Definiteness and Maximality in French Language Acquisition, More Adult-Like Than You Would Expect

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This study considers the mastery of maximality, or domain restrictions, in a group of 47 children acquiring French (aged 4.06–8.09), as well as a control group of young adults. Singular definite (*le* "the") and indefinite (*un* "a/one") plural (*des* "some," *les* "the") and explicitly maximal contexts (*tous les* "all the") were provided to participants. Animals were arranged in groups of three. Participants were asked to select one or more animals from these groups and give them to the experimenter (similar to Munn et al., 2006). Following Munn, we expected children to make maximality errors on the singular definite items. However, we did not observe this pattern. On the contrary we observed more errors on plurals generally. Further, the developmental patterns show that participants become *less maximal* in their responses to *indefinite* plurals (an adult-like pattern, also found in Caponigro et al., 2012) with *no important changes* on definite types: no strong age effects are observed on maximality patterns. These point to the importance of cross-linguistic data for the understanding of child language acquisition and error patterns in psycholinguistic theory.

Keywords: definiteness, maximality, French, language acquisition, language comprehension

INTRODUCTION

Studies of the acquisition of (in)definiteness distinctions in child language have demonstrated that although spontaneous production of definite and indefinite determiners (i.e., producing *the* vs. *a*) appears early on in production (Brown, 1973), there are stages in development in which child learners handle definite determiners in conspicuously non-adult-like ways (e.g., see Gordon, 1988 for English, and Valois and Royle, 2009 for French). A classic case of such overuse of definites, for example, is Sarah's production *I want to open the door* when the referent is known to her but not to her mother (Mother: *What door?* Brown, 1973, p. 354). Children occasionally also do the opposite, using indefinite determiners for specific referents (e.g., Eve: *He on a fox's nose*, *ibid.* p. 354), but less often. What is the constitutive difference between child and adult language that makes this so?

Explanations put forward in the literature aim to characterize the underlying etiology of such patterns of misuse of definites in English. For example, EGOCENTRICITY-based explanations (Maratsos, 1976; De Cat, 2013) suggest that children may not reliably accommodate the fact that what is a unique or salient entity for them may be neither unique nor salient for their interlocutor. Indeed, evidence suggests that even adults may be governed by such egocentric biases, and that

what may differentiate them from children is that they are better able to quickly suppress these (arguably automatic) tendencies in real-time interactions (Epley et al., 2004). Schafer and de Villiers (2000) argue that egocentricity cannot account for errors, as children ages 3.6–5.5 use appropriate indefinites in a "specific" condition (e.g., "I bet you have something hanging on your wall at home. What is it?" *A picture*), but not in a "multipac" condition (e.g., "Three ducks and two dogs were walking over a bridge. One of the animals fell off and said, 'Quack!' What was it?" *The/a duck*).

Other work has explored the idea that there may be periods in development where children instead have difficulty either with handling UNIQUENESS or MAXIMALITY presuppositions of definites (Wexler, 2011), or with implicit inferences involved in DOMAIN RESTRICTION (Munn et al., 2006). The former view claims that non-adult behavior with definites is traceable to an underlying difference in how children lexically encode the various semantic contributions definite determiners make. The idea is that while children and adults may both connect definites to presuppositions regarding the EXISTENCE of entities picked out by the noun, children differ from adults in not additionally encoding maximality presuppositions (maximality denotes uniqueness in the case of singular definites—i.e., exactly one—but all, and not some, relevant members of a set in the case of plural definites). The latter view—that children may have difficulty with domain restriction—suggests that there is nothing at all deficient or non-adult-like about the way children represent the semantics of definites. The claim is that children may instead be non-adult-like in the ways that they engage in pragmatic inferencing required to circumscribe the relevant (sub-)domain of entities within which uniqueness or maximality presuppositions are to be satisfied.

More recently, van Hout et al. (2010) evaluated children aged 3.1–5.8 on determiner production and comprehension using either a truth-value judgment task (TVJT) or *referent selection* [a task where the child was asked to move an element in a picture containing multiple examples of an item, e.g., *John sees his teacher with a piece of cake. He asks her if he can have a piece of cake* (the child must move a different piece of cake toward John)]. They showed a double dissociation between definite and indefinite determiner comprehension and production, with definites exhibiting expected better comprehension than production but indefinites better production than comprehension. Children accepted definite expressions for contexts with new referents, and, importantly, interpreted indefinite determiners as potentially referring to an already named referent (i.e., following the example above, the child would move the teacher's piece of cake toward John). The authors interpret their results as being caused by immature pragmatics specifically with regards to scalar implicature. Within the context of optimality theory, they argue that on a scale from strong to weak, definite NP are strong terms and indefinites weak ones. In the referent selection task, children understand indefinite NPs as being true for established referents in truth-value-judgment tasks but during referent-selection tasks they will accept indefinites for both old and new referents.

Maximality and Domain Restrictions in Child Language

To illustrate what could in principle distinguish between these two views, consider a study by Munn et al. (2006), which the present investigation aimed to replicate in French. In this study, the authors examined child behavior in an act-out task involving contexts like those depicted in **Figure 1**.

We would clearly expect, in this context, that an instruction to an adult to "Give me the cow next to the barn" would be reliably carried out by the selection of the cow that is *closest to* the barn. But note that carrying out this instruction requires some additional effort, given that there are three salient next-to-the-barn cows present (compared, e.g., to a situation where there is only one possible referent, i.e., only one cow next to the barn). What has to be inferred from the use of the singular definite in this context is that the relevant sub-domain for which uniqueness or maximality presuppositions are satisfied must be restricted implicitly (i.e., of the {1st, 2nd, 3rd}-next-to the barn cows, give me the 1st-next-to the barn). Now contrast this with the use of the plural definite in "Give me the cows next to the barn." Expected adult compliance with such an instruction would involve gathering all three cows grouped closer to the barn (and not those two closer to the barn, or two random cows close-ish to it). This illustrates the notion of maximality, which is for plurals the correspondent to Russellian uniqueness (Russell, 1905), i.e., the maximal set of all relevant objects (Link, 1983).

Suppose that while children may reliably encode existence presuppositions of definites, they may still have specific difficulties with maximality, as has been argued by Wexler (2011, see also discussion below of Caponigro et al., 2012). If this is the case, children tested on this act-out task should show equal difficulties with both plural and singular definites. In contrast, Munn et al. (2006) reasoned that if child language difficulties reside in inferential processes used to accommodate implicit domain restrictions, and not with maximality *per se*, then adult-like maximal responses (i.e., all the cows) are expected for the plurals, since in this case there is no need to restrict the domain more narrowly than is explicitly determined by "next to the barn." On the other hand, non-adult responses would be expected for the singular definite cases, because an additional inference is required to more narrowly restrict the domain beyond what is explicit (i.e., that "next to barn" has to be interpreted as "right next to the barn" or "closest to the barn"). In fact, precisely this predicted pattern is reported by Munn et al. (2006). While both English (aged 3.0–5.5, $M = 4;1$, $n = 15$) and Mexican Spanish learners (aged 3.2–4.11, $M = 4;3$, $n = 20$) successfully responded in an "adult-like" (see below for details about adult testing in comprehension studies) manner for plural definites, explicitly maximal cases ("Give me all the cows..."), and singular indefinites (in English, only singular cases were tested, in Spanish plural indefinites were 87.5% correct), they were reliably worse in their performance with singular definites (that is not always giving the cow closest to the barn). This finding is consistent with the hypothesis that difficulties reside in handling inferences needed for implicit domain restriction, and not with maximality encoding.
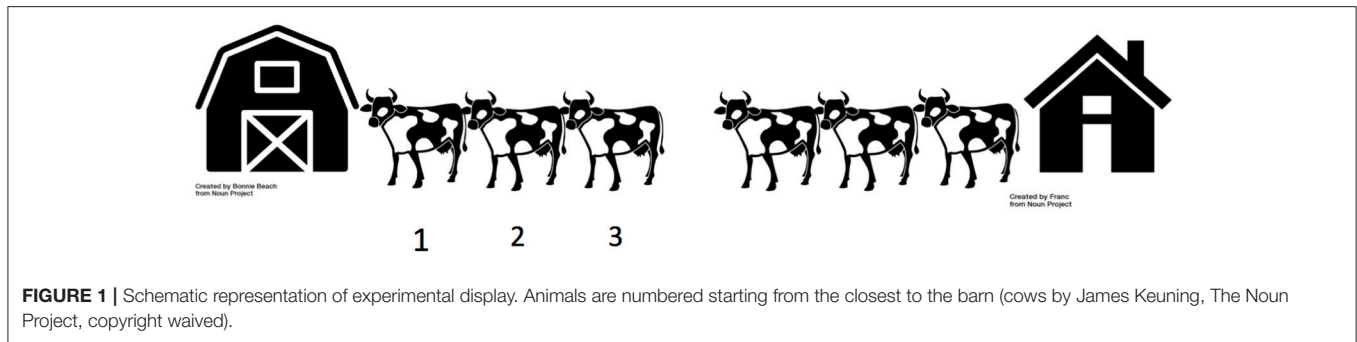
FIGURE 1 | Schematic representation of experimental display. Animals are numbered starting from the closest to the barn (cows by James Keuning, The Noun Project, copyright waived).

However, a more recent study (Caponigro et al., 2012) raises worries about Munn et al. (2006), suggesting that their data may be understood as reflecting a general bias in the plural conditions toward retrieving *all* the objects. Caponigro et al. correctly observe that inclusion of an indefinite plural control condition in the Munn et al. study would enable a demonstration that the response patterns for definite plurals may *not* have been due to a bias toward ALL responses in plural conditions independent of determiner type. However, recall that Munn et al. tested both English and Spanish children, and while it is true that their English version did not include an indefinite plural control condition, their Spanish study did (e.g., *Dame una<u>s</u> gata<u>s</u>* = Give-me some.pl cats.pl). Unlike definite plurals, maximal responses were significantly reduced for indefinite plurals in Spanish-speaking children (74%, compared to 97% for definite plurals). This aspect of Munn et al.'s data suggests that at least the pattern found in the Spanish learners cannot be attributed to a more general bias toward maximal responses for all plural conditions.

On the other hand, Caponigro et al.'s (2012) criticism of the Munn et al. study is raised in the context of their own empirical work, including a TVJT and an act-out task (different from Munn et al.) examining English learners' comprehension of both definite plurals (*the things on the plate*) and free relatives (*what is on the plate*). Free relatives are of interest because their interpretation is also thought to be governed by maximality (see Caponigro et al., for discussion and references). They conclude that, contra Munn et al., maximality does not seem to constrain child behavior until quite a bit later in development (not until around age 6 or 7). In particular, maximal responses are *not provided* to contexts such as "Give me the things on the plate," where four items of fruit are on the plate. Several features of the Caponigro et al. study make their findings compelling. First, they tested a larger sample than Munn and colleagues (N = 67) across a range of ages (4–7), in addition to adult controls who performed the same task as the children, enabling inspection of developmental changes against target performance on their tasks. Second, they tested the two separate cases (definite plurals and free relatives), which implicate maximality. This is of interest for a number of reasons, not the least of which is the fact that the constructions differ in their frequency. Their findings suggest that maximality mastery reflects age-related changes that cannot be simply input or exposure driven. We will return to these results below in the Discussion. For the moment the main point that we wish to register is that the

available data are in conflict. Munn et al.'s findings indicate that maximality may be in place early on, while Caponigro et al.'s findings show only later emergence (around age 6–7) in English-speaking children. Further, Caponigro et al. show that difficulties are observed in plural definites *not* singular ones. They argue against Wexler's (2011) theory, according to which children do not assign the maximal meanings to definite noun phrases due to delays in logical semantic development, as some explanation for the maturational delay would be needed. They suggest rather that children have "simply not yet developed the adult-like mapping between those linguistic structures and plural individuals, [on] which the notion of a maximal plural individual is based" (p. 285). Caponigro and colleagues explain their discrepancy with Munn and colleagues by noting that, in the English version of Munn's task, no indefinite plural condition (i.e., *Give me some…*) was used, thus probably promoting maximal responses over non-maximal ones in the plural items of their task. Note also that although TVJT tasks are thought to be a good measure of child linguistic comprehension, van Hout et al. (2010) show that these paradigms allow for indefinites to be accepted in conditions where a definite would be more appropriate (e.g., *A boy was flying his kite* [the kite flies away] a. *Did a kite fly away?* Target: Yes). From a cross-linguistic perspective, some inconsistencies between English and French (and English and Spanish) acquisition have been also observed. We first present a short review of acquisition studies for French determiners in elicited and spontaneous production contexts, as well as in comprehension, before moving to our experiment.

French Determiners and Acquisition
Production Studies
French-speaking children must learn a number of different determiners to identify semantic features such as definiteness, mass/count distinctions, genitive, and demonstrative, in addition to using appropriate feminine and masculine forms in the singular, or the appropriate plural form (which is unmarked for gender, in most cases). **Table 1** presents a sample of the most common determiner types. A peculiarity of French (which is similar to Spanish but different from English) is that the masculine singular indefinite determiner (*un*) is also the numeral "one." This does not seem to hinder its acquisition. We also note an important cross-linguistic difference between English and French (and to a lesser extent, between Spanish and French). English allows bare plurals (for example in universal or generic

TABLE 1 | A subset of the French determiner system.

Type of determiner	Singular		Plural
	Masculine	**Feminine**	
Definite	le /lœ/	la /la/	les /lɛ/ or /le/
before #_ V	l' /l/	l' /l/	les /lɛz/ or /lez/
Indefinite	un /œ/	une /yn/*	des /dɛ/ or /de/
before #_ V	un /œn/	une /yn/*	des /dɛz/ or /dez/
Partitive (mass nouns)	du /dᶻy/	de la /dœla/	—
before #_ V	de l' /dœl/	de l' /dœl/	—
Demonstrative	ce /sœ/	cette /sɛt/	ces /sɛ/ or /se/
before #_ V	cet /sɛt/	cette /sɛt/	ces /sɛz/ or /sez/
Possessive (e.g., 1pers.)	mon /mɛ/	ma /ma/	mes /mɛ/ or /me/
before #_ V	mon /mɛn/	mon /mɛn/	mes /mɛz/ or /mez/

Often pronounced [œn] in informal Quebec French, thus creating ambiguity between the masculine and feminine, especially when immediately preceding vowel-initial words (Barbaud et al., 1982).

TABLE 2 | Mean age (in months and years) for different groups of participants.

	Age group									
	G45		**G6**		**G7**		**G8**		**Adults**	
	(n = 13)		**(n = 14)**		**(n = 11)**		**(n = 13)**		**(n = 12)**	
	M	**SD**	**M**	**SD**	**M**	**SD**	**M**	**SD**	**M**	**SD**
Age in months	62	4.7	76	3.5	91	2.6	99	2.8	285	17.21
Age in years	5;02	–	6;04	–	7;07	–	8;04	–	23;09	–

All the statistical models introduced Age as a continuous variable: grouping was only used for visualization purposes.

statements, *Lions are carnivores*), whereas French common nouns must nearly always be accompanied by a determiner (Les lions *sont carnivores*) except in highly literary contexts (see e.g., Beyssade, 2011).

A longitudinal study of Pauline (Bassano and Maillochon, 1994), a French child from France aged 1.3–2.6 (Valois and Royle, 2009), and a cross-sectional study of 15 children, aged 1.8–3.0 years (Valois et al., 2009) reveal high levels of mastery of all types of determiners produced in spontaneous speech. While determiner omission is common before age 2.0, they are nevertheless produced in obligatory contexts (see also van der Velde, 2004). For example, before age 1;8 Pauline produces definite determiners *le* and *la* "the.m/f" and their contracted form *l'*, the definite plural *les* "the.pl," and the indefinite singulars *un* and *une* "a/one.m/f." Correct production is globally high (around 82% of obligatory contexts in Valois et al., 2009, with small numbers of gender errors). Van der Velde and collaborators show similar levels of mastery after age 1.10 at the two word stage, and French-speaking children aged 3–6 omit definite determiners less than 5% of the time in elicitation (with picture books), which contrasts with Dutch-speaking children who omit determiners more often (5–25% of the time) (Van der Velde et al., 2002; van der Velde, 2004; see also Guasti et al., 2008 for similar comparisons across Dutch, Italian, and Catalan-speaking children aged 3). Most errors observed in these children are

linked to gender agreement. Karmiloff-Smith (1979) elicited determiner production in contexts with similar objects of the same color [indefinite: *a (green) ball*], similar objects differing in color (definite + adjective: *the red frog*) and unique objects (definite with no need for adjectives: *the plane*). The youngest group used a high number of demonstrative pronominal expressions (e.g., *celui-là* "that-one"), and all children below age 8 showed worse performance on indefinite vs. definite determiners (including contexts eliciting definite noun phrases with adjectives), mirroring what had been found by Warden (1976) in English children. More recently De Cat (2013) showed that in a blindfold tester situation, French-speaking children aged 2.7–3.3 show high, but sometimes erroneous, levels of correct indefinite production (83–95%) if the story context (new) and the picture (new) warrant its use, and perfect production in definite contexts (old story, old picture). Interestingly, in the in-between context (old story, new picture), children go from being undecided between using the definite or indefinite determiner (50/50) at age 3 to preferring the definite at ages 4.6–5.7 (83% definite), thus showing a general preference for indefinites early on[1]. These changes were not correlated with results on a theory of mind task, which led the author to conclude that it is not egocentricity that is driving errors. She suggests that definiteness errors in production are linked to a tendency to "assume a wider implicit common ground than adults would" (p. 68) in contexts which allow one to rely on the visual stimuli for reference, as well as potential fleeting difficulties monitoring the interlocutor's perspective. Data from Bresson et al. (1970) provide evidence for definiteness errors in 25 French-speaking children aged 4–5 years-old. The study found age differences in the use of indefinite determiners in French children describing items for a doll with a turned back (1a) with 5-year olds showing strong abilities in singular and plural forms (85–91%), and definite determiners to describe changes in these groups (see 1b, scores between 85 and 100%), but difficulties when prompted for indefinite determiners in the same context (1c). Here, scores were quite low in contrast to condition (1a) the highest being 24% target production on indefinite singular forms at age five. The most common response in both groups, in the singular and plural, was to provide a definite form.

(1) a. *Il y a un/des* [œ̃/de] *mouton/s*[2]   "There is a/some sheep"
     b. *Qui est parti? Le/les mouton/s*   "Who left? The.sg/pl sheep,"
     c. *Qui est parti? Un/des moutons/s*   "Who left? A/some sheep"

Finally, French-speaking children aged 6 can adapt to their interlocutor's knowledge level—adults who know or do not know a story—by using appropriate definite and indefinite determiners to introduce new referents in a comic-strip story-board. At age 6, a typical pattern, where first mentions of a referent tend to prefer

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[1]It may also be that the child does not realize that a protagonist is the same across images. However, this is unlikely, given the design seems to have involved a consistent picture for each animal.
[2]Note that the *s* is silent on nouns in French and only the determiner carries number features.

the indefinite determiner is observed especially when the interlocutor is not informed of the story (de Weck and Jullien, 2013).

Comprehension

In a comprehension task involving new or already-moved items in an array of similar objects (e.g., *A/the dog jumped on the table*), Maratsos (1976) showed that French-speaking children aged 3 and 4 years old performed on average above chance. Indefinite determiners led to the highest levels of error: children tended to move a previously moved object where a new one was expected. Maratsos interpreted these results as signaling egocentricity in children, that is not taking into account the interlocutor's point of view. However, this explanation is not entirely convincing. Results could be due to an experimental bias toward maintaining the same referent across different actions (based on his own data, Wexler, 2011, also argues against the egocentricity account). It is also possible that children interpret *a* as "any/whichever" member of a given category, including the referent already used, a feature that may have to do with the specific/non-specific distinction rather than definiteness in French. Karmiloff-Smith (1979) studied French-speaking children aged 3–11 years old, using an adaptation of Maratsos' task as well as others. In her comprehension task, we observe a reversal of the Maratsos pattern for French, as well as the English comprehension and production patterns, that is, better comprehension of indefinite than definite determiners at young ages, but high variability in results up to age 10 and a reversal of the pattern, which resolves in definites being better comprehended than indefinites.

It thus appears that French-speaking children do not necessarily show the same difficulties as English children mastering definiteness, with globally more efficient mastery of indefinites than definites in comprehension at young ages (viz. Karmiloff-Smith, 1979), but the opposite pattern in elicited production. Further, Karmiloff-Smith reveals variable behavior across age groups for indefinite comprehension, even at age 10. One wonders whether all the children show variability or if only a subset do (only global averages are reported), and whether this pattern resembles that of adults. None of the studies reviewed were run on adult speakers, except Bresson (1974), and Munn et al. (2006)—in English but not Spanish, although the adults performed a different task. This is important, as pre-testing with adults is useful to establish whether children have attained adult-like performance in the tasks and, importantly, whether variability is also observed in the adult grammar[3]. As noted, tasks used to evaluate their behavior might affect results, as spontaneous speech production reveals few errors (mostly

gender errors and omissions), while Bresson et al. (1970) also observe better results in a production task with simple object denomination. Our goal was to adapt the maximality experiment to French and test it on French-speaking children and adults to allow for a better understanding of definiteness interpretation in French. We were interested in studying an age-range across a larger time-span than Munn et al. (2006), similar to Karmiloff-Smith (1979) and Caponigro et al. (2012), in order to establish whether developmental stages for definiteness comprehension could be observed.

Based on the reviewed studies, we expect French children to show difficulties comprehending definite singular forms up to age 8 (coherent with Karmiloff-Smith, 1979 for French and contra Maratsos, 1976, for English and Spanish) especially with regards to maximality (viz. Munn et al.'s, 2006 Spanish data), while indefinites should show better but variable comprehension in the singular (Karmiloff-Smith, 1979). Plural (in)definites should not result in comprehension difficulties since these were well understood by Spanish-speaking children in Munn et al. (2006)[4]. We also expected to observe the consolidation of definiteness comprehension in the plural between ages 6 and 7, based on Caponigro et al. (2012).

METHODS

Participants

All participants were recruited from the greater Montreal area in Québec. A group of 12 adults was first tested to establish adult-like behavior on the task. Following this, 52 French-speaking children aged 4.06–8.09 were tested (see **Table 2** for details). They were recruited through local schools and daycares. All participants were native French speakers with children having a minimum of 80% exposure to French, both parents being French speakers, and being in French school or daycare, while adults were from French-speaking backgrounds and French-dominant if bilingual. None of the speakers had any history of neurological or other learning impairments. All had normal or corrected-to-normal vision. Children were additionally assessed with a language comprehension battery (*Evaluation du langage oral*, Khomsi, 2001) in order to ensure that they had typical language comprehension abilities. One child was excluded from the analyses because he had an undiagnosed visual impairment. This study was run within the context of a larger project investigating the acquisition of gender agreement in French noun phrases using event-related brain potentials (ERPs) (Royle et al., 2009–2013; Courteau et al., 2013, 2015). A number of psycholinguistic off-line experiments aimed at evaluating language development in French children were run. The definiteness comprehension task was run after all other experiments in the protocol had been passed. In children, this was on the second day of testing (additional details about other tasks and the full protocol can be found in Courteau et al., 2013). This study was carried out in

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[3]Wexler (2011) assumes that since 9 year-olds tested by Karmiloff-Smith (1979) have achieved "perfection" in her definiteness task (seemingly agreeing with "adult judgments and the results of linguistic theory" p. 19), adult controls are not necessary. This is a doubtful argument, as adults are known to deviate from standard form for many reasons, including processing costs (e.g., Franck et al., 2004 and attraction effects) and pragmatics (e.g., Noveck, 2001). Anderson and Boyle (1994) show that adults will occasionally use definites to refer to elements they but not their interlocutor can see, thus not taking their point of view into consideration.

[4]English children have difficulty with both singular and plural definites in Munn et al. (2006) but this might be due to determiner ambiguity (*The* being used for both the singular and the plural), a feature which is not present in French.

accordance with the recommendations of the SSHRC funding agency, with written informed consent from all subjects. In accordance with the Declaration of Helsinki, written and informed consent was obtained from all adult participants and from the parents/legal guardians of all non-adult research participants. Monetary compensation of 15$ per hour was provided for their participation. The protocol was approved by the ethics committees of The McGill Faculty of Medicine, the Centre de recherche CHU Ste-Justine and the Centre de Recherche de l'Institut universitaire de Gériatrie de Montréal. A parent or tutor was always present during child testing and research assistants worked in tandem.

Materials and Procedure

The present study constitutes a replication of the Spanish (because it includes an indefinite plural condition not used in English) act-out study in Munn et al. (2006), testing child comprehension of maximality with definite determiners. Sentences evaluated included singular (2a) and plural (2b) definites, singular (2c), and plural (2d) indefinites, as well as knowledge of *tous* "all" (2e), an explicitly maximal plural condition (see Appendix in the Supplementary Materials for a full list of stimuli). Note that the plural in French (unlike in Spanish) is in the vast majority of cases only marked on the determiner, which does not carry gender information in the plural (*le* [lœ] "the.m.s," *la* [la] "the.f.s," *les* [lɛ] "the.pl"). The verb used (*est/sont* [ɛ/sɔ̃] "is/are") is, however, marked for number, as it is irregular and exhibits stem changes. The task was repeated with four different objects, for a total of 20 trials per child, and took about 5 minutes. Two versions with different animal presentation orders were used, counterbalanced across participants.

(2) a. *Donne-moi* <u>la</u> *vache qui est à côté de la ferme.*
Give me <u>the</u> cow that is beside the farm.   DEF-SG

b. *Donne moi* <u>les</u> *vaches qui sont à côté de la ferme.*
Give me <u>the</u> cows that are beside the farm.   DEF-PL

c. *Donne-moi* <u>une</u> *vache qui est à côté de la ferme.*
Give me <u>a</u> cow that is beside the farm.   INDEF-SG

d. *Donne-moi* <u>des</u> *vaches qui sont à côté de la ferme.*
Give me <u>some</u> cows that are beside the farm.   INDEF-PL

e. *Donne-moi* <u>toutes les</u> *vaches qui sont à côté de la ferme.*
Give me <u>all the</u> cows that are beside the farm.   PL (*explicit maximal*)

Before testing, participants were asked to name all targets and buildings used in the task, with feedback if necessary. If the participant persisted in using alternate terms (e.g., *lamb* instead of *goat*), these were used in the task. Comprehension of *à côté de*, "beside," was also tested by placing four different animals side-by-side and asking "What is beside the farm?" During the experiment, three animals of the same type were lined up beside the house and three beside the farm (**Figure 1**). The experimenter asked the child to give them an animal or multiple animals following examples in (2).
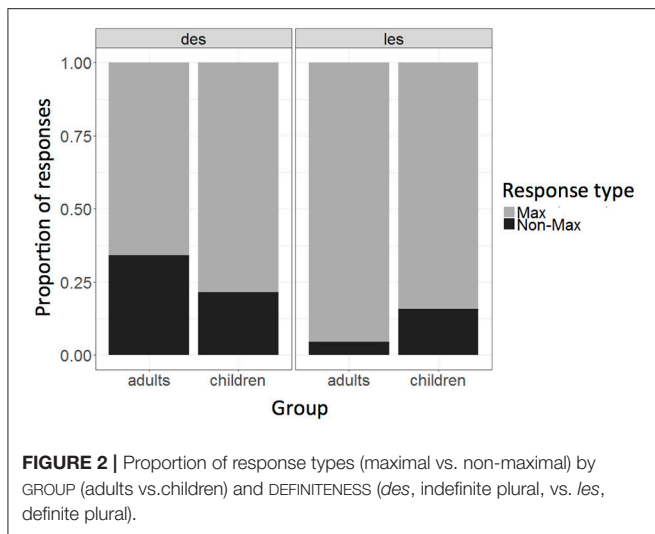
RESULTS

Data Processing, Response Coding, and Statistical Analyses

Individual participant responses were examined for indications of anomalous task behavior: one adult participant was excluded from analyses because he declared having misunderstood the task. For visualization purposes, we grouped the remaining subjects into age groups: younger children (4 and 5 yo—GA45) were collapsed together given that there were few children in these two age-groups (*n* = 13). Two dependant variables were computed. For plural trials, participant responses were coded according to whether they selected all three items or not. For singular trials, responses were coded depending on whether participants chose the item closest to the barn vs. any other item. Data from the 52 children and 11 remaining adult controls were subjected to a set of logistic regression analyses using the lme4 package in R (*lme4* package 1.1.12, Bates et al., 2016). For each analysis, we first selected the random structure by calculating an empty model and removing all random effects with an *intraclass correlation coefficient* (ICC) of less than 0.05[5] using the *sjstats* package (Lüdecke, 2017). The optimal random structure included random intercepts for participants (ICC = 0.79). Following Barr et al. (2013) we created a maximal model including fixed factors DEFINITENESS and GROUP. In order to make the models easier to interpret, we used an ANOVA wrapper (Type III Wald chi-square test) with the *car* package (Fox and Weisberg, 2011). When needed, post-hoc pairwise comparisons were performed using the *multcomp* package (Hothorn et al., 2008). These analyses included planned comparisons between definite and indefinite plurals on the one hand, and singular definites vs. singular indefinites on the other.

Definite vs. Indefinite Plurals

A logistic regression comparing definite and indefinite plurals (*les* vs. *des*) showed a significant effect of DEFINITENESS [$\chi^2_{(1, N=63)}$ = 11.60, *p* = 0.0007] and a significant DEFINITENESS:GROUP interaction [$\chi^2_{(1, N=63)}$ = 5.52, *p* = 0.019]. Full models are presented in Tables 1–5 in Data sheet 2. This is illustrated in **Figure 2**. Pairwise comparisons revealed

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[5]The intra-class correlation coefficient calculates the proportion of between-subject variance to total variance: a low value indicates that the random factor level does not affect the estimate.

FIGURE 2 | Proportion of response types (maximal vs. non-maximal) by GROUP (adults vs.children) and DEFINITENESS (*des*, indefinite plural, vs. *les*, definite plural).

that both adults and children correctly assigned maximal *vs.* non-maximal interpretations to definite and indefinite determiners, respectively. However, the effect is larger for adults [$t_{(487)} = 3.252$, $p = 0.0007$] compared to children [$t_{(487)} = 0.842$, $p = 0.03$]. As a follow-up analysis, we investigated AGE effects[6] in children. As the mixed-effects model did not converge, we ran a logistic regression (without a random structure): therefore the model is less conservative. Results show a significant effect of DEFINITENESS [$\chi^2_{(1, N = 52)} = 10.06$, $p = 0.0015$] and a DEFINITENESS x AGE interaction [$\chi^2_{(1, N = 52)} = 8.00$, $p = 0.0047$]. When analyzing definite and indefinite plurals separately, we observed a significant effect of AGE for definites [$\chi^2_{(1, N = 52)} = 28.32$, $p < 0.001$], and a marginal but non-significant effect for indefinites [$\chi^2_{(1, N = 52)} = 3.69$, $p = 0.055$]. These results suggest that children responses become more adult-like as they get older, but only for the definite plurals. **Figure 3** illustrates these patterns. The youngest children produced ∼37% non-maximal responses for definite plurals (*les*) (e.g., giving two cows in response to "Give me the cows"), and did not reliably distinguish between definite and indefinite plurals (*des*). Older children and adults (see **Figure 2** for adult data) produce less non-maximal responses for definite plurals ∼10 and 5% of the time respectively. Indefinite plurals are given non-maximal responses ∼20% of the time in older children and 35% of the time by adults.

Definite vs. Indefinite Singulars

A logistic regression comparing definite and indefinite singular conditions (*le* vs. *un*) shows that mastery of implicit domain restrictions across the groups, including even the younger children, cannot be explained by any general preference for picking the animal closest to the barn. That is, "closest-to-the-barn" responses were significantly more likely for definites

[$\chi^2_{(1, N = 63)} = 7.41$, $p = 0.007$] across both groups, as can be clearly seen in **Figure 4**. For definite singulars, all participants almost systematically preferred this interpretation (about 97% of trials). Though there was also a preference for "closest" responses in the indefinite singulars, other responses arose for ∼25–30% of trials (just over 27% collapsing over groups).
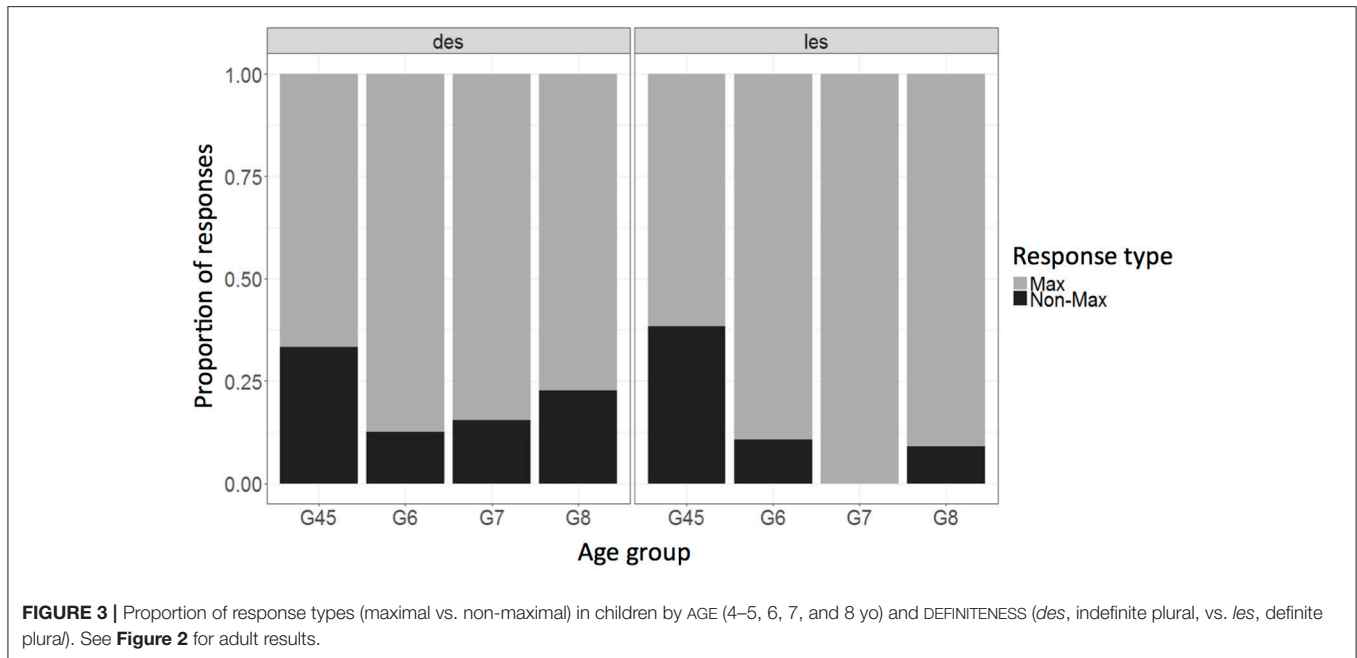
In sum, slight differences between definite singulars and plurals were visible in our data, but this difference trended in the opposite direction of previous findings, with superior performance on singulars over plurals in French children (and adults). Responses in the definite and indefinite singular conditions clearly showed that even the younger children handled implicit domain restriction in the expected adult-like way (interpreting "next-to-the-barn" with singular definites as "closest-to-the-barn"). However, our comparison of definite and indefinite plurals suggests a developmental trend for maximality (i.e., an interaction of DEFINITENESS and AGE). Like the adults, the older children *differentiated* between definite and indefinite plurals, allowing more non-maximal responses for indefinites, whereas this discrimination was not evident in the responses of the younger group (**Figure 3**). Critically, even younger children make only few mistakes in determiner interpretation. For indefinite plurals, their maximal interpretations were correct, but slightly different from adult interpretations. Finally, we note that maximality errors in the plural or singular were not equally present in all participants, but were only found in a subset of them, a result that is not highlighted when presenting group means.

DISCUSSION

Previous findings from studies investigating maximality and definiteness in child language have yielded inconsistent findings. We conducted a replication of Munn et al.'s (2006) act-out experiment with French children and adult controls, and our findings were quite different in several respects that, we argue, paint a picture that is more in line with Caponigro et al.'s (2012) general conclusions "that the difficult[ies] likely [lie] in mapping [of] linguistic structure[s] to the associated concepts/objects, rather than in the maturation of either conceptual or semantic resources" (p. 287). First, we observe that some children have difficulties understanding plural determiners (independently of their status as definites or indefinites) but not singular ones, which was unexpected based on Munn et al. (2006) or even our general intuitions about French acquisition. For example, a child might give only one cow when asked *Donne-moi les vaches* …"Give me the.pl cows …." Only a subgroup (eight children) showed these difficulties. This unexpected result was also observed for the explicit plural form *tous les* "all the" although less often (presumably because *tous les*, contrary to just *les*, by being overtly maximal, leads with much more difficultly to a non-maximal interpretation)[7].

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[6]In our statistical model, AGE is implemented as a continuous variable, and centered using the built-in *scale* function in *R*. For visual purposes only, we separated our participants into age groups.

[7]One could argue that the phonological difference between singular *le* [lœ] "the.m"/*la* [la] "the.f" and plural *les* [lɛ/e] "the.pl" is not salient enough, but this would be highly unlikely since these vowel contrasts are acquired by age four in

FIGURE 3 | Proportion of response types (maximal vs. non-maximal) in children by AGE (4–5, 6, 7, and 8 yo) and DEFINITENESS (*des*, indefinite plural, vs. *les*, definite plura*l*). See **Figure 2** for adult results.

Recall Munn et al.'s (2006) prediction that a problem with maximality should lead to erroneous responses in both the plural and singular conditions, while a maximal answer in the plural but not in the singular condition would be an indication of a problem with implicit domain restrictions on determiners. They found maximality errors only in the singular condition in English and Spanish, consistent with the latter account. In our experiment, all groups handled maximality in the singular better than in the plural, and although adults showed better results than children, this pattern did not change with age. Subgroups of adults and children (around 25% of the sample) did not produce maximal plural responses to *Donne-moi les vaches à côté de la ferme* "Give me the.pl cow beside the barn." These patterns are illustrated in **Figure 5**.

Although most of our participants, except for the youngest ones, were older than those tested in Munn et al. (2006), it is not clear that adding younger children in our study would have lent support to the domain restriction hypothesis, as non-maximal responses were mostly found for plural (*les*) but not singular (*le/la*) definite determiners. Further, and different from Caponigro et al. (2012), we find that adults provide the same type of responses as children do, and roughly within the same proportions. Therefore, our data suggest that, at least in French, *there does not appear to be a difference between child and adult behavior in this domain of reference.* If children were not respecting maximality in the definite condition, then we would predict at least some instances where the children picked two of the three toys, as was found in English by Caponigro et al., but this almost never happened and was not distributed evenly across children: some children never made this error. Furthermore, the

FIGURE 4 | Proportion of response types (closest vs. other) by GROUP (adults vs. children) and DEFINITENESS (*le*, definite singular, vs. *un*, indefinite singular).
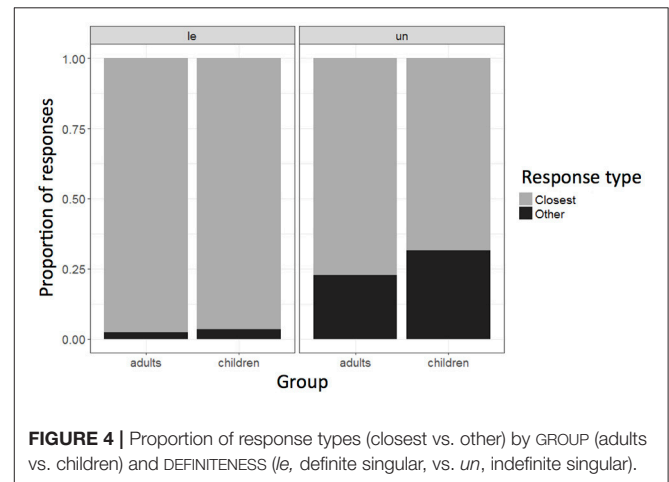
fact that the indefinite plural condition in French elicited non-maximal responses roughly 30% of the time is evidence that the children were not picking all of the toys in the definite condition simply as a bias of the task, which is reassuring given Caponigro et al.'s worries about our type of paradigm. However, the tendency to provide partial (one or two out of three) items was not an overwhelming response in the indefinite plural condition either (see **Figures 2**, **5**). Older child participants, just like adults, apparently distinguish better between definite and indefinite plurals, at an age similar to Caponigro et al.'s participants, but note that age is not a significant predictor for indefinite comprehension in our model. Further research is clearly needed to show that maximality is respected in other contexts, and that possible task biases toward a maximal response can be controlled for as well.

French (Martinet, 1974; De Boysson-Bardies et al., 1989). As mentioned above, as part of the protocol, all the children were screened for hearing difficulties.
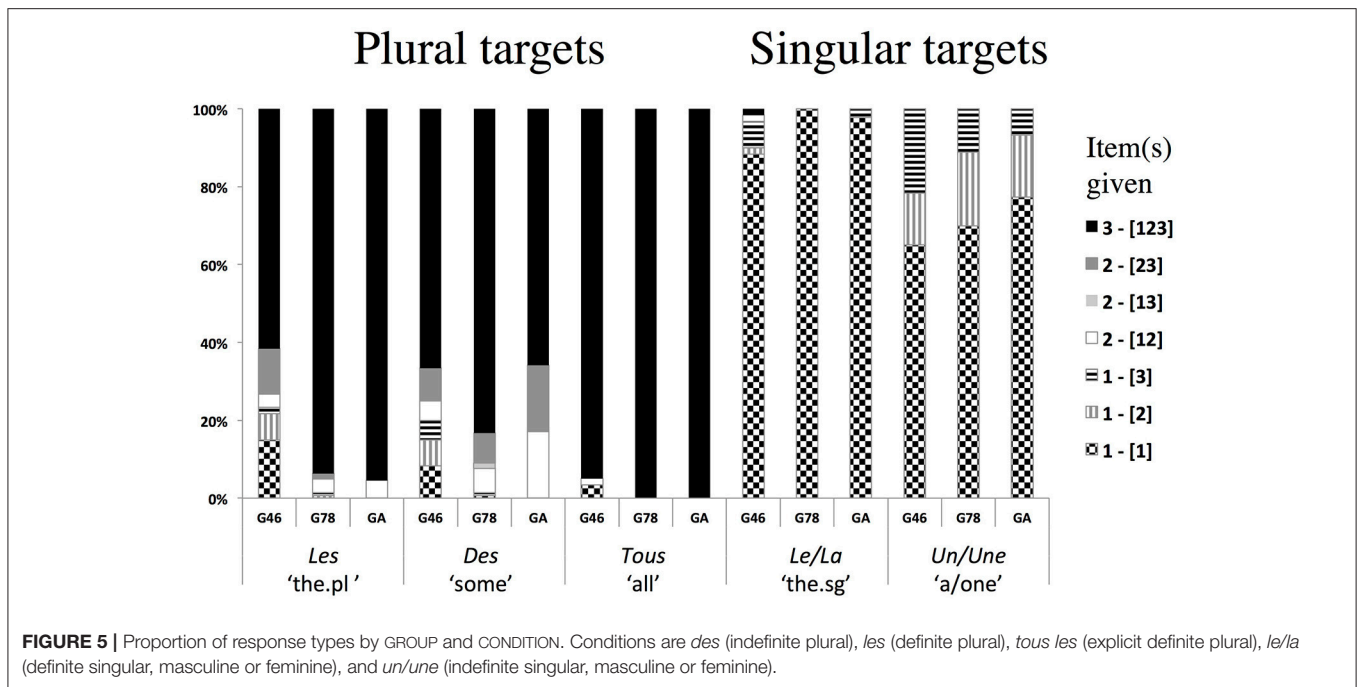
FIGURE 5 | Proportion of response types by GROUP and CONDITION. Conditions are *des* (indefinite plural), *les* (definite plural), *tous les* (explicit definite plural), *le/la* (definite singular, masculine or feminine), and *un/une* (indefinite singular, masculine or feminine).

How could we explain French children's better mastery of domain restriction in the singular than English children? As noted above, there are typological distinctions between the two languages, the most important probably being that the use of bare nouns is quite restricted in French. Thus French-speaking children receive more input on how to divide up the referential space using determiners and quantifiers. Furthermore, important referential information about gender and uniqueness, and thus reference, are borne by the determiner. A third reason why we may be observing these differences is linked to the way both languages instantiate number marking on definite singulars. English uses an ambiguous determiner *the*, which can denote singular or plural. It is the number marking on the noun that disambiguates its meaning. French, on the other hand only marks number on the determiner and has lost overt regular plural marking on the noun[8]. If we were observing effects of language structure on ability to comprehend (and produce) definiteness and maximality, this would force us to reconsider semantic-only accounts of definiteness acquisition.

How would we explain the early acquisition of maximal interpretations for definite plurals in French but not in English? As noted above, in French these definite determiners are used for universal or generic statements and bear the meaning "all members of the set X," whereas in English they are not, possibly making it more difficult for English-speaking children to interpret them as maximal, and it thus might take English children more time to acquire this aspect of their system, apparently up to age six or seven. However, we do not know from Caponigro or Munn's data, whether there are subsets of their participants who fully master singular or plural definiteness at

early ages, as what was observed in French, since we are presented with average scores only. In essence, what French children might have to learn is where maximality is *not* applicable: although maximal responses are not pragmatically correct for indefinite plurals they are logically correct, and this will intersect with issues concerning the acquisition of scalar implicature and "some": (i.e., sorting out that "some" includes "but not all"). This result is consistent with van Hout et al. (2010) for singular determiners in English. A study by Noveck (2001) testing truth value judgments in French-speaking children and adults with felicitous (e.g., *Some birds live in cages*) and infelicitous sentences (e.g., *Some giraffes have long necks*) which are both true, shows that younger children (aged 7–8 but even 10–11) will accept both as being true, while adults disprefer the second because of it's implicit meaning "but not all" (they are accepted on average by 41% of adults and 87% of children). Our data are not inconsistent with this view, however we fail to find significant age effects for indefinites contrary to Noveck (2001). This might be due to differences in task: while we asked children to provide us with a number of animals, Noveck asked children to judge statements. In addition, our statistical methods, which were not used by previous authors, include participants as random variables. These models are thus more conservative. Moreover, Barbet and Thierry (2016) show, using statistical models similar to ours, that processing of "some" in adults varies according to personal tolerance for its pragmatic interpretation (*some but not all*) over its literal and logical sense (*some OR all*). More work is needed to fully disentangle the questions raised, but our data is roughly consistent with Caponigro et al. (2012) and inconsistent with Munn et al. (2006). If this line of thinking is right, we may expect different patterns cross-linguistically with respect to when learners sort out, not just the meaning of one versus another particular determiner, but how a system of determiners carves up

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[8]Except in a few lexically marked cases such as *cheval/chevaux* [ʃəval]/[ʃəvo] 'horse/horses'.

the variety of types of nominal reference. Of particular interest to us, would be to run these tasks on bilingual children who speak both English and French. The main question would be whether we would observe inverse problems in the two languages in the same children (i.e., errors on singular vs. plural definites and indefinites going in opposite directions in both languages), which is what we would predict based on our interpretation of this data, or whether these bilingual children show similar difficulties in both languages. Another approach would be to study a language such as German, a language with three genders, where the feminine singular definite determiner, *die*, is homophonous with the gender-underspecified plural definite determiner, *die* (similar to *the* singular/plural in English). If confusion between singular and plural is driving English errors, than German children should show a similar pattern but only for feminine targets.

AUTHOR CONTRIBUTIONS

PR: Task design, experiment supervision, literature review, background on French, data interpretation, manuscript writing. LF: Statistical analyses, data interpretation. JD: literature review, data interpretation, manuscript writing.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fcomm.2018.00027/full#supplementary-material

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