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A comparative and dynamic approach to the development of determiner use in three children acquiring different languages

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Abstract

The study investigates the development of determiner use in three children acquiring French, Austrian German and Dutch, from the onset of language until age 3;0. Noun constructions (determiner omission, correct bare nouns, filler and determiner uses)

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in the children and in their inputs are analysed, providing evidence of similarities in developmental shape as well as differences in frequencies and timing. As expected, determiner use was delayed in the Germanic languages as compared to French. Differences between the Austrian and the Dutch child were explained by language properties and by child characteristics. Modelling dynamic input–output relations provided evidence of styles of long-term parental adaptation (accommodation for the French and complementarity for the Dutch and Austrian children).

Keywords
determiner use development, dynamic modelling, Germanic/Romance languages, input–output relations, noun constructions

Introduction

Using obligatory determiners with nouns is a central morphosyntactic constraint in a number of languages (e.g., English *A man came in*, French *Un homme est entré*). Signalling the construction of the noun category, the acquisition of this constraint is crucial in children's early grammatical development (Bassano, Maillochon, & Mottet, 2008; Pine & Lieven, 1997; Valian, 1986). Recently, cross-linguistic research contrasting Germanic and Romance languages on this topic has illuminated controversial issues such as general vs. specific processes in the acquisition of grammar, the role of prosodic, lexical or semantic factors and the role of the input (Guasti, De Lange, Gavarro, & Caprin, 2008; Kupisch, 2007, 2008; Lleó, 2001; Lleó & Demuth, 1999; Van der Velde, 2004). These issues are addressed in the present research project, which takes a comparative perspective on the emergence and early development of determiner use in longitudinal data from the free speech of three children acquiring different languages, French, Dutch and German. These languages use obligatory determiners but vary in their determiner systems. We provide the general framework of our approach and examine two main issues: (1) when and how the three children acquire the determiner use constraint, i.e., the requirement for obligatory determiners before nouns, and (2) what is the role of the input and how can the relationships between input and output be described in the form of a dynamic model.

A comparative and dynamic approach to the development of determiner use in children

Our comparative approach to the development of determiner use focuses on cross-linguistic variation. Starting from previous research on French (Bassano, 2000; Bassano & Eme, 2001; Bassano et al., 2008), the present study relies on the typological contrast opposing Romance and Germanic languages. French, which is the most restrictive Romance language with respect to determiner use, is contrasted with Dutch and German, both Germanic languages known to allow more frequent bare nouns than Romance languages in general, and French, in particular. To our knowledge, the present study is the first to address the issue of determiner use by directly contrasting French with two different Germanic languages and to generate hypotheses on typological or idiosyncratic differences among these three languages.

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Our investigation uses dynamic systems theory, which views developmental processes as non-linear dynamic systems, characterized by complexity, non-linear change and self-organization (see Bassano & Van Geert, 2007; Van Geert, 1991, 1994, 2008; Van Geert & Van Dijk, 2003). A dynamic systems model describes the variables as a network of connected forces that influence one another over the course of time. Any variable – for instance, the child's determiner use – can be treated as a dynamic variable in such a network, with the adult's determiner use acting as another, connected, variable. A dynamic systems model generates predictions of long-term processes, which need to be validated by means of longitudinal data from individual participants (or parent–child dyads). Accordingly, we chose to work on longitudinal data from individual children because this type of data gives access to the developmental changes and phenomena we are looking for here, such as explosions, regressions, (inverted) U-shaped curves or peaks of frequencies. These phenomena are important because they are indicative of underlying developmental mechanisms and dynamic processes such as developmental transitions. Dynamic systems models aim to explain how one step or state in a developmental process develops into another step or state over the course of time. They provide a mathematical formulation of hypothesized developmental mechanisms and generate process models that can be tested against the available empirical data. The main advantage of the type of dynamic system used in this article is that it provides an explicit and deductive model of long-term change; its main disadvantage is that it confines itself to broadly defined variables such as determiner use, and thus requires an additional qualitative analysis of the data.

The comparative perspective taken in the study is twofold, applying to the children and to the language addressed to the children (input). First, the comparison between the children's productions is aimed at providing evidence for general vs. more specific aspects of determiner acquisition by putting forward similarities and differences in the determiner acquisition patterns. The overall assumption is that similarities among the children indicate general aspects of the developmental processes, while differences indicate aspects related to the specific language or to individual characteristics. Of course, as data from only one child in each language are available in the study, it is difficult to distinguish between language-related and individual-related patterns. However, the typological description yields indices consistent with the interpretation that those differences predicted by the cross-linguistic model are language-related specificities.

Second, analyses of naturalistic child-directed speech (CDS) allow for direct comparisons between the child's output and his/her input, as well as among the different inputs. Input–output comparisons might provide evidence for specific developmental processes occurring in child language and not in the caregiver's adult language. On the other hand, input–output correspondences may be informative of possible input effects in children's construction of grammars. We propose a new modelling approach for addressing the relation between input and output and focus on the process of parental adaptation. We argue that CDS is the result of a transactional process of dynamic adaptation between the child and the adult. The adaptation is dynamic in that 'output', i.e., the child's actual production of language, changes as a consequence of the 'input' (the ambient, perceived language), whereas properties of the input change as a consequence of properties of the output.

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In what follows we present a typological description of determiner systems in the three languages, a review of relevant acquisition studies on Romance and Germanic languages and, finally, our hypotheses and expectations.

Determiner systems in French, Dutch and German: Main differences

All three languages studied here are article languages that use obligatory determiners preceding nouns, except in certain contexts where determiners are avoided. However, the three languages differ with respect to these contexts. The most striking differences oppose the two Germanic languages to French in how they refer to non-specific entities. In contrast to French, Dutch and German have no plural indefinite articles (e.g., F. *des enfants*, D. *kinderen*, G. *Kinder* 'children'). Moreover, they avoid articles before mass nouns, where French commonly uses determiners, such as specific partitive articles resulting from the contraction of the preposition and the definite article (e.g., F. *boire du lait,* D. *melk drinken*, G. *Milch trinken* 'to drink milk'). Thus, French has a much greater presence of articles than Dutch and German, which both allow more frequent bare nouns in argumental positions.

Regarding prosodic properties, French contrasts strikingly with both Germanic languages. French is classified as a syllable-timed language with a clear preference for iambic prosodic structures (phrase- or word-final accent), whereas Dutch and German, like English, are stress-timed languages with a preference for trochaic word structures (word-initial stress). While there is a universal binary preference for disyllabic words, French has a higher proportion of monosyllabic words than Dutch and German, which have more multisyllabic nouns. This is one symptom of French being more similar to the isolating language type and less similar to the inflecting-fusional language type than Dutch and German (Kilani-Schoch & Dressler, 2001, 2005). Finally, French determiners are all monosyllabic and unaccented words: they are proclitic and tend to be regularly prosodified with the following noun. When the noun is monosyllabic, the determiner and the noun can form an iambic disyllabic structure (e.g., *le chat* 'the cat'). In Dutch and German, determiners do not always form a prosodic unit with the following noun (Booij, 1995; Guasti et al., 2008; Kupisch, 2008; Lleó, 2001; Lleó & Demuth, 1999). Although articles are most often proclitic, they can be enclitic to the preceding word (generally a verb) if they are reduced. This results in ambiguous models for the prosodification of articles in Dutch and German.

Finally, the three languages vary strongly with respect to the morphological complexity and transparency of their determiner systems. French determiners are marked for number (singular and plural) and for two genders (masculine and feminine) in the singular. The German system is much more complex, since, in addition to number, it encodes three genders (masculine, feminine and neuter) in the singular, and four cases. The Dutch system has evolved from three genders to a system with two genders, neuter and non-neuter, in which case forms occur only in fossil expressions. As a result, the Dutch system is more simple and has less phono-morphological salience than the German system. In all three languages, there exist homophonies which reduce the number of different phonological forms and introduce polyfunctionality, particularly in German. Focusing on articles, Appendix 1 summarizes the paradigms of the three languages.

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Determiners in acquisition: The contrast between Germanic and Romance languages

Studies on English determiner acquisition have generated opposing theoretical positions, in line with Universal Grammar approaches (Valian, 1986; Valian, Solt & Stewart, 2009) or with gradualist models (Pine & Lieven, 1997; Pine & Martindale, 1996). In recent years, several comparative studies of the typological contrast between Germanic and Romance languages have shown that the timing in determiner omission and appearance varies across these two types of languages (Guasti et al., 2008; Kupisch, 2007, 2008; Lleó, 2001; Lleó & Demuth, 1999; Rozendaal & Baker, 2008; Van der Velde, 2004). The Germanic/Romance contrast is of particular interest because both types of languages use obligatory determiners before nouns but differ along a number of properties which are consistent with an earlier development of determiners for Romance languages. A constant finding across studies is that determiner omission is more frequent and enduring in the Germanic than in the Romance languages. Lleó and Demuth (1999) and Lleó (2001) found that Spanish-acquiring children produce proto-articles at an earlier age than German-acquiring children. Comparing Dutch with Catalan and Italian, Guasti et al. (2008) found that Catalan- and Italian-speaking children reach a high level of article use (75%) earlier than Dutch-speaking children, who show higher omission of articles during the whole developmental course. Finally, comparing German with French and Italian, Kupisch (2007, 2008) found that children acquiring German showed higher rates of early determiner omission than children acquiring French and Italian, while the difference between French and Italian was not very pronounced.

Among explanations of the cross-linguistic Germanic–Romance variation, prosodic and syntactic-semantic mapping accounts were the most frequent (Bassano et al., submitted; Guasti et al, 2008; Kupisch, 2007; Lleó, 2001; Lleó and Demuth, 1999; Van der Velde, 2004). These studies point out that Germanic languages display mismatches between prosody and syntax and between syntax and semantics of nouns, contrary to Romance languages, French in particular.

Variation in input

Children acquiring Germanic and Romance languages are exposed to CDS that varies with respect to determiner use and bare nouns. While Germanic languages lack determiners for indefinite plural and avoid them with mass nouns, Romance languages have a much more regular use of determiners with nouns. Investigation of the influence of the input (CDS) frequency of bare nouns on determiner development has obtained mixed results. Kupisch (2007) found a significant contrast in the token frequency of bare nouns between Romance languages (French and Italian) and German, but she emphasized that token frequency alone is insufficient to account for cross-linguistic differences in the rate of determiner acquisition. Guasti et al. (2008) observed that adults' use of bare nouns in CDS did not change during development. Moreover, the proportion of bare nouns in the caregivers' speech was not different in the investigated languages (Catalan, Italian and Dutch). The authors concluded that children's determiner omission is not input-driven, at least not in a superficial sense. It must be noted that these studies varied in the count of

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bare nouns (for instance, Kupisch's count excluded proper nouns, while Guasti et al.'s count depended on the language). These mixed results suggest that further research is needed to shed light on the role of the input in children's determiner acquisition.

Monolingual acquisition of determiners

With respect to German, Penner and Weissenborn (1996) reported that children's first productions of proto-articles and articles appeared at about 1;10 in Bernese German and High German. They argued in favour of an early acquisition of the syntactic structures of the determiner phrase (acquired before morphological regularities concerning inflectional paradigms), in line with the strong continuity hypothesis. Morphosyntax is a central concern of many studies on German determiners, and on how children acquire case, gender and number morphology (Bittner, 2006; Koehn, 1994; Korecky-Kröll & Dressler, 2009; Mills, 1986; Szagun, Stumper, Sondag, & Franik, 2007; Tracy, 1986; Wittek & Tomasello, 2005).

The picture is different for Dutch children's use of noun phrases (Gillis & De Houwer, 1998). Studies on early determiners in Dutch-speaking children have paid attention to how rhythmic constraints influence omission or realization of determiners (Wijnen, Krikhaar, & Den Os, 1994), as well as to how fillers – that is, schwa-elements resembling articles and likely to be precursors of grammatical morphemes – are affected by rhythmic and positional constraints, or by lexical environment (Taelman, Durieux, & Gillis, 2008).

Studies of acquisition in French have focused on how the grammatical distinction between nouns and verbs emerges in young children (Bassano, 2000; Bassano & Eme, 2001; Bassano et al., 2008; Veneziano, 2003; Veneziano & Sinclair, 2000). French has poor noun morphology and the acquisition of the determiner use constraint is a central aspect of the development of the grammatical category of nouns. Bassano et al. (2008) relied on analyses of cross-sectional data from 20 children aged 1;8, 2;6 and 3;3, and concluded that grammatical development of nouns is a gradual process. This process starts early, involving transitional structures, such as early prenominal fillers, and goes on with increasing diversity in the content and context of determiner use. Analyses of prosodic and lexical factors in determiner use suggest that prosodic influences predominate in the first steps of the developmental process in French, while lexical influences might emerge in later steps.

Study of the three children: Cross-linguistic predictions and hypotheses

The central purpose of the present study was to compare the three children on the basis of the Germanic–Romance contrast: to what extent will the two children acquiring Germanic languages – Dutch and German – be similar to or different from the French-acquiring child and to what extent will they differ from each other?

With respect to the first issue – when and how is the determiner use constraint acquired by the three children – the typological description and previous acquisition studies suggested that determiner use should emerge earlier in the French-acquiring child than in her

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Dutch- and German-acquiring counterparts. We expected also that determiner omission should be less frequent and less enduring in French. However, it is unclear from previous studies how the two Germanic languages, Dutch and German, should differ one from each other in respect to determiner use and beyond the comparison with French. The present study should shed light on this question.

The second issue – concerning the structure and possible role of the input with respect to determiner use – is controversial. If CDS conforms to the typological description, proportions of bare nouns should be higher in both Germanic languages than in French, which is more restrictive with respect to the determiner use constraint. However, we saw that studies contrasting Germanic to Romance languages showed mixed results. By using similar categories and methods of analysis, our present study should allow reliable comparison between French, German and Dutch inputs and provide information on which kinds of bare nouns are found in the corpora.

In addition, we propose a new approach that uses modelling analyses to investigate the possible dynamic relations between changes in input and output variables in determiner use (a process we call adaptation, or fine-tuning, accommodation, etc.). For instance, it is known that the parent's level of adaptation to the mean length of utterance (MLU) of the child (in terms of parental MLU in CDS) appears to depend on the child's current linguistic level (Phillips, 1973; Van Dijk et al., submitted). The aim of the study is to show whether and possibly how adaptation applies to the development of determiner use. For example, one might expect that children would initially omit determiners, although they would vary in frequency and duration of determiner omission. If caregivers adapt to the child's level, they can judge, in due course, that the child now knows quite a lot of words and needs to refine his/her productions. Does this lead to a surge in caregiver determiner modelling around a certain level of child output? Such issues are addressed by our modelling analyses.

Method

Participants

The database consisted of longitudinal speech corpora from three monolingual children: one girl acquiring French, one boy acquiring Austrian German and one girl acquiring Dutch. The French girl, Pauline, was the youngest of four children in a middle-class family living in a middle-sized city in the north of France. The Austrian boy, Jan, was the younger of two children in a middle-class family living in Vienna. The Dutch girl, Jessica, was the second child in a middle-class family living in the north of the Netherlands. The participating families were recruited through direct relationships or through informal contacts.

Data collection and sampling

Although they were collected independently for previous research,[1] the three children's data had been obtained using a similar method based on spontaneous speech sampling under naturalistic conditions. Each child was audio- or video-recorded at home two or

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three times per month during everyday activities (such as eating, washing, playing, picture book reading, etc.) in unstructured interactive sessions. In addition to the mother, other members of the family could be present, as well as an observer (familiar to the child and parents) who operated the camera. The French girl was recorded from 1;2 to 3;0, the Austrian boy from 1;3 to 3;0 and the Dutch girl from 1;6 to 2;6 (with an additional recording a 2;10). Transcriptions were made according to the CHAT format (MacWhinney, 2000). All child and child-directed adult speech was transcribed (orthographically and, if necessary, phonetically) and indications were provided about the situations, contexts and gestures.

Analyses were conducted on monthly child speech samples consisting of 120 utterances selected from transcriptions in each corpus. As there was generally more than one observation in one month, we selected 60 utterances from two different sessions recorded during the month. Utterances were defined as the vocal productions that were prosodic and meaningful units, including at least one element resembling a word of the respective language. Vocalizations, babbling, incomprehensible productions and singing were excluded from the samples. Imitations, repetitions, yes/no were included. The monthly CDS samples consisted of 100 utterances (two sets of 50 utterances) directed to the child in the part of the session selected for the child. In Pauline's and Jan's corpora, the input samples always consisted of the mother's utterances. In Jessica's corpus, they consisted of either the mother's or father's utterances, because both parents participated roughly equally in the sessions.

Coding systems

All speech samples were coded for noun constructions. We considered as nouns in child productions those terms that are nouns in standard adult language. In order to clearly distinguish nouns from other categories, in particular from adjectives, we used a strict categorization of nouns. For example, in all three languages, the noun/adjective distinction was not obvious in cases of colour terms, which could be either colour names (e.g., F. *Prends le/du bleu*, D. *Neem het blauw*, G. *Nimm das/vom Blau* 'Take the (colour) blue') or adjectives correctly used with ellipsis of the governing noun (e.g., F. *Prends le (crayon) bleu,* D. *Neem de blauwe*, G. *Nimm den Blauen* 'Take the blue (pencil)'). We decided to include colour name uses in noun count, but to exclude adjectives with ellipsis of noun.

Noun constructions were analysed using four main categories. Two of them concerned nouns used without determiner. A first 'correct bare noun' category corresponded to cases in which a determiner is not required in the standard adult language. The content of this category depends in part on the language. In all three languages, it is likely to include proper names (although Austrian German uses the definite article before proper names), nouns used as proper names in particular contexts (such as 'mummy', 'daddy', 'baby', etc.), nouns within formulaic expressions (e.g., French *avoir faim* 'to be hungry', Dutch *op tafel* 'on the table', German *Bauchweh kriegen* 'to get a stomach-ache'), nouns used within certain prepositional constructions or other syntactic constructions (e.g., vocative, predicative, role constructions) and, finally, nouns used without determiner for contextual reasons (e.g., citation, correction, breaking in with the determiner produced in the preceding utterance). In addition, for both Germanic languages, it included mass nouns

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(e.g., D. *wil je jogho* 'do you want yoghurt', G. *sie trinken Wasser* 'they drink water') and indefinite plural nouns (e.g., D. *aardappels koken* 'cooking potatoes', G. *da sind Autos draußen* 'there are cars outside'). By contrast with the 'correct bare noun' category, the second category, 'determiner omission', corresponded to cases in which an obligatory determiner was lacking, whereas it is required in the standard adult language.

The third category, 'filler use', typically found in children, consisted in producing the noun with a preceding monosyllabic item, probably a placeholder for a determiner lacking in specification, for example, F. [ə] *chat* '/fill/ cat', D. [ə] *beer* '/fill/ bear', G. [ə] *Maus* '/fill/ mouse'. Conditions for categorizing a prenominal item in 'filler use' were that: (1) this item differed from an adult-like determiner in phonological realization and in generality (it is used for various adult target forms); (2) it was not obviously part of the beginning of the following word (e.g., F. *(l)apin* is interpreted as *lapin* 'rabbit' rather than *[a] (la)pin* 'filler rabbit); and (3) the item was not another part of speech, such as exclamation, preposition or copula. The distinction between articles and fillers was not easy, in particular for French and Dutch, because of the resemblance between certain articles and fillers: all French and Dutch articles are monosyllabic, and in Dutch all contain a schwa, i.e., the form [ə]. One additional difficulty was to determine when a prenominal item was a filler precursor of determiner rather than another element of the utterance (e.g., F., [ə] *chat* could be *un/le/les chat(s)* or *est chat* 'is cat'). In such cases, the decision was made on the basis of the probability of appearance of one or the other part of speech in the context (of course, this procedure could lead to some over- or under-estimation of fillers considered as precursors of determiners).

Finally, the 'determiner use' category corresponded to the production of a well-formed adult determiner, which could be subclassified into definite or indefinite, demonstrative or possessive determiners (for example, F. *le chat* 'the cat', *un gâteau* 'a cake', *cette viande* 'this meat', *ma maison* 'my house'; D. *de tak* 'the branch', *een bal* 'a ball', *deze pop* 'this doll', *mijn knikker* 'my marble'; G. *der Ball* 'the ball', *ein Auto* 'a car', *dieses Mikrophon* 'this microphone', *unser Haus* 'our house'). For general quantitative analyses, in addition to correct determiners, the 'determiner use' category also included incorrect determiners (e.g., with gender or number error), as well as other minor and infrequent erroneous subcategories (e.g., producing a determiner with the noun when the determiner was not required).

The whole series of coding was performed on each of the three corpora by the French, the Austrian and the Dutch team, respectively. However, all the methodological questions raised with respect to one of the corpora were discussed among all the three teams to ensure consistency in data coding. The reliability of the procedure was assessed through various means by double-checking within each team; initial agreements were invariably high (80–90%) and disagreements were resolved in discussion.

Data analyses

Developmental analyses of noun constructions and determiner use consisted mostly of describing and comparing children's individual trajectories on the basis of the relative frequencies of the categories under study. Modelling was based on the raw input and output frequencies. Raw data for each individual child and parent were smoothed by

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means of non-linear smoothing procedures (see later). Subsequently, a dynamic model of the mutual connections between growth of determiner use in the child (output) and adaptation of parental determiner input was formulated.

Results

The results are organized in three sections. A short first section gives an initial frame for the subsequent core analyses by providing an overview of some relevant general variables. The second section analyses noun constructions and the development of determiner use in the three children and in their inputs. Finally, the third section uses modelling techniques to explore the dynamic relationships between determiner use in the children and in their inputs.

Initial frame for comparing the three children

Children were compared on the basis of MLU in words, number of noun types (lemmas) and number of noun tokens (see Appendix 2a for the children and 2b for corresponding inputs). The three variables increased across time in all three children. The three children had similar MLU scores until around 2;0. However, while Pauline and Jan showed similar developmental trajectories from 2;0 to 2;6 (afterwards, Pauline had higher scores than Jan), Jessica had a clearly slower MLU development than the other two children. The developmental trajectories of noun types were roughly similar in the three children, although between 1;10 and 2;4 Jan had slightly higher scores than the other two children, and Pauline slightly higher scores afterwards. With respect to noun tokens, the three children had similar scores until 1;8. Between 1;10 and 2;6, Jan had much higher scores than the other two children, and Pauline higher scores afterwards.

In summary, the Dutch child has delayed development in MLU from 2;0 to 2;6, the Austrian child has a higher production of noun tokens in roughly the same age period, and the French child has slightly higher scores in MLU, noun types and noun tokens in the last months.

Noun constructions and the development of determiner use

Description of noun constructions in the three children. The four noun constructions showed differences in frequencies and developmental patterns. In the French child, correct bare nouns did not present clear developmental changes and formed around 30% of all nouns, despite relatively strong local fluctuations mostly apparent in the first period. The other three categories changed markedly across age. Determiner omission concerned around 60% of all nouns until 2;0, progressively decreased, showing strong local fluctuations, and quite completely disappeared from 2;6 on. Prenominal filler use showed an inverted U-shape. It concerned around 25% of nouns between 1;6 and 2;0 (with a peak of almost 30% at 1;8–1;9), and completely disappeared from 2;4 on. Finally, determiner use remained infrequent until 2;0 (less than 10%) but showed a sharp explosion from 2;3–2;5 on as it reached 65–70%. Thus, as early as 2;5, the French child produced only the two adult noun constructions which showed no further variation: correct bare nouns, forming around 30–35% of nouns, and nouns used with determiner, forming around 65–70%.

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In the Austrian child, correct bare nouns showed local fluctuations, without clear developmental change, and formed 23% of all nouns. Interestingly, except for three cases (at 2;0, 2;4 and 2;5), prenominal filler use was almost absent. As a consequence, the other two categories showed strikingly contrastive developmental changes. Determiner omission was strongly predominant at first, applied to more than 70% of all nouns until 2;0. It decreased sharply thereafter, concerning only 10% of nouns at 2;2 and continuing to decrease, with sparse omissions in the last months. In contrast, determiner use was absent from Jan's productions until 1;10, and showed a sharp explosion from 2;1–2;3 on as it reached 70–80% of all noun constructions. In the Austrian child's data, as in the French child, the two main adult noun constructions were steadily set up from 2;5 on: correct bare nouns formed 20–25% of nouns and nouns used with determiner, 70–75%.

Finally, in the Dutch child, correct bare nouns remained highly variable across the entire trajectory. They oscillated between 10% and 60% of all nouns, with an average of 35%. Determiner omission concerned around 40% of nouns until 1;10 and seemed to decrease thereafter, but continued to show strong fluctuations, keeping a 15% level in the last observations. Filler use showed a slight inverted U-shaped curve, presenting a maximum around 45% at 2;2, but was frequent during the entire trajectory, with an average of 22%. Determiner use remained infrequent until 2;2 (less than 20%). It showed a clear increase at 2;3–2;5, but reached only 20–25%. So, at 2;6, the distribution of the Dutch child's noun constructions clearly differed from that of the other two children: correct bare nouns had the highest frequencies (around 50%), nouns used with determiners were still infrequent (around 25%), while proportions of determiner omission (around 15%) and filler use (around 8%) remained relatively important.

Similarities and differences across the children. Our following step is to highlight the similarities and differences between the children, regarding the Germanic/Romance contrast hypothesis. A first similarity lies in the developmental shape of determiner use. As described above, the frequency of determiner use increased markedly after 2;0 in all three children, taking the shape of an explosion that, however, varied in timing and amplitude across children. The determiner use explosion is clearly present in Figure 1, which shows the development of determiner use in obligatory contexts (a classical index calculated by dividing the number of nouns used with determiner by the number of nouns requiring determiner in the target language, i.e., excluding correct bare nouns, as well as the few cases of non-required determiner use). The Austrian boy showed the sharpest and earliest explosion (getting a 0.80 value at 2;2), the French girl closely followed (getting the same value at 2;4), and both were at ceiling as early as 2;5–2;6. The Dutch girl showed a later and attenuated explosion (0.50 at 2;5–2;6). The development of determiner use presented a more limited explosion than the other two children, but since Jessica's data are limited to age 2;6, it is not possible to know when and how she will have reached ceiling value. So, by 2;5–2;6 the Austrian and the French child have acquired the constraints on determiner use, while this is not the case for the Dutch child.

The filler use pattern shows less similarity between the children. While the Austrian boy used almost no prenominal fillers, the French girl used them with relatively high frequency (8% of noun constructions on average) and the Dutch girl with very high frequency (22% on average). In both girls, filler use showed an inverted U-shaped curve,

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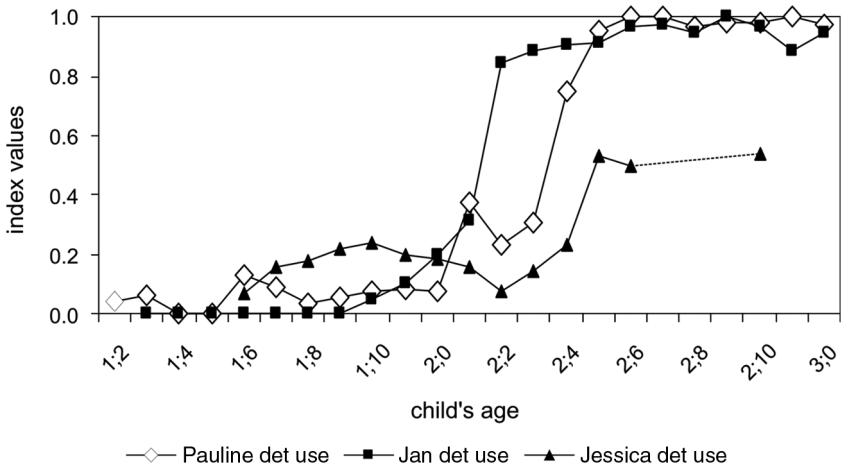

Figure 1. Development of determiner use in obligatory contexts in Pauline (F.), Jan (AG.) and Jessica (D.)

Note: In Jessica, simulated missing values are connected by dashed lines.

which was particularly clear in Pauline. The production of fillers was lower and lasted less time in Pauline than in Jessica, reaching a peak earlier in Pauline (around 30% at 1;8 and another one at 2;0) than in Jessica (around 45% at 2;2). In both girls, the decrease in prenominal filler production co-occurred with the increase in determiner production. These results suggest that filler use is a transitional procedure that differs among children and in part 'compensates' for the lack of adult-like determiners. Figure 2 illustrates this interpretation by showing the development of filler/determiner use in obligatory contexts. This 'generous' measure of noun grammatical development cumulates filler use and determiner use constructions. In the Austrian child, the generous measure does not differ from the strict measure (Figure 1) because Jan does not produce nearly any fillers. In the French and the Dutch children, it presented similar progressions from 1;6 to 2;5, showing a regular increase that contrasts with the strong determiner explosion observed in the Austrian boy.

Linguistic structure of the inputs. The children's inputs showed only the two main adult noun constructions, correct bare nouns and determiner use (except the Dutch input which presented determiner omissions until 2;0).

In all three inputs, correct bare nouns as well as nouns used with determiner showed local fluctuations, but did not change across time. In the French input, the proportion of correct bare nouns oscillated between 10% and 50% with an average 31%, and the proportion of nouns used with determiner between 50% and 90% with an average 69%. These proportions are close to the proportions found in the child's data in the last period of the corpus. In the Austrian German input, correct bare nouns and nouns used with determiner presented contrasting frequency profiles, in correspondence with the last

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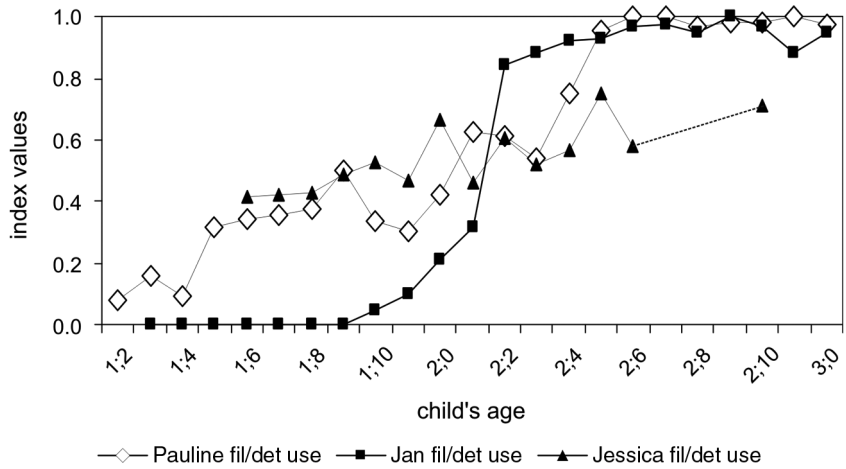

Figure 2. Development of filler/determiner use in obligatory contexts in Pauline (F.), Jan (AG.) and Jessica (D.)

Note: In Jessica, simulated missing values are connected by dashed lines.

period of Jan's data. Correct bare nouns formed on average 18% of nouns and determiner use 82%. Finally, the Dutch input presented relatively high and strongly fluctuating proportions of correct bare nouns (average 38%). Determiner use also fluctuated, overall higher (average 55%) than correct bare nouns. While the overall stability in the inputs is also found in the children with respect to correct bare noun production, it contrasts strongly with the children's explosions in determiner use. Such a discrepancy indicates that the appearance of determiner use is a real developmental phenomenon, which does not seem to be obviously determined by a clear change in the input. However, the local fluctuations exhibited in the three inputs need to be further explored.

The average frequency of determiner use constructions in the input shows individual variation (82% of nouns in Jan's input, 69% in Pauline's input and 55% in Jessica's input). These differences in input frequencies correspond with the differences mentioned above concerning the timing and amplitude of determiner use explosions in the children. Individual variation is also found in the average frequency of correct bare nouns (18% in Jan's input, 31% in Pauline's input and 38% in Jessica's input). This hierarchy mirrors that of the children's production of correct bare nouns. These numbers suggest that there exists a good input–output correspondence in determiner use vs. correct bare noun productions in all three corpora. They also show unexpected input frequencies: percentages of correct bare nouns were higher in the French and Dutch inputs than in the Austrian German input.

To better understand this point, we looked at the nature of correct bare nouns in the different language inputs. Of the 447 correct bare nouns produced in the French input to Pauline (23 speech samples), 34% were proper names and 22% were nouns used as proper names (one-third in vocative constructions). Other large parts were idiosyncratic

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expressions (18%) and prepositional constructions (20%). The remaining 6% were contextual uses, such as citations, corrections, interruptions, etc. Turning to the 218 correct bare nouns produced in the Austrian German input to Jan (22 speech samples), we found that 32% were proper names (one-half in vocative constructions), while only 2% were nouns used as proper names. Only 6% were idiosyncratic expressions, 5% prepositional constructions and 6% pure vocative or exclamative constructions. In contrast, 25% were indefinite plurals and 12% were mass nouns. The remaining 12% were contextual uses. Finally, of the 240 correct bare nouns produced in the Dutch input to Jessica (14 speech samples), 51% were proper names (one-third in vocative constructions) and 11% were nouns used as proper names. Only 5% were expressions, 5% pure vocative or genitive constructions and 3% contextual uses. In contrast, 14% were indefinite plurals and 11% were mass nouns. From this analysis it emerges, on the one hand, that bare nouns involved high frequencies of proper names in all three inputs, and, on the other hand, that they consisted of a good number of indefinite plurals and mass nouns in both Germanic inputs, that were absent from the French input which contained more idiosyncratic expressions and prepositional constructions.

In summary, the above comparisons reveal striking similarities in the shape of development among the three children with respect to determiner use and correct bare nouns and, to less extent, filler use, whereas clear differences appear in frequencies and timing of development. Similarities in shape and differences in relative frequencies are also apparent in the three inputs with respect to determiner use and correct bare nouns. Descriptive comparison suggests that there exist subtle input–output relations that will be further examined with modelling techniques below. Furthermore, the comparisons among the three corpora show that the picture of similarities and differences is too complex to be mapped immediately and directly onto the general Germanic/Romance contrast.

Modelling dynamic relations between determiner use in the child and the input

In order to study the occurrence of long-term adaptations in determiner use in CDS, we need to take into account that such changes are likely to be non-linear and dependent on the child's level of determiner use. The data analysis must capture long-term trends while remaining sensitive to local or temporal changes in the relationship between input and output. We suggest two methods. First, we employ descriptive smoothing techniques to visualize the long-term process of input–output adaptation. Second, we present a dynamic model of adaptation and simulate the data in order to obtain an estimation of the model's adaptation parameters.

Data smoothing and visual correspondence analysis. Smoothing techniques can be employed to reduce local variation in the data and to reveal non-linear long-term trends (Simonoff, 1996). The determiner data from the three children and parents were smoothed by means of the Savitzky–Golay algorithm, with optimized window length. Smoothed data from the child and parent are then normalized (minimum = 0, maximum = 1) to compare parental input and child output on the basis of the form of the curve, discarding the eventual quantitative differences (Figure 3).

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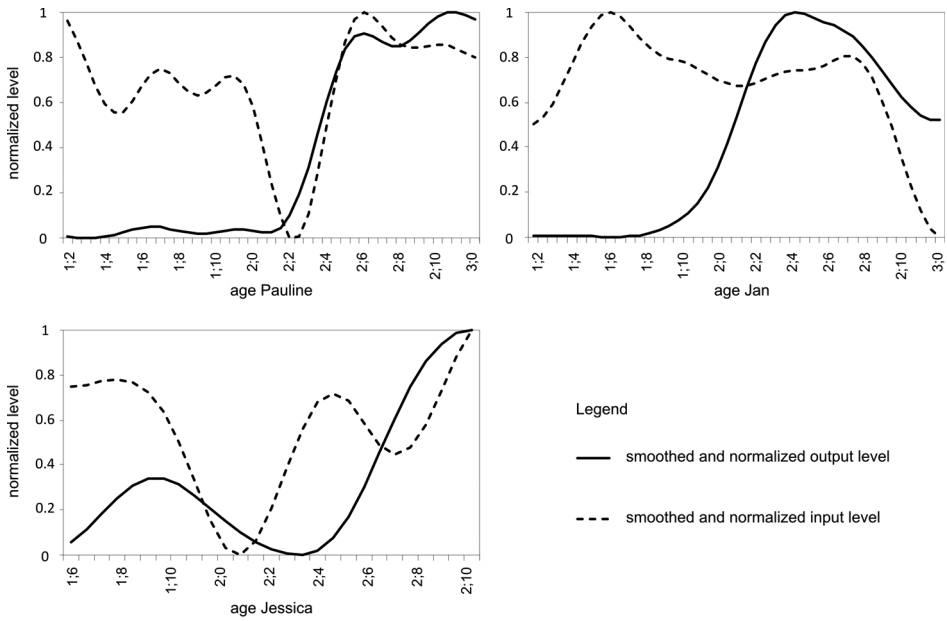

Figure 3. Smoothed and normalized curves (minimum value = 0, maximum value = 1) for determiner use in the child's output and parental input for Pauline (F.), Jan (AG.) and Jessica (D.)

Before comparing the curves, we should remember that Pauline and Jan's trajectory of determiner use covers growth from beginning to end, in that both reach the determiner frequency of their parental input. The Jessica data, on the other hand, come no further than about half of the parent's determiner frequency.

The qualitative patterns are very different for the three children. In Pauline's case, input first slowly adapts to Pauline's low, initial level of determiner use, and then follows almost exactly her rapid growth of determiners until she has reached the parental input level. Jan's trajectory of determiner use shows an anomaly in that, after a rapid increase up to the level of parental input frequency, use of determiners drops rather dramatically. The input trajectory is to a certain extent the inverse of the child's trajectory, since the fluctuations are opposite to the changes in the child's determiner use. After an initial increase (not mirrored by any increase in the child), a decrease occurs that corresponds with the rapid growth of determiner use in the child, followed by another increase as the child's determiner use starts to decrease, and finally a corresponding decrease both in input and output. The final decrease in determiner use is probably related to a local prominent use of correct bare nouns in the last sessions. Finally, Jessica's data show adaptation in the first phase, in the form of a significant reduction in input (as compared to the parent's habitual level of determiner use), followed by a rapid increase that does not correspond with the child's determiner growth. The input frequency then decreases again, to increase right after the onset of determiner growth in the child. Although the overall developmental trajectories are different, a common pattern in the three children

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is the decrease in determiner use in the input before the spurt in the children's determiner use. This pattern is particularly clear in Pauline's case, but it is also apparent in Jessica's data, and, to a lesser extent, in Jan's data.

In order to obtain a better insight into the correspondence between input and output over the long-term, we can compare the rates of change of the input and output function as they themselves change over time. Close adaptation to the output means that increases or decreases in input correspond with increases or decreases in the output. In Pauline, the correspondence between long-term increases and decreases in determiner use is truly amazing. Jan's data show that extremes of change in the output correspond with zero change in the input and vice versa, except for the last part of the curve where the changes do correspond (due to the decline in both input and output). Growth rates in Jessica further strengthen the impression that the relationship between change in input and output is complementary: the single growth peak of output lies between the two peaks in the change of the input. These complementary relationships may correspond with timing properties in the input: changes in the input may precede changes in the output by several months. Thus, while close correspondence in changes in input and output, such as with Pauline, suggest a direct process of more or less immediate fine-tuning of the input to the output properties (and eventually also vice versa), Jessica's data suggest a process of complementary adaptation. Jan's data show an anomalous pattern, which is closer to the complementary type than to the direct type.

Finally, we inspected the association between the variability in parental input on the one hand and the occurrence of the growth spurt of determiner use in the children. Variability is defined as the amount of difference between the observations and the corresponding value of the smoothed curve. Pauline's data showed a significant drop in parental variability corresponding with the spurt in determiner use. Both Jan and Jessica showed an increase in parental variability at the beginning of the growth spurt, corresponding with the fact that parental input in Jan's and Jessica's case follows a complementary pattern with output, whereas Pauline's input closely matches the output characteristics.

Dynamic modelling of input–output relationships. To investigate further the relationships between determiner input and output, we have fitted a dynamic model of parental adaptation. The model is an extension (with some simplifying assumptions) of a dynamic model of scaffolding (Van Geert & Steenbeek, 2005) and is explained in detail in Van Dijk et al. (submitted). Scaffolding is a general form of educational support, involving the adaptation of the educator to the performance level of the child, while staying ahead of the child's level. Change in the child's performance is based on a process of growth, in which the adult's level of performance acts as the attractor level for the child's performance. The present model refines this general scaffolding model and describes a system of three coupled equations. The child's determiner growth is represented in the form of one equation, based on the standard logistic growth equation (Van Geert, 1991, 1994). An important parameter in this model is the carrying capacity, which is the level at which growth stabilizes. Since determiner growth implies that the child will somehow approach or eventually reach the parent's habitual level of determiner use, the carrying capacity parameter in the child's growth model refers to the parental input level (this represents the coupling of the output level equation to the equation governing parental input). The

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second equation in the model specifies the parental input, i.e., the frequency of determiner use in CDS. Parental input level depends on the parent's habitual level of determiners (in colloquial, non-CDS), the child's current level of determiner use and finally, the parent's tendency or willingness to adapt the input level to the child's level. The final equation models the parent's tendency to adapt, which is a covert or latent variable. The tendency to adapt to the child's level can differ among parents, but it may also change over the course of the child's determiner acquisition process. For instance, some parents may show only a very low tendency to adapt their determiner input level to the child's as long as the child does not show any particular use of determiners. As determiners begin to appear in the child's language, the parent's tendency to change determiner frequency in the input may increase. Note that the actual adaptation (the second equation) is a product of the parental tendency to adapt, on the one hand, and the distance between habitual parental level and the child's output level, on the other hand.

The simulation results are presented in Figure 4. The model for Pauline closely corresponds with the data: the tendency to adapt to the child's level gradually increases (curves coming closer to one another), then disappears again as the child reaches the parental level. Jessica's best fitting model suggests that determiner input at the beginning was already strongly adapted to the child's level (showed by the sharp drop in the first data point, which represents the distance between the parent's estimated habitual determiner

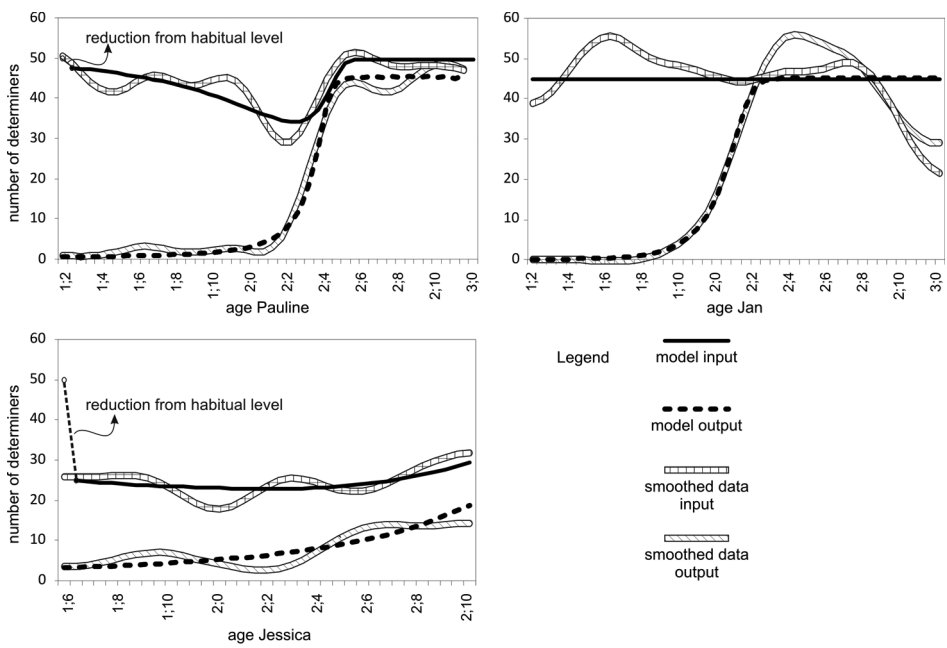

Figure 4. Comparison between smoothed input and output curves and curves resulting from the dynamic model of adaptation for Pauline (F.), Jan (AG.) and Jessica (D.)

Note: The shorter dotted line represents estimated reduction from the parent habitual level in non-CDS.

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Table 1. Goodness-of-fit of the model to the smoothed data for output and input in Pauline, Jan and Jessica

	Pauline	Jan	Jessica
R^2 output	.99	.91	.73
R^2 input	.74	.21	.67
p-value of input model fit	.002	.16	.03

level and the determiner level in CDS). Later, adaptation to the child's level gradually increases (note that the growth curve for Jessica reaches only half the level it is supposed to finally reach). It should also be noted that Jessica's model does not capture the apparent peaks in input frequency preceding the onset of determiner use in the child. Finally, Jan's best fitting model shows no adaptation at all. The model curve of parental input is a flat line. The flat line is probably the model's best possible summary of the anomalous pattern in Jan's input (and partially also in the output, which diminishes towards the end).

Table 1 shows the goodness-of-fit of the model with the smoothed data by means of R^2 values. All values are equal to or above .67, except one, which is Jan's input model. *P*-values represent the chance that the input is not adaptive, i.e. that the variations in the input level are merely accidental. As expected from the R^2 value, Jan's input model has a high *p*-value (.16), meaning that the null-hypothesis (there is no adaptation) cannot be rejected. However, inspection of the smoothed data curves suggested that there was adaptation in Jan's case, but that the adaptation was anomalous. The lack of fit of Jan's input model suggests that the principles of linguistic adaptation are not consistent across the period covered by our observations.

In summary, both the adaptation data and the results from the dynamic model simulation show clear evidence of long-term adaptation, although the nature of the adaptation differs among the children. The data suggest a distinction between an accommodation style of adaptation in the French child's case, and a more complementary style in the Dutch and Austrian German child's case, which might suggest a more preparatory or stimulating style of adaptation against a more imitative one.

Discussion

In this study, we took a comparative perspective to investigate the emergence and early development of determiner use in the free speech of three children acquiring Austrian German, Dutch and French, respectively. Our contribution concerns two issues: the development of determiner use and the input–output relations in determiner use.

The development of determiner use: A cross-linguistic account for similarities and differences across children

A first series of predictions relying on the typological description was that determiner use should emerge earlier in French than in the Germanic languages, while determiner omission should be more frequent and last longer in the Germanic languages. In

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conformity with previous studies on French (Bassano, 2000; Bassano et al., 2008; Veneziano, 2003; Veneziano & Sinclair, 2000), we found that the French girl, Pauline, showed an early use of relatively frequent prenominal fillers, a relatively early use of adult-like determiners before the determiner explosion, and complete disappearance of determiner omission from 2;5 on, when she reached the adult level.

The comparison of the German-speaking Austrian boy, Jan, with Pauline fits expectations. Although Jan showed determiner explosion slightly before Pauline and reached the adult level at the same age as the French girl, he did not show early emergence of determiners. He used very few if any prenominal fillers, few if any adult-like determiners before the explosion, and he had initially highly frequent determiner omissions. Overall, Jan's data are in line with the results from other cross-linguistic studies including German-acquiring children. In studies contrasting German with Spanish (Lleó, 2001; Lleó & Demuth, 1999), the development of articles in German was shown to take place half a year later than in Spanish, but the two language groups meet at 2;3. In studies contrasting German with French, Kupisch (2007, 2008) reported clearly higher omission rates in monolingual German- than in monolingual French-speaking children until around 2;6. The developmental patterns shown by Pauline and Jan fit the model of an earlier emergence of determiner use in French than in German, and their reaching an equivalent adult level in the middle of the third year. The early emergence of determiner use in child language is related in part to prenominal fillers, which can be viewed as precursors of grammatical morphemes, although their exact nature is debated (Peters, 2001; Peters & Menn, 1993; Veneziano & Sinclair, 2000). The absence of prenominal fillers in Jan's data does not mean that fillers are not produced at all by German-speaking children. However, it may be that some languages are more susceptible to filler use than others. Fillers are likely to be more frequent in a language such as French, which has many more proclitic elements preceding nouns and main verbs than German (Bassano, Laaha, Maillochon, & Dressler, 2004; Peters, 1997).

The comparison of the Dutch-speaking girl, Jessica, with the other two children is less clear. Jessica showed a later and much more moderate determiner explosion than the other children, and had a much higher omission rate at 2;6. This pattern indicates that she is delayed in the acquisition of the adult level of determiner use as compared to the French child. Jessica's delay in determiner acquisition is in accordance with observations from other studies comparing Dutch to Romance languages. Guasti et al. (2008) reported that Dutch-acquiring children had determiner omission rates (in obligatory contexts) around 20% at 3;0. However, our study also indicates differences between the Dutch and the Austrian child. Before she showed her moderate determiner explosion, Jessica produced frequent prenominal fillers, and adult-like determiners were not infrequent in the first observations. This result indicates that Jessica's late acquisition is associated to a relatively early emergence of determiner use, mostly through prenominal filler use. To our knowledge, this finding has not been noticed in previous comparative studies including Dutch-speaking children. It seems to contradict Guasti et al. (2008)'s study, in which particularly high proportions of article omission were found also in the first periods for the Dutch-acquiring children. This difference between the two studies is probably due to methodological options: Guasti et al. focused on article omission and considered only target-like forms in their assessment of article omission, whereas our study analyses the full range of noun constructions and considers that prenominal filler use contributes to the emergence of determiner use.

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A substantial production of fillers was also reported in a recent longitudinal study of the Dutch girl Cato from ages 1;10 to 2;7 (Taelman et al., 2008). Cato's data contained 623 fillers, and the frequency of fillers passed through a rise and a decline with a maximum around 2;1–2;3. Thus, the comparison between Jessica's and Cato's data shows a strong agreement in respect of the production of fillers. This frequent use of fillers by Dutch-acquiring children can be partly explained by the phonological form of determiners in the target language, in particular articles, which are all monosyllabic clitics containing a schwa or a schwa-like vowel. Like French, and contrary to German, Dutch seems to be a language likely to stimulate frequent fillers in children's production. In addition, the strong resemblance between articles and fillers could also account for the unexpected early production of adult-like determiners in Jessica's data, since the two categories are hardly distinguishable on a phonological basis.

To summarize, the development of determiner use, as predicted, is delayed in Dutch and in Austrian German as compared to French. However, our study shows that the Dutch- and the German-acquiring children differed from each other in their contrast to the French child. While the French child showed an early emergence of determiner use (through prenominal fillers) as well as an early acquisition (i.e. reaching the adult level), the Dutch child showed an early emergence of determiner use, but she was clearly delayed in acquisition. In contrast, the Austrian child showed a late emergence of determiner use, but he reached the adult level as early as the French child. So, when compared to the French child, the Austrian child was delayed in determiner emergence, while the Dutch child was delayed in determiner acquisition. This picture suggests specific language effects in Dutch and German and indicates that the general cross-linguistic model opposing Germanic to Romance languages cannot account for all the differences between the children. Differences between Dutch and German (e.g., morphophonological properties of the determiner systems) result in different acquisition processes. Furthermore, it is likely that individual characteristics of children's developing systems (e.g., Jessica's slower progression in MLU, Jan's almost total absence of fillers contrasting with Jessica's particularly high and late production of fillers), as well as differences in the inputs (low frequency of determiner use in the Dutch CDS contrasting with particularly high frequency in the Austrian CDS), have also to be taken into account.

Structure and role of the input in determiner use: Input–output dynamic relations

The typological model opposing Germanic and Romance languages predicts higher input frequencies of determiner in French than in the Germanic languages, which should show higher frequencies of bare nouns. This expectation was not verified in our data. Determiner use formed 69% of nouns in the French input, 82% in the Austrian German input and 55% in the Dutch input. Correct bare nouns formed 31% of nouns in the French input, 18% in the Austrian German input and 38% in the Dutch input (which, in addition, presented ungrammatical bare nouns). These results indicate, first, that bare nouns were relatively frequent in the French input to Pauline. This was not an individual bias, since similar proportions (30% on average) were found in the cross-sectional study using mothers' utterances addressed to 10 different children (Bassano et al., 2008). Second, the

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proportion of bare nouns was unexpectedly lower in the Austrian German input to Jan than in the French input to Pauline. These results contradict those of other comparative studies. Kupisch (2007) found that bare nouns formed 18% of nouns in German input, a proportion that was significantly higher than proportions in French (6%) and Italian (12%) inputs. On the other hand, Guasti et al. (2008) found no significant differences between Dutch, Catalan and Italian inputs.

The comparison between the different studies is difficult because they vary on what they included in the count of bare nouns, in particular with respect to proper names (e.g., Kupisch's study excluded proper names). To clarify this question, we conducted more specific analyses on the constructions in which correct bare nouns were used in the different language inputs. This investigation showed that bare proper names were frequent in all three inputs, with the highest frequency in the Dutch input. Bare common nouns used as proper names, such as *mummy*, *daddy*, etc., were frequent in the French input and very infrequent in the Austrian input. This may be partly due to the fact that, unlike Dutch or French, Austrian German frequently uses proper names and nouns used as proper names with a determiner, which must result in less frequent bare nouns in these categories (and in less frequent bare nouns overall). When proper names and nouns used as proper names are removed from the count of bare nouns, proportions of correct bare nouns in the three inputs become quite similar: 13% for the French input to Pauline, 12% for the Austrian German input to Jan, 14% for the Dutch input to Jessica. Thus, even with a restricted count, bare nouns were not more frequent in the Germanic languages than in French. However, they differed in nature. In the French input, the most frequent categories (after proper nouns and nouns used as proper names) were frozen expressions and prepositional constructions (together 38%). As expected, they were indefinite plurals and mass nouns in the Dutch input (together 25%) as well as in the German input (together 37%). Thus, the Germanic inputs qualitatively differed from the French input in the predicted way.

Frequencies of determiner uses and bare nouns in the input are generally used for testing the hypothesis that the development of children's determiner use depends on this input variable. Guasti et al. (2008), for instance, found no systematic decrease in the rate of bare nouns in adults' speech during the course of children's development and concluded that children's omission is not input driven. Our initial analyses were in agreement with these observations. They indicated that there were no clear changes in the rate of bare nouns or nouns used with determiners in children's inputs. Thus, it appears that children's explosions in determiner use are not directly caused by developmental increases of determiner use and decreases of bare nouns in their inputs. However, the comparison among the three corpora in these initial analyses showed two noticeable phenomena: there were striking individual correspondences between children and their inputs in overall frequencies of correct bare nouns and determiner uses, and there were striking local fluctuations in all three inputs.

To complement the typological analysis of input and output relationships, we proposed a dynamic modelling approach. This approach shifts from a basic search for direct input effects to an explicit model of transactional relationships between parental and child language. The dynamic models of the three children show clear evidence of changes in the input, signalling long-term adaptation processes. However, the nature of the adaptation differs among the children. Visual inspection of the smoothed data curves showed an

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almost imitative pattern of adaptation in the French input to Pauline, and a complementary pattern in the Dutch and Austrian inputs to Jessica and Jan. Jan's input pattern is anomalous in that it shows opposite adaptation tendencies. The distinction between imitative patterns of adaptation and complementary ones is also obvious in the relationship between variability in the input (changes in frequency between observations) and the growth of determiner use in the child. The French child shows a drop in parental variability corresponding with the spurt in determiner use. Both the Austrian and the Dutch child show an increase in parental variability at the beginning of the growth spurt. Data from the three children corroborated that input frequency drops right before the child's determiner use takes off.

Results of parameter fits supported the dynamic model. Output fits were exceptionally good, input fits were more variable, with Jan's model suggesting no input adaptation. This lack of adaptation is most likely due to the fact that the apparent adaptation is anomalous and dramatically changing over the course of Jan's determiner acquisition.

In sum, dynamic modelling showed that mutual long-term adaptation of parental input and child output is a robust and consistent phenomenon in some children, and considerably less so in others, suggesting that adaptation is an individual strategy of a parent. If adaptation occurs, it shows a number of general properties. We conclude that the acquisition of determiner use in French, Austrian German and Dutch is consistent with the expectations based on the grammatical nature of determiners in the three languages. Our study also demonstrates the importance of differences among individual children and parents that exceed or complement the differences caused by the languages spoken by the children and parents at issue.

Appendix 1: Definite and indefinite article paradigms in the three languages

Paradigms of definite and indefinite articles in French

	Singular		Plural
	Masculine Def. / Indef.	Feminine Def. / Indef.	Def. / Indef.
	le / *un*	*la* / *une*	*les* / *des*

Paradigms of definite and indefinite articles in German

Case	Singular			Plural
	Masculine Def. / Indef.	Feminine Def. / Indef.	Neuter Def. / Indef.	Def.
Nominative	*der* / *ein*	*die* / *eine*	*das* / *ein*	*die*
Accusative	*den* / *einen*	*die* / *eine*	*das* / *ein*	*die*
Dative	*dem* / *einem*	*der* / *einer*	*dem* / *einem*	*den*
Genitive	*des* / *eines*	*der* / *einer*	*des* / *eines*	*der*

Paradigms of definite and indefinite articles in Dutch

	Singular		Plural
	Masculine and feminine Def. / Indef.	Neuter Def. / Indef.	Def.
	de / *een*	*het* / *een*	*de*

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Appendix 2a: Comparative frame: MLU, number of noun types and number of noun tokens in the three children's samples

	Child Pauline			Child Jan			Child Jessica		
	MLU	Types	Tokens	MLU	Types	Tokens	MLU	Types	Tokens
1;2	1.13	12	32						
1;3	1.12	16	55	1.02	14	28			
1;4	1.18	15	52	1.02	15	48			
1;5	1.18	11	39	1.11	19	35			
1;6	1.29	15	44	1.12	18	54	1.12	19	48
1;7	1.42	14	51	1.08	23	41	1.18	24	55
1;8	1.46	24	38	1.13	18	72	1.40	18	53
1;9	1.33	11	30	1.14	24	50	1.41	31	58
1;10	1.47	14	32	1.54	19	59	1.42	14	23
1;11	1.82	19	44	1.71	35	94	1.57	26	42
2;0	1.93	14	36	1.89	25	83	1.54	23	52
2;1	2.00	13	22	2.46	25	83	1.57	21	34
2;2	2.23	18	36	2.38	26	58	1.59	32	53
2;3	2.44	22	47	2.89	33	75	1.73	23	34
2;4	3.30	28	62	3.57	36	68	2.01	18	33
2;5	3.28	35	61	3.33	31	77	2.14	36	68
2;6	4.43	34	71	3.86	30	83	2.16	28	59
2;7	4.22	32	71	2.73	29	47			
2;8	3.71	27	44	3.68	38	74			
2;9	4.96	48	79	2.99	29	51			
2;10	4.42	35	83	3.27	28	42	3.44	34	53
2;11	4.38	40	68	3.42	23	48			
3;0	4.45	36	61	3.15	27	49			

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Appendix 2b: Comparative frame: MLU, number of noun types and number of noun tokens in the three children's input samples

	Input Pauline			Input Jan			Input Jessica		
	MLU	Types	Tokens	MLU	Types	Tokens	MLU	Types	Tokens
1;2	4.24	43	71						
1;3	4.20	29	72	4.09	22	51			
1;4	3.94	35	66	3.44	17	62			
1;5	4.01	34	60	4.33	25	53			
1;6	4.56	39	65	4.57	27	67	3.26	34	58
1;7	4.75	34	73	4.04	27	69	3.31	22	43
1;8	4.74	35	57	4.62	20	55	3.73	24	49
1;9	4.34	31	52	4.54	30	62	2.85	33	49
1;10	3.92	33	47	4.17	27	50	3.24	25	32
1;11	4.82	43	66	4.58	28	69	4.13	31	42
2;0	4.09	32	52	4.19	26	44	3.36	24	31
2;1	4.28	25	45	4.13	19	54	3.47	25	37
2;2	4.72	38	49	4.03	19	46	3.81	31	57
2;3	4.73	26	45	5.02	38	67	4.09	25	43
2;4	4.34	30	49	4.04	24	49	3.89	23	28
2;5	5.36	51	73	4.76	33	63	3.71	23	35
2;6	5.92	48	82	5.66	30	60	4.10	33	52
2;7	6.49	39	96	5.08	31	44			
2;8	6.06	42	74	4.79	32	60			
2;9	5.49	42	73	5.39	30	59			
2;10	5.09	45	61	4.30	19	35	4.73	41	64
2;11	5.76	35	62	5.02	28	40			
3;0	6.02	46	75	4.66	24	42			

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Note

1 For Pauline, data collection (by I. Maillochon) took place from 1991 and 1994. For Jan, it took place from 1999 to 2003 (by K. Korecky-Kröll), and for Jessica from 1998 to 1999 (by M. van Dijk).

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