explicit knowledge can facilitate the acquisition of implicit knowledge by directing the learners’ attention on relevant aspects of their input (N. Ellis, 2005; see Krashen, 1982 for the non-interface position; DeKeyser, 2003 for the strong interface approach).

Children acquire their first language by engaging with their caretakers in natural meaningful communication. They automatically extract complex knowledge of their language structures and develop firm implicit knowledge as evidenced by children’s intuition about acceptable or unacceptable sentences in their language(s) (see MacWhinney, 2018). From 5 onwards, children develop self-awareness and start gaining some metalinguistic knowledge and conscious awareness of grammaticality (Karmiloff-Smith, 1979; M. Paradis, 2004). They form new independent and explicit representations. Consequently, older children can explain simple structures such as how to form the plural in English (N. Ellis, 2015). In some countries, children are trained to use morpho-phonological and syntactic features frequent in daily speech through explicit grammar teaching (Dąbrowska, 2012). This implies that the children’s implicit knowledge of their L1 can be reinforced by explicit teaching which contributes to their acquisition of explicit knowledge.
Although many studies have examined the role of implicit vs. explicit linguistic representation in naturalistic vs. instructed second language learners, no research has been carried out on the role that schooling might have on simultaneous bilingual children’s development of linguistic representations.

Specificity and Genericity in French and English

Determiners are at the crossroads between discourse-pragmatics, semantics and syntax. They have proven to be particularly vulnerable to CLI in the context of Romance-Germanic language pairs (Hervé & Serratrice, 2018; Kupisch, 2003; 2007; Kupisch & Pierantozzi, 2010; Serratrice et al., 2009). In these languages, article use as well as several other cues indicate whether a nominal referent has a specific or a generic reading, including verb type (e.g. *copula, love/like/hate/dislike* are often associated with a generic reading), tense and aspect, and adverbs (e.g., *usually, always, generally* with a generic reading; *now, at the moment* indicate a specific reading).

The fundamental cross-linguistic differences between French and English, that largely apply to Romance and Germanic languages respectively, are displayed in the encoding of plural nouns and mass nouns in specific and generic contexts. Specific reference refers to discourse contexts in which the speaker is talking about a particular referent. Generic reference characterises contexts in which the speaker refers to the whole kind as opposed to a subset of the kind (e.g. *cars/dogs* as a class of objects/individuals vs. *my car/my dogs*, a sub-group of the class). French is the most restrictive Romance language as overt determiners are obligatory in argument position regardless of the semantic context (Longobardi, 2001). English, like other Germanic languages, allows bare mass nouns (BMNs), i.e. *flour, milk*, and bare plural nouns (BPNs), i.e. *sweets, cakes*, in all argument positions depending on the pragmatic and semantic context.

As summarised in Table 1, plural and mass nouns occur in English without determiners in generic context and in [+hearer new] [+discourse new] specific context. In contrast, French relies on
the use of a definite article in generic context and on a partitive to encode NPs in [+hearer new] [+discourse new] specific context. But in [-hearer new] [+/- discourse new] specific context, plural and mass nouns occur with a definite article in both languages.

Table 1. The encoding of plural and mass nouns in specific and generic contexts in French and English

<table>
<thead>
<tr>
<th>Contexts</th>
<th>French</th>
<th>English</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specific</td>
<td>du, de la, des</td>
<td>Ø</td>
<td>Vincent a acheté du lait / des pommes</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Vincent bought Ø milk / apples</td>
</tr>
<tr>
<td>Specific</td>
<td>le, la, les</td>
<td>the</td>
<td>Vincent a acheté le chocolat / les bonbons dans cette boutique</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Vincent bought the chocolate / sweets in this shop</td>
</tr>
<tr>
<td>Generic</td>
<td>le, la, les</td>
<td>Ø</td>
<td>J’aime le chocolat / la glace</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>I like Ø chocolate / Ø ice-cream</td>
</tr>
</tbody>
</table>

The present study focuses exclusively on one of the two cross-linguistic differences – the encoding of genericity, paired with the use of a definite article in [-hearer new] [+/- discourse new] specific context.

Bilinguals’ comprehension and production of the encoding of genericity and specificity

Only two experimental studies have examined school-aged bilinguals’ comprehension of genericity and specificity in Romance-Germanic language pairs. Serratrice et al. (2009) tested 6-10-year-old Italian-English and Italian-Spanish bilinguals. Two groups of Italian-English bilinguals (UK vs. Italy), a group of Italian-Spanish bilinguals (Italy), as well as both Italian and English monolingual children and monolingual adults took part in a judgement acceptability task where they were asked to judge grammatical and ungrammatical specific plural NPs (e.g. *Qui, Ø/le fragole sono rosse/Here, *Ø/the strawberries are red) and generic plural NPs (e.g. In genere, *Ø/gli squali sono pericolosi/In general, Ø/*the sharks are dangerous) in subject position. In English, performance was fairly poor for all the English-speaking children. Overall, responses were more
accurate in specific than generic contexts. In Italian, responses were at ceiling for the monolingual adults, children and the Italian-Spanish bilinguals. In contrast, the English-Italian bilinguals, especially those living in the UK, accepted significantly more ungrammatical BNs in generic contexts in Italian than all other groups. Only the Italian-English bilinguals exhibited CLI from English to Italian, the opposite direction from that predicted by Hulk & Müller’s (2000) hypothesis. The authors discussed this unexpected direction of CLI with reference to Chierchia’s (1998) Nominal Mapping Parameter hypothesis (NMP) that characterises languages according to the way they refer to kinds. Romance languages are assigned the [-argument, +predicate] setting as all nouns are by default predicates and require the projection of a determiner to appear in argument position. Germanic languages are assigned the [+argument, +predicate] setting as nouns either denote a predicate or an argument. Nouns denoting kinds (e.g. Advice is available online/*The advice is always welcomed) have a mass denotation and appear without determiner in every syntactic position and are not marked for plural. Nouns denoting predicates are countable; they need a determiner in argument position and take plural marking (e.g. I moved the/*Ø chairs into the room). Bare plural arguments still exist in English with individual level predicates (e.g. I like sweets). The type shifting operation that applies to kind-referring plural nouns to turn them into arguments in generic sentences is interpreted in terms of economy considerations since it generates the appropriate semantic interpretation without the projection of a determiner in Germanic languages. Serratrice et al. argue that the direction of CLI implies that the children relied on the English economical system in Italian. But the group differences also indicate that language exposure affects this phenomenon.

In a similar study, Kupisch & Pierantozzi (2010) examined 6-to-10-year-old Italian-German bilingual children’s (in Germany) knowledge of definite plural nouns in a truth-value judgement task. In Italian, the bilinguals accepted significantly fewer generic interpretations (50%) than Italian monolinguals (about 70%) suggesting that the German association of definite plural nouns with specificity may have reinforced this form-semantic association in the bilinguals’ Italian to a larger
extent than in Italian monolinguals. In German, adults, monolingual children and bilingual children all over-accepted target-deviant generic readings with definite plural nouns, adults doing it less (20%) than the monolinguals and bilinguals (both 37%). This pattern decreased with age implying that the morphological cues for the interpretation of specificity and genericity is acquired later in German, after school enrolment, where children may be taught explicitly about article use. The unidirectional CLI from the Germanic language to Italian supports Serrratrice et al.’s (2009) hypothesis whereby the bilinguals will occasionally favour the Germanic economical determiner system.

In a recent corpus study, Hervé & Serratrice (2018) examined the development of determiners in two French-English bilinguals aged between 2;4-3;7. Over the twelve-month period, bi-directional CLI was observed in the rate of determiner development (i.e. accelerated development in English; delayed acquisition in French). But transfers were unidirectional from English to French as evidenced by determiner omission in non-specific contexts (e.g. Maman, tu veux (du) thé? / Mum, you want tea?) and generic contexts (e.g. J’aime rice-crispies / I like rice-crispies). Crucially, the transfers were constrained to a small class of nouns and verbs that are high frequency words in the children’s input (e.g. chocolate, tea, rice-crispies, love, do). They also only occurred at times when the children displayed a dominance in terms of greater English language use regardless of the language being spoken to them. The overall individual measures of language exposure (i.e. calculated over the 12-month period) did not have any effect on the likelihood of these transfers. While neither Hulk & Müller’s (2000) proposal, nor Serratrice et al.’s (2009) economy hypothesis can predict all these instances of CLI at the determiner level, this corpus study argues that the lexical and expressive dominance constraints governing the transfers lend support to Nicoladis’ (2006) processing account of CLI.
Research questions and predictions

The literature indicates that CLI occurs in three different ways in the course of determiner development in Romance-Germanic bilinguals. Pre-school children display (i) an early determiner development in the Germanic language, (ii) a delay in the Romance language when the child is dominant in the Germanic language; and (iii) unidirectional transfers from the Germanic to the Romance language. School-aged children (8-10-year-olds) seem to have completed their determiner development and only exhibit transfers during offline sentence processing. The language of the wider-community (Serratrice et al., 2009) or the children’s productive abilities (Hervé & Serratrice, 2018) would predict the likelihood and magnitude of CLI. In the present study, we set out to assess whether school-aged French-English bilinguals process differently the local markers of specificity and genericity in offline and online tasks. We also compare the children’s performances in the two comprehension tasks with their performance in a constrained written production task. We question to what extent their implicit and explicit linguistic knowledge of the two linguistic systems affect their performances. Finally, we aim to refine the role of individual and group measures of the children’s relative dominance by using performance-based (proficiency scores) and experience-based (language exposure) measures.

Following the L2 literature on the role of implicit and explicit knowledge on L2 processing, the bilinguals’ implicit knowledge during sentence processing was assessed by means of a self-paced reading task (Jegerski, 2014; Marsden, Thompson, & Plonsky, 2018). Their explicit knowledge was examined with an untimed grammaticality judgement task (Godfroid, et al., 2015). Finally, cloze-tests, a constrained production measure, was included to examine whether the children’s responses varied in comprehension and production. A comprehensive overview of the methodological details is specified in the methods section.

Predictions on the children’s performances
Serratrice et al.’s (2009) economy hypothesis predicts that the French-English bilinguals should display unidirectional CLI from English to French as evidenced by (a) a lack of sensitivity to grammatical violation in the French SPR, i.e. comparable reading times (RT) for ungrammatical and grammatical sentences; (b) a lower accuracy at rating grammatical French sentences than monolinguals in the GJT; (c) some determiner omission in the c-test. In English, the bilinguals should perform like the monolingual group.

The processing accounts (Nicoladis, 2006; Serratrice, 2016) supported by Hervé & Serratrice’s (2018) corpus study predicts bi-directional CLI. In the English to French direction, CLI should follow the same pattern as detailed above based on the economy hypothesis. In the French to English direction, CLI should be evidenced in the form of (a) a lack of sensitivity to grammatical violation in the English SPR, i.e. comparable reading times (RT) for ungrammatical and grammatical sentences; (b) a lower accuracy at rejecting ungrammatical English sentences than monolinguals in the GJT; (c) less accurate determiner use (the vs. Ø) than monolinguals in the English c-test.

Predictions on the nature of linguistic representation

If the children have developed both implicit knowledge (i.e. through their naturalistic exposure from birth) and explicit knowledge (e.g. from explicit teaching) of article use (i.e. of the encoding of genericity and specificity), then their performances should be alike across tasks. However, if the children have only developed implicit linguistic representation of these structures, then they should display higher sensitivity to grammaticality violation in the SPR tasks than in the untimed GJT tasks.

Predictions for language dominance

Hervé & Serratrice (2018) report an effect of productive abilities on the degree of co-activation of the language-specific form-function mapping in the encoding of genericity and
specificity. Therefore, the bilinguals with the highest English proficiency should exhibit CLI from English to French, while the children with the highest French proficiency should display CLI from French to English.

In contrast, Serratrice et al. (2009) observed an effect of the language of the home country on CLI. In that case, the magnitude and direction of CLI should be mediated by language exposure. Specifically, the percentage of language exposure should be correlated to the bilinguals’ sensitivity to grammaticality violation in the SPR and to their accuracy in the GJT and c-test.

Method

Participants

Two groups of French-English simultaneous bilinguals participated in the French and the English studies: 23 children attending a bilingual school in London (mean age = 8.99, SD = 0.69, range: 8.1-10.2), and 20 children attending a bilingual school in Paris (mean age = 8.97, SD = 0.46, range: 7.7-9.8). Twenty-four French monolinguals (mean age = 9.30, SD = 0.59, range: 8.4-10.4) and 20 English monolinguals (mean age = 9.39, SD = 0.45, range: 8.9-10.5) also took part in the study in their respective language. The monolinguals were recruited in schools that matched the upper-middle class status of the children attending the private bilingual schools.

All the bilingual participants were exposed simultaneously to English and French from birth or soon after. They were either the offspring of mixed French-English couples (N = 24), or of French couples living in the UK (N = 18), or of an English-speaking couple living in France (N = 1). The parents were asked to report on their child’s language background using a modified version of Cattani, Abbot-Smith, Farag, Krott, Arreckx, Dennis and Floccia’s (2014) questionnaire which provides an estimate of the child’s language exposure and proficiency. The questionnaire requested information about (i) the average number of hours spent by the child in the bilingual school and with
a childminder; (ii) the language(s) spoken by each parent in the home; (iii) the weekly number of hours spent by the child alone with each parent; (iv) whether the parents engaged equally with their child; (v) an evaluation of the number of hours of the child’s sleep in a typical day; and (vi) the parents’ estimate of their child’s proficiency in both languages on a scale from 1 (poor) to 10 (perfectly fluent). The school teachers were also independently asked to rate the children’s proficiency in their teaching language. Overall the parents’ and teachers’ proficiency scores mostly matched. When proficiency scores differed, we opted for a mean rating. The questionnaire data revealed very different patterns of language exposure and proficiency among the children in France and in the UK. Following Cattani et al. (2014), 60% of exposure to a language marked the cut-off point for establishing the majority input language. As observed in Hervé et al. (2016), the children were not systematically mostly exposed to the language of the wider environment (see Table 1).

| Table 2. Language exposure and proficiency scores in the Paris and London bilingual groups |
|------------------------------------------|----------------|----------------|
| Exposure   | Paris bilinguals | London bilinguals |
| French > 60% | 3             | 13             |
| 60%>Exp>40% | 6             | 5              |
| English > 60% | 9             | 3              |
| NA          | 2             | 2              |
| Proficiency |               |                |
| 10=French; 9≥English | 8             | 9              |
| French=10; English=10 | 7             | 10             |
| 10=English; 9≥French | 5             | 4              |

**Materials**

Materials were identical in all tasks and corresponded to translation equivalents in the French and the English experiments. Sixteen doublets of grammatical and ungrammatical sentences were constructed. Eight paired sentences included a critical NP in a generic context, 8 contained a critical NP in a specific context. In each condition, both the English count/mass distinction and the French gender distinction were counterbalanced. In the generic condition, sentences began with a phrase that introduced the discourse context “Louise loves green fruit”/“Vincent hates sweet food”. The
semantics of the verbs *(love, hate)* contributed to establishing the generic context. The second part of the experimental sentence contained the critical NP “*she thinks that the/∅ kiwis are delicious/*” “*he thinks that the/∅ honey is gooey/*”. In the specific condition, the test sentences were prefaced by a phrase such as “*Adam wants to get/buy some fruit at the market/shop/*”. The second part of the sentence contained the critical segment “*he thinks that the/∅ pears are ripe/*” (see Table 3). All critical NPs included inanimate objects from the food and fruit semantic categories. They were all followed by the copula “*be/être*” in the present tense and by an adjective. They were controlled for length (i.e. number of syllables and letters) and frequency of occurrence. In English, frequency was assessed with the NOW corpus ([https://corpus.byu.edu/now/](https://corpus.byu.edu/now/)) which contains 5.0 billion words of data from web-based newspapers and magazines from 2010 to the present time. Frequency was established for the 2010-July 2017 period. In French, the database Lexique3 ([http://www.lexique.org/](http://www.lexique.org/)) was used to measure frequency. This database gathers 135 000 French words from film and textual sources (New, Pallier, Ferrand, 2005).

### Table 3. Summary of the experimental sentences

<table>
<thead>
<tr>
<th>Cond.</th>
<th>Noun Type</th>
<th>Gender</th>
<th>No. of items</th>
<th>English test sentences</th>
<th>French test sentences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Generic</td>
<td>plural</td>
<td>masc</td>
<td>2</td>
<td>Paul / loves / green fruit; / he / thinks / that / ∅/∅ *the /*kiwis / are / delicious. /</td>
<td>Paul / adore / les fruits verts; / il / pense / que / *les/∅ ∅ kiwis / sont / délicieux. /</td>
</tr>
<tr>
<td></td>
<td></td>
<td>fem</td>
<td>2</td>
<td>Louise / hates / red berries; / she / thinks / that / ∅/∅ *the / strawberries / are / juicy. /</td>
<td>Louise / déteste / les fruits rouges; / elle / pense / que / *les/∅ ∅ fraises / sont / juteuses. /</td>
</tr>
<tr>
<td>Specific</td>
<td>plural</td>
<td>masc</td>
<td>2</td>
<td>Vincent / loves / fruit spreads; / he / thinks / that / ∅/∅ *the / jam / is / tasty. /</td>
<td>Vincent / adore / les pâtes à tartiner fruitées; / il / pense / que / *la/∅ ∅ confiture / est / savoureuse. /</td>
</tr>
<tr>
<td></td>
<td></td>
<td>fem</td>
<td>2</td>
<td>Adam / wants to get / some fruit / at the market; / he /</td>
<td>Adam / veut acheter / des fruits / au marché; / il / pense</td>
</tr>
</tbody>
</table>
### Procedure

The SPR experiment was based on a non-cumulative Moving Window task (Just, Carpenter, & Woolley, 1982) and was run using E-prime 3 (Schneider, Eschman, & Zuccolotto, 2002). The 16 experimental items were pseudo-randomized and mixed with 32 fillers that referred to animate subject NPs from the animal semantic category (e.g. *In the forest, the fox is running with a cousin*). Participants were assigned to one of the two experimental lists that were created so that participants would only see one of the grammatical doublets. In order to ensure that participants read for meaning, all the test items and half of the fillers were followed by a yes/no comprehension question (e.g. *Is she talking about a dairy product? Is it in the forest?*). The comprehension statements required the same number of correct and incorrect responses. A full list of the test items, fillers, and comprehension questions used in the French and English experiments are included in the appendix.

The experimental sentences were presented in a segment-by-segment fashion. All the generic sentences were split into 9 segments and the specific sentences were divided into 10 segments for presentation purposes. Reading times were collected for each segment as well as response accuracies for the comprehension questions. Each trial sentence was preceded by a fixation cross in the centre of the screen. All text was presented in white 18-point Courier New font on a black background in

<table>
<thead>
<tr>
<th>Gender</th>
<th>Mass</th>
<th>Sentence Structure</th>
<th>French Translation</th>
</tr>
</thead>
<tbody>
<tr>
<td>fem 2</td>
<td></td>
<td>thinks / that / the/*Ø apricots / are / big.</td>
<td>Julie / veut acheter / des fruits / au marché; / elle / pense / que / les/*Ø abricots / sont / gros./</td>
</tr>
<tr>
<td>masc 2</td>
<td></td>
<td>Helen / wants to buy / some / fruit / at the market; / she / thinks / that / the/*Ø pears / are / ripe.</td>
<td>Éric / veut acheter / des / boissons / à la boutique; / il / pense / que / l’/*Ø eau / est / hors-de-prix./</td>
</tr>
<tr>
<td>fem 2</td>
<td></td>
<td>Eric / wants to buy / some / sweets / at the shop; / he / thinks / the/*Ø chocolate / is / expensive.</td>
<td>Éric / veut acheter / des / sucreries / à la boutique; / elle / pense / que / le/*Ø chocolat / est / cher./</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Procedure</th>
<th>think that the apricots are big.</th>
<th>que les abricots sont gros.</th>
</tr>
</thead>
<tbody>
<tr>
<td>想想/认为/这里的李子大。</td>
<td>思考/认为/这里的李子大。</td>
<td>思考/认为/这里的李子大。</td>
</tr>
<tr>
<td>Julie wants to get / some / fruit / at the market; / she / thinks / that / the/*Ø pears / are / ripe.</td>
<td>Julie / veut acheter / des fruits / au marché; / elle / pense / que / les/*Ø abricots / sont / gros./</td>
<td></td>
</tr>
<tr>
<td>Helen / wants to buy / some / sweets / at the shop; / she / thinks / that / the/*Ø pears / are / ripe.</td>
<td>Hélène / veut acheter / des / sucreries / à la boutique; / elle / pense / que / le/*Ø chocolat / est / cher./</td>
<td></td>
</tr>
<tr>
<td>Eric / wants to buy / some / drinks / at the shop; / he / thinks / the/*Ø water / is / overpriced.</td>
<td>Eric / veut acheter / des / boissons / à la boutique; / il / pense / que / l’/*Ø eau / est / hors-de-prix./</td>
<td></td>
</tr>
</tbody>
</table>
the centre of a 13.3-inch Macbook Pro laptop (LED-backlit display, 5120x2880 resolution at 60Hz). The participants were told to read each segment at their own pace for comprehension and to press on the pace button to move to the next segment. They were informed that most sentences would be followed by a yes/no comprehension question that should be answered with the corresponding keys on the response box (key 2: ‘yes’, key 3: ‘no’, key 4: ‘don’t know’). Accuracy on the comprehension question varied across groups for English (Paris bilinguals: M = 74%, SD = 0.44; London bilinguals: M = 80%, SD:0.40; English monolinguals: 87%, SD:0.34) and French (Paris bilinguals: M = 74%, SD = 0.44; London bilinguals: M = 85%, SD:0.36; French monolinguals: 78%, SD:0.41). Reading time analyses were only performed on the items that were followed by a correct response.

In the GJT, the participants had to rate each of the 16 sentences as acceptable, unacceptable or ‘I don’t know’. In the c-test, the participants were presented with a gap-fill exercise that included the same experimental sentences. The participants had to write either ‘the’ in English, ‘le, l’, la, les’ in French or ‘leave a blank’ depending on whether they thought an article was needed.

The participants were seen individually. The participants all completed (1) the SPR task followed by (2) the untimed GJT and then (3) the untimed c-test. Prior to the experiments, the participants were given the instructions orally in the language of their testing session (i.e. counterbalanced across bilingual participants). In the SPR, the test phase started with a short practice session including 3 practice sentences. The participants were given the opportunity to ask any questions until the end of the practice session. The total duration of each testing session lasted about 15min.

**Results**

In both the French and the English studies, analyses were conducted with R (R Core Team, 2013). Separate linear mixed effects models were fit for each test in each language with the lme4
package (Bates, Maechler, Bolker, Walker, 2015). Random effects in all models included only by-subject and by-item random intercepts, and the inclusion of both random and fixed effects in each model were justified by means of likelihood ratio testing. All continuous variables were centred prior to inclusion. The reported p-values were estimated with the lmerTest package (Kuznetsova, Brockhoff & Christensen, 2017). Posthoc pairwise comparisons used Tukey’s adjustment and were estimated using least-squares means via the emmeans package (Length, 2018).

In the GJTs, we measured the participants’ accuracy at accepting grammatical sentences and at rejecting ungrammatical sentences in the generic and specific conditions. Note, however, that for the purpose of the study, the attention will be drawn mainly to ungrammatical sentences which have a clear critical area (i.e., the error) that may invite the use of explicit knowledge (see Godfroid et al., 2015). All the responses were binary (correct “1” vs. incorrect “0”). In the GJTs, the analyses were conducted using a binomial GLMM treating accuracy as the dependent variable and grammaticality, condition, bilingual status as fixed factors. English exposure, English proficiency, age, and word frequency were included as continuous covariates. However, as measures of English proficiency and exposure were highly colinear, only a single predictor was included in each model. The selection of either proficiency or exposure was justified via likelihood ratio testing as with other fixed factors.

In the c-tests, we measured the participants’ accuracy at selecting the appropriate article (i.e. a definite or a null article) to complete the test sentences. The model was identical to that of the GJT except that grammaticality was removed from the analysis since the test items did not include grammaticality as a variable (i.e. grammaticality depended on the children’s own choice of article).

In the SPRs, RTs from three segments were analysed: Segment 8, the critical segment, and Segments 9 and 10, in order to investigate for any potential spill-over effects. But only the results from Segment 8, the critical segment, are reported as there were no spill-over effects. RRTs were treated as the dependent variable and grammaticality, condition, Noun Type (MNs vs. BPs) and bilingual status were treated as fixed factors. Age and word frequency were included as covariates,
as were English exposure and English proficiency. As with the previous models, proficiency and exposure variables were highly colinear, and thus both variables were not included in the models. The choice between the inclusion of proficiency or exposure was justified with likelihood ratio testing for each model.

**Study 1: French results**

*Grammaticality Judgement Task*

Figure 1 reports the mean number of acceptances of grammatical sentences and the mean number of rejections of ungrammatical sentences in specific and generic contexts for the bilingual and the French monolingual children. In both semantic contexts, grammatical sentences were overwhelmingly accepted by the bilingual (88%) and the French monolingual (86%) children. Ungrammatical sentences were also mostly rejected by the monolinguals (83%) and the bilinguals (81%) in the specific condition. However, the bilinguals (68%) were less accurate at rejecting ungrammatical sentences than the monolinguals (78%) in the generic condition.

This finding was confirmed by the statistical model which indicated that bilingual status was involved in a significant interaction with grammaticality (F(1,968) = 4.25). Post-hoc testing revealed that the bilinguals were significantly less accurate with ungrammatical than grammatical sentences (z = -5.39, p < .0001, OR = .25). Additionally, the bilinguals were more accurate than the monolinguals at identifying grammatical sentences (z = 2.97, p < .01, OR = 7.17). The remaining pairwise comparisons showed no significant differences between bilinguals and monolinguals, or between grammatical and ungrammatical sentences.

Grammaticality was also involved in a significant interaction with condition (F(1,968) = 15.35). Post-hoc testing showed a significant difference in accuracy only in the generic condition, where responses to grammatical sentences were more accurate than ungrammatical sentences (z = -5.86, p < .0001, OR = .18).
Finally, English exposure also had a negative effect on accuracy, which suggests that the participants exposed the least to English were performing better on the task ($z = -3.01$, $p < .01$, OR = 0.05). Age also had a significant effect on accuracy, such that older subjects were more accurate than younger subjects ($z = 2.54$, $p < .05$, OR = 2.04). There was no statistically significant effect of word frequency.

![Bar chart showing mean accuracy scores in the generic and specific condition for the bilinguals and French monolinguals.]

**Figure 1.** Mean accuracy scores in the generic and specific condition for the bilinguals and French monolinguals

In sum, all the children were overwhelmingly accurate at accepting and rejecting specific sentences in the French GJT. However, sentence rejection in the generic condition was more problematic for the bilingual group, especially for the bilinguals the greatest exposed to English. Finally, older children performed better than younger children. These findings suggest that the bilinguals' explicit knowledge of French article use in generic sentences is less established than the monolinguals’.
Processing markers of genericity and specificity

Self-paced reading

Before analysis were run on the reading time data, outliers RTs which were faster than 200msec or slower than 2000msec were removed. This affected 2% of the French data. The critical segment differed in length depending on the presence or absence of a definite article that manipulated grammaticality in the NP. In order to remove the effect of length (i.e. presence vs. absence of an article based on grammaticality), the analyses were conducted on the residualized reading times (RRTs).

Figure 2 reports the RTTs of the grammatical and ungrammatical segments in the generic and specific conditions for the bilingual and French monolingual participants. In general, ungrammatical segments took longer to read than grammatical segments. However, there was a significant interaction between grammaticality and condition (F(1,815) = 9.30, p < .01). Posthoc testing showed grammatical segments had shorter RTs than ungrammatical segments in both the specific (d=207.2, t(824)=6.36, p < .0001) and the generic conditions (d=68.3 t(822)=2.14, p < .05). Additionally, while there was no difference in RT for grammatical segments across conditions (d=20.1, t (26) = 0.52, p > .05), ungrammatical segments had shorter RTs in the generic than in the specific condition (d=-118.7, t (32) =-2.92, p < .001). Group showed no significant effect on RT, and did not interact with condition or grammaticality.
Longer RTs in the ungrammatical condition are taken to signal an increased processing load, which is regarded as evidence for a reader’s sensitivity to grammatical violation. In this data, all the children discriminated grammatical violation regardless of the semantic context. The absence of interaction with group or English exposure indicates that the bilinguals behaved largely like the French monolinguals even when reading generic sentences.

**Cloze-test**

Figure 3 shows the mean accurate responses for article use in the generic and specific sentences for the bilingual and the French monolingual children. Overall, all the children were at ceiling in the specific condition (bilinguals: 97%; monolinguals: 97%) and in the generic condition (bilinguals: 97%; monolinguals: 99%). All the monolinguals accurately used overt definite articles in French. Six monolinguals made a total of 7 number errors (e.g. *les fraise* instead of *la fraise*). In the bilingual group, 4 participants omitted a total of 9 definite articles, two subjects made a gender error and 7 children made a total of 10 number errors. Statistical analysis confirmed that none of the
factors included in the model reached significance. These results indicate that the bilinguals, regardless of language exposure, are largely target-like in written production.

![Figure 3. Mean accuracy of French article use in generic and specific sentences across group](image)

**Discussion**

The results of the French study display an interesting picture of the bilingual and monolingual children’s sensitivity to grammatical violation in the encoding of genericity and specificity. Different patterns are observed in the different tasks. The three different tasks were selected as they are known to tap into different kind of linguistic representation. Self-paced reading tasks utilise implicit knowledge while untimed grammaticality judgement tasks, i.e. specifically the rejection rate of ungrammatical sentences, give insights into participants’ explicit knowledge. Finally, the cloze-test, our only production measure, taps primarily into the children’s implicit knowledge.

In the GJT, the French monolinguals were largely successful at rejecting ungrammatical sentences with both generic and specific readings. However, the bilinguals were more accurate than the monolinguals in accepting grammatical sentences. Additionally, the children exposed the least to English and the older children were more accurate on this task. These findings show that increased
exposure to English where both overt and null articles are available in the input decreases the bilinguals’ sensitivity to grammatical violation in French, a language in which articles are obligatory in argument position. These results are in line with previous offline studies (Serratrice et al., 2009; Kupisch & Pierantozzi, 2010). They corroborate recent evidence supporting the role of individual measures of language exposure on the likelihood of CLI (Hervé et al., 2016). The age effect also suggests that the bilinguals’ cumulative language experience leads towards greater sensitivity to the target-language structures with time. With age, children come to learn explicitly at school or acquire some metalinguistic awareness of article use in subject/object position. They also develop greater attentional skills (Robson, 2006).

In the online task, all the children discriminated ungrammatical segments from grammatical ones. Although the RT were shorter for ungrammatical segments in the generic condition than in the specific condition, the lack of group or English exposure/proficiency effects indicates that the bilinguals’ and the monolinguals’ performance were largely in line. These findings suggest that all the children had firm implicit knowledge of French article use. In the cloze-test, all the children performed at ceiling in this constrained written production task. The parallel results between the c-test and the SPR confirm that the children have been relying on their implicit knowledge of article use when completing the French c-test.

**Study 2: English results**

**Grammaticality Judgement Task**

Figure 4 reports the mean number of acceptances of grammatical sentences and the mean number of rejections of ungrammatical sentences in specific and generic contexts for the bilingual and the English monolingual children. Responses were much more accurate to grammatical than ungrammatical sentences (z = 8.59, p < .0001, OR = 12.17), highlighting the fact that participants
overwhelmingly accepted grammatical sentences and failed to reject most ungrammatical sentences across conditions. While monolinguals were slightly more accurate in both the generic (40%) and the specific (38%) conditions than the bilinguals (about 30% in both conditions), this difference was not significant. In fact, the GLMM revealed no significant effect of group, English exposure, or word frequency.

![Figure 4. Mean accuracy scores in the generic and specific condition for the bilinguals and English monolinguals](image)

**Self-paced reading**

As in the French study, outlying RTs were removed before analysis affecting 5% of the English data and the analysis was conducted on the residualized reading times (RRTs) in order to remove the effect of length (i.e. presence vs. absence of a definite article).

Figure 5 reports the RRTs of the grammatical and ungrammatical segments in the generic and specific conditions for the bilingual and English monolingual participants. Surprisingly, the English monolinguals exhibited longer RT for ungrammatical segments than for grammatical segments only in the generic condition. In the specific condition, they displayed comparable RT regardless of
grammaticality implying they have not completely acquired the encoding of NPs in specific sentences. The bilinguals had longer RT for grammatical segments than for ungrammatical segments in both conditions which indicates that the bilinguals’ knowledge of English article use is slightly less developed than English monolinguals’.

Figure 5. Residualized reading times (RRT) for the critical segment of grammatical and ungrammatical sentences in the English generic and specific conditions across group

The linear model revealed a significant three-way interaction between grammaticality, condition and noun type (F(1,826) = 5.48, p < .05), as well as significant two-way interactions between group and condition (F(1,824) = 5.41, p < .05) and between English proficiency and condition (F(1,815) = 4.82, p < .05). We therefore ran two additional models, one for each condition separately.

Generic condition

Analysis of RTs in the Generic condition showed a significant interaction between noun type (plural/mass) and grammaticality (F(1,391) = 8.96, p < .01). For grammatical segments, posthoc
testing showed no difference between plural nouns and mass nouns ($d = -59.9$, $t(24) = -1.5$, $p > .05$).

But in ungrammatical segments, reading times were slower for plurals than for mass nouns ($d = 94.3$, $t(24) = 2.45$, $p < .05$) indicating that ungrammaticality was more salient for plural NPs than MNs. Moreover, plural NPs had longer reading times for ungrammatical than grammatical segments ($d = 104.5$, $t(392) = 2.84$, $p < .05$), while for mass nouns there was no significant difference between grammatical and ungrammatical segments ($d = -49.8$, $t(392) = -1.37$, $p > .05$).

There was no difference between monolinguals and bilinguals in RT for generics ($t(46) = 0.85$, $p > .05$), however, an effect of English proficiency scores was observed. As English proficiency increases, reading times for generics decrease ($t(51) = -2.5$, $p < .05$). This final result corroborates with the opposite pattern of RTs observed in Figure 5 where the bilinguals display longer RT for grammatical than ungrammatical segments when the monolingual group successfully discriminated ungrammatical segments.

Specific condition

Contrary to the results reported for the generic condition, there was no effect of noun type ($t(5) = -0.33$, $p > .05$) or grammaticality ($t(389) = 1.77$, $p > .05$) on RTs in the specific condition. However, in this model we did observe a group effect showing that monolinguals were faster at reading specifics than bilinguals ($t(53) = -2.19$, $p < .05$). There was no concomitant detriment in RT for specifics as a function of proficiency ($t(56) = -0.54$, $p > .05$).

Cloze-test

Figure 6 displays the mean accuracy of the participants’ article use in generic and specific sentences in English. Overall, all the participants were more accurate in the specific than in the generic condition, although this was only marginally significant in the GLMM ($z = 1.87$, $p = .06$, OR $= 1.5$). While condition did not interact with bilingual status, English exposure had a significant
effect on accuracy. Surprisingly, the participants the most exposed to English were the least accurate ($z = -2.38, p < .01, OR = 0.18$). Age was also significant, so that older children were more likely to give correct responses than younger children ($z = 3.91 p < .0001, OR = 2.47$).

![Figure 6. Mean accuracy of English article use in generic and specific sentences across group](image)

Bilingual status was involved in a significant interaction with noun type (plural vs. mass) ($F(1,960) = 5.04, p = .02$). Pairwise comparisons showed that the bilinguals were less likely to answer correctly with plural nouns than the monolinguals ($z = -3.01, p < .01, OR = 0.25$). However, there was no significant difference between the bilinguals’ and the monolinguals’ accuracy for mass nouns ($z = -1.47, p > .05, OR = 0.52$). Additionally, the monolinguals did show a distinction between responses as a function of noun type, with plural nouns being overall more accurate than mass nouns ($z = 2.82, p < .01, OR = 2.74$). Interestingly, the same effect was not observed for the bilinguals, whose responses to plural nouns and mass nouns were not statistically different ($z = 0.96, p > .05, OR = 1.32$).
In sum, there is a trend towards higher accuracy in the specific than the generic condition across group – the opposite pattern observed in the SPR task. This discrepancy might suggest that the children are not solely relying on their implicit knowledge while doing the untimed written production test. The absence of time constraint does allow the children to call for explicit knowledge. The monolinguals’ greater accuracy with plural nouns reinforces the results from the SPR indicating that the encoding of mass nouns is more challenging for children. The effect of age indicates that the acquisition of the local markers of genericity is problematic in written production for English-speaking children as it is not fully settled at 8 to 10 years of age. Finally, the surprising negative effect of English exposure suggests that the children exposed the least to English were the more accurate – a result discussed in depth in the general discussion.

Discussion

The results of the English study show an interesting picture of the role of the children’s implicit vs explicit knowledge, English exposure, English proficiency and noun type denotation (count vs mass) on their sensitivity to grammatical violation at the level of the morpho-syntactic markers of genericity and specificity. In the untimed GJT, performance was poor overall regardless of the children’s language background. These findings are comparable to previous experimental studies on article use on other Romance-Germanic language pairs (Kupisch & Pierantozzi, 2010; Serratrice et al., 2009). Sentence rejection potentially triggers a mental search for a rule or a cue that helps identifying the error (Bialystock, 1979; 1982; R. Ellis, 2005; Gutiérrez, 2013). The results suggest that these English-speaking children have not developed (sufficient) explicit linguistic representation of the local markers of genericity and specificity to reject ungrammatical sentences in the different semantic contexts.

In the SPR, the English monolinguals displayed some sensitivity to grammatical violation when processing of the critical segments associated with a generic reading. But the significant effect
of English proficiency scores confirms that the bilinguals did not discriminate sentence grammaticality even in generic context. As for specific segments, monolinguals and bilinguals were largely not sensitive to grammatical violation. These contrastive results suggest that the monolinguals have developed some implicit knowledge of the encoding of genericity but have not fully acquired specificity marking of plural count nouns and mass nouns. This finding is reinforced by the significant interaction between noun type and grammaticality in the generic condition which shows that the children strongly associated bare plural nouns with a generic reading but did not display a firm understanding of the semantic interpretation of bare mass nouns.

In the untimed cloze-test, the participants may respond according to feel or according to rule. The results of the cloze-test are in line with SPR task which suggests that the participants might have been relying primarily on their implicit linguistic representations. The bilinguals were less accurate than the monolinguals at selecting the appropriate markers of specificity and genericity. Crucially, an effect of noun type was also observed in the monolingual children which confirms that children acquire the encoding plural count nouns before learning that of mass nouns. The effect of age further suggests that the acquisition of the encoding of mass nouns is a late phenomenon. Finally, the balance of language exposure in the two bilingual schools (i.e. more children predominantly exposed to English in the Paris school, more children exposed primarily to French in the London school) indicates that the negative effect of English exposure may reveal a difference in teaching approaches relative to the English determiner system across schools rather than an individual exposure effect.

**General discussion**

In the present studies, our aim was to contribute to the general understanding of the mechanisms at play on the phenomenon of CLI at the determiner level. We specifically tested out French-English bilinguals’ and their monolingual counterparts’ ability to discriminate grammatical
violations when processing specific and generic sentences (e.g. $\emptyset$/the milk is a dairy product vs. the/$\emptyset$ milk is outdated). Online self-paced reading tasks (implicit knowledge) and offline grammaticality judgement tasks (explicit knowledge) (see Godfroid, et al., 2015) were used to assess whether and to what extent the bilinguals’ different types of linguistic knowledge are vulnerable to CLI at the determiner level in French and English. We also supplemented this data by measuring the children’s productive abilities in cloze-tests to assess to what extent the children’s performance during sentence comprehension was related to their productive abilities. A secondary aim was to tease apart the role of language dominance on the direction and magnitude of CLI. We combined individual measures of the children’s receptive abilities (language exposure) and of their productive skills (proficiency scores).

Our first main finding is that the bilingual children’s sentence processing in the comprehension and production tasks differed from that of the French and of the English monolinguals. In French, accuracy decreased with increased exposure to English in the offline task. In English, the bilinguals failed to discriminate sentence grammaticality regardless of the semantic context in the offline task when the monolinguals did discriminate generic ungrammatical segments. Moreover, English proficiency had an effect on grammaticality discrimination in the generic condition. Finally, the bilinguals were also less accurate at selecting the target determiner in the cloze-test as a function of English exposure. We thus observed bi-directional CLI across the different tasks. These findings are somewhat different from previous experimental studies which predicted unidirectional CLI from English to French in school-aged bilinguals (Serratrice et al., 2009; Kupisch & Pierantozzi, 2010). This bi-directionality rules out Serratrice et al.’s (2009) economy hypothesis, which predicted CLI from English to French only, and, Hulk & Müller’s (2000) structural overlap hypothesis which anticipated CLI from French to English.

A crucial finding though is that the direction of CLI differed depending on whether we tapped into the children’s implicit or explicit linguistic representation of article use. CLI was
observed from English to French in the offline GJT task that taps into explicit knowledge, as increased English exposure led to lower accuracy at systematically rejecting ungrammatical BNs in French generic contexts. In the online SPR task, CLI occurred from French to English as evidenced by the delayed development of the bilinguals’ implicit linguistic representation of the encoding of plural and mass nouns in generic contexts in comparison to the English monolinguals. In the written production tests, the direction of CLI matched that observed in the online comprehension tasks. Reflecting on the underlying linguistic representations, these results indicate that the bilinguals’ implicit knowledge was vulnerable to CLI in English, while their explicit knowledge was affected in French. The task-dependency of CLI provide new empirical evidence supporting the processing account of CLI (Nicoladis, 2006; Serratrice, 2007, 2016) conceptualising this phenomenon as the result of competition between bilinguals’ co-activated language-specific form-function mapping leading occasionally to the sub-optimal entrenchment of a structure from language A into language B. First, the small but significant differences between the bilinguals’ and the monolinguals’ performances in the English study and the significant effect of English exposure on accuracy in the French GJT is consistent with the conceptualisation of CLI as a minimal processing cost. Second, the vulnerability of the bilinguals’ online and offline processing to CLI adds further empirical evidence by showing that different types of linguistic representation are permeable to interferences. Finally, the relationship between CLI and other extra-linguistic factors such as language dominance and age are compatible with a processing approach as additional factors may have a direct effect on the degree of co-activation of the competing language-specific form-function associations.

The nature of linguistic representations

The differential direction of CLI in the online and offline tasks leads us to consider the children’s implicit and explicit knowledge of article use in French and English. Research on L2 processing has shown that online and offline tasks tap into different kinds of linguistic
representations (see Jegerski, 2014; Godroid et al. 2015). Unlike grammatical sentences, ungrammatical sentences have a clear critical area (i.e., the error). In untimed grammaticality judgement tasks, participants’ identification and rejection of ungrammatical sentences is considered to call for their use of explicit knowledge (see Bialystok, 1979). In contrast, self-paced reading tasks are thought to tap into participants’ implicit underlying linguistic representations (Marsden et al., 2018). Indisputably, children primarily acquire their first language(s) implicitly. They start developing some metalinguistic awareness around the age of 4 (MacWhinney, 2018). At school, children can also be taught grammatical features available in their daily input. Considering the schooling context of our participants provides a deeper understanding of our results - an essential point when testing school-aged children. Clear national pedagogical differences emerge with regard to the teaching of grammatical features. In England, the National curriculum in England for English programmes of study states that primary school pupils build their grammatical knowledge “through a focus on grammar within the teaching of reading, writing and speaking. […] they (pupils) should be encouraged to apply and explore this concept in the grammar of their own speech and writing” (Ofsted, 2013: 1). Determiners are first introduced in Year 3 (7-8-year-olds) where pupils are familiarised with the vowel-dependency of a/an before a noun. While no information regarding the use of the was found in the national curriculum for England, the teachers from the primary school involved in the study reported that Year 5 pupils are taught about the before a noun. Our Year 4 participants (8-9-year-olds) had not been taught about the grammatical feature under study (cf. personal communication with the teacher). In France, the Ministère de l’Education et de la Jeunesse (2018: 18-21) states in the French national curriculum that grammar must be taught daily from age 6. Grammar teaching must be done explicitly through a progressive approach based on pupils’ ability to identify, manipulate, classify and transform forms and sentence types which is completed through the regular and repeated use of numerous training exercises (e.g. gap fill exercises, sentence transformations, reordering sentences, matching sentences to pictures) and then transposed during
speaking, reading, and writing activities. By age 8-9, French children must have acquired the
different constituents of NPs including determiners (i.e. definite and indefinite articles), adjectives,
nouns and their agreements in gender and number. Overall, grammar appears to be taught inductively
in England, through the generalisations of patterns observed in texts when the French approach is
more prescriptive as it involves the repeated use of practice exercises aiming at automatizing the
newly learnt linguistic knowledge. Crucially for our study, the Paris and London French-English
bilingual schools follow the French curriculum even in English lessons. All subjects, including
grammar, are taught in both languages. However, the Paris English teacher reported not teaching
English grammar as she did not feel confident enough in her own linguistic expertise. Based on these
cultural and school differences relative to grammar teaching, it is safe to conclude that the children
were not familiarised with article use in the same way. The French monolinguals and London
bilinguals had been taught and trained explicitly to use articles in their respective language(s). The
English monolinguals mainly had implicit knowledge of article use as they knew what a determiner
is and how to use *a/an* but had not yet been taught how to use *the* in English. Finally, the Paris
bilinguals were taught article use in French but not in English. Thus, they should have the smallest
metalinguistic awareness of English article use.

This pattern is largely confirmed by our results. The French online comprehension and
production tasks indicate that all the children, regardless of the linguistic context, have acquired
implicit knowledge of French article use to discriminate grammaticality violation and select the
appropriate forms to complete sentences. However, the grammaticality judgment task indicates that
the bilinguals showed greater flexibility to grammatical violation than the monolinguals. This finding
questions to what extent the bilingual children’s French metalinguistic awareness is affected by age
and English exposure (see next sub-sections).

In English, all the children performed poorly in the grammaticality judgement task. In light of
the education system described above, these findings do not come as a surprise given that this task
calls primarily for the children’s explicit knowledge of specificity and genericity marking, i.e. article use. Apart from the London bilinguals, the English-speaking children have not yet been taught the use of the English definite article. Therefore, most of the children may possess only basic metalinguistic knowledge that would help them complete the task. These results are very similar to findings of Serratrice et al. (2009) in which the English-speaking participants, adults included, failed to reject outright grammatical violation associated with a generic and a specific reading. They are also in line with Kupisch & Pierantozzi’s (2010) results in which German-speaking subjects over-accepted target-deviant DPs in generic context. While these studies did not consider the role of metalinguistic awareness on their participants’ judgements, they posited instead that it is always possible in some sense for English/German comprehenders to conjure up a semantic context in which the morphosyntactic marking is acceptable, a phenomenon also observed in comprehenders of all ages and linguistic backgrounds (e.g. Galambos & Goldin-Meadow, 1990; Gavarró Pérez-Leroux, & Roeper, 2006). In the self-paced reading task tapping into implicit knowledge, the English monolinguals discriminated grammatical violation in generic sentences. But they failed with specific sentences. These findings indicate that the English monolinguals have acquired implicit knowledge of genericity marking. However, their representation of specificity marking is not fully settled yet. The bilinguals display a delayed development of their implicit knowledge of genericity and specificity marking as they were not sensitive to grammatical violation in either of the semantic contexts. A parallel trend is observed in the English c-test although the children are surprisingly slightly more accurate in production with specific than generic sentences. While this latter finding is in line with previous experimental work (Serratrice et al., 2009), this is the exact opposite from what is observed in the self-paced reading task. These contrastive results suggest that the children are not only trusting their implicit knowledge when completing the untimed written production test but might also be relying on some of their metalinguistic awareness of the encoding of plural and mass nouns. The strong association between bare plural count nouns and genericity observed in SPR and
the higher accuracy in the choice of plural count noun marking in the c-test suggest that the children’s difficulty arises when associating the encoding of mass nouns with the correct semantic interpretation in both comprehension and production even at an older age. Therefore, the developmental issue may not so much be related to assigning to NPs the appropriate semantic reading of the discourse context but with acquiring the encoding of NPs based on the count/mass semantic distinction.

**The role of language dominance**

Another main finding is that individual English exposure and oral proficiency scores, as well as group differences affected the magnitude of CLI differently. In French, the children exposed the least to French were the least accurate at rejecting ungrammatical sentences. This finding was observed at the individual (percentage of English exposure) level but not at the group level. Greater English exposure may hinder the bilingual children’s judgments of ungrammatical sentences and give rise to a greater linguistic flexibility when judging sentence acceptability. A parallel phenomenon has been observed in French-English bilinguals’ production of dislocations where relative amount of language exposure in each language predicted the likelihood of CLI in French and English (Hervé et al., 2016).

In English, the picture that emerges from our results is less clear-cut. In the online comprehension task, we observed group and individual differences. However, English proficiency scores rather than English exposure played a role on grammaticality violation detection in the generic condition in the online task. In the production task, the group variable showed that the monolinguals outperformed the bilinguals, whereas the continuous English exposure factor reveals that accuracy increased with decreased English exposure. This is all the more surprising as the opposite pattern would be expected in the c-test. Recall, however, that most of our London bilinguals are more exposed to French when most of our Paris bilinguals are dominantly exposed to English. Our results
imply that the bilinguals exposed the least to English, mainly the London bilinguals, performed better than the bilinguals exposed the most to English, largely the Paris bilinguals. Now taking the teaching approach differences at face value, these unexpected findings seem to reveal a school rather than an English exposure effect per se. These results raise the question of whether the London bilinguals were endorsing their implicit intuition with metalinguistic knowledge acquired in class when completing the untimed cloze-test. Subsequently, the results would infer that most of the Paris bilinguals whose implicit knowledge of the encoding of plural and mass NPs is delayed in comparison to the monolingual group (as observed in the SPR task), could not compensate their weaker implicit representations with explicit knowledge learnt in class to complete the written production task. Our results uncover a new complexity in the relationship between language dominance and CLI in school-aged bilinguals, adding the new dimension of linguistic representations to this already unsettled debate (see Nicoladis, 2016).

Our study provides further experimental evidence supporting recent work establishing a direct relationship between individual measures of input quantity and the likelihood of CLI (Hervé, et al., 2016). In contrast to large-scale production studies (e.g. Nicoladis, 2006, Nicoladis et al., 2010, Nicoladis & Gavrila, 2015), it also sheds light on the role of individual measures of proficiency on CLI during online sentence processing.

The role of age

Finally, our results also contribute to the debate on the impact of age on CLI. As the children get older, their performance converges on the monolinguals'. In the French grammaticality judgement task, the younger children were less accurate at rejecting grammatical violation. The French-speaking children’s metalinguistic awareness seems to become more established as they get older. Another compatible interpretation is that the children’s attention increased with age as evidenced in research on cognitive development (Robson, 2006). In English, age was a significant
predictor only in the production task in which the older children were more accurate than the younger ones. In other words, the children’s cumulative linguistic experience increased their ability to identify the semantic cues to select the appropriate English morphosyntactic markers of specificity and genericity. This confirms that the acquisition of the English article use is a late phenomenon for both bilingual and English-speaking monolingual children as observed in prior experimental research (Serratrice et al., 2009; Kupisch & Pierantozzi, 2010). Genericity is much less frequent than specificity in the children’s daily English input (see Hervé, 2014). English-speaking children get exposed to an increasing number of generic instances in their input with time which will allow them to form the correct linguistic representation. As it is the case in the London French-English bilingual school, formal instruction of the English determiner system, i.e. explicit teaching, can help bilinguals to overcome this delay in the development of implicit representations caused by reduced English input in comparison to monolinguals.

Conclusion

Our studies displayed cross-linguistic influence in the bilinguals’ implicit and explicit knowledge of article use. Its bi-directionality, vulnerability of different kinds of linguistic representation, as well as the role of language dominance and age provide further evidence supporting the processing account of CLI (Nicoladis, 2006; Serratrice, 2007, 2016). Finally, our results provide a new picture of the role of individual measures of language exposure and proficiency measures on the likelihood of CLI.

References


Processing markers of genericity and specificity

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