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Usage-based approaches to child code-switching: State of the art and ways forward

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ABSTRACT

Input-output effects have been the subject of keen research for several decades in the study of monolingual acquisition from a usage-based perspective (Ambridge & Lieven, 2011). However, for bilingual acquisition, similar studies are only beginning to emerge. One major challenge for such studies is to explain why young children switch between their two languages (e.g., *Ich bin ready* 'I am' *ready*) even when they hear no such switching in their input. This article reviews a strand of recent studies in children aged two to three to explain this apparent paradox. It demonstrates how the focus on one aspect of input, the child's own prior speech, can explain *how* and *why* code-switching occurs. The article examines a range of psycholinguistic processes, showing how they drive variation in children's use of mixed utterances. Its main contribution lies in its summative value and the recommendations made for future research in early code-switching.

1. Introduction

A great paradox of bilingual acquisition is that children aged two to three switch their two languages even when these languages are largely separated in their environments. Even when two languages are used in different domains of life, employed by different caregivers, and associated with different geographical locations, the very fact that they are acquired alongside each other grants children the ability to shift back and forth between them. This effortless alternation, or code-switching (CS), is particularly striking when observed in a quick succession within individual turns.

Many published accounts of CS are based on studies of middle-class children in expat families in Western countries where there is an expectation of language separation (e.g., Bernardini & Schlyter, 2004; Cantone, 2007; Cantone & Müller, 2005; Deuchar & Quay, 2000; Deuchar & Vihman, 2005; Gawlitzek-Maiwald & Tracy, 1996; Lanza, 1997; Müller et al., 2015; Vihman, 1985, 2018). Such children grow up in families that practise parent-based language choice ('One Parent One Language', or OPOL) as their 'Family Language Policy', sometimes strictly adhered to (Quick et al., 2021b), at other times perhaps violated despite claims of strict adherence (Genesee et al., 1995). Largely monolingual societal norms mean that children hear minimal to no switching in their input, and that

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they end up speaking each of their two languages in separate contexts or at least to different interlocutors, only one at a time, much like their monolingual counterparts.

When children go to school, they have completed much of their early acquisition and various sociolinguistic influences on linguistic development start to have a huge impact, with children incorporating attitudes towards the two languages as they are held in the community and in society at large. Montanari et al. (2019) report, for example, that the Spanish-English bilingual children studied longitudinally in the US between the ages of 3;6 and 4;5 gradually move away from switching any Spanish into their English, in accordance with school and societal norms, while switching English into their Spanish continues, in accordance with community conventions. When children grow up, an even larger array of factors can affect their CS, as bottom-up processes, such as priming, start being modulated by top-down influences which help older speakers to convey their communicative intentions (e.g., Beatty-Martinez et al., 2020). But in this article, we wish to focus on the period of acquisition in which such societal issues pertinent to older children, and adults, play only a limited role: while they obviously impact the type of input a child receives, young children who are not in school yet tend to be less exposed to societal debates about identity that could influence how they feel about each of their two languages. This makes it possible to explore how the mechanisms which underlie early language acquisition play out in bilingual contexts, specifically input-driven processes. These lie at the heart of usage-based (UB) theory, the usefulness of which we discuss in this paper.

Children from middle-class expat families, raised in Western countries, pose a pressing issue from the usage-based point of view: despite language separation in their child-directed speech, or 'input', and despite the monolingual societal norms, during preschool years these children have often been demonstrated to use CS in their language as a temporary feature in their own speech, or 'output', which decreases with age (Cantone & Müller, 2005; Genesee, 1989). At face value, this is a problem for studies which assume a close relationship between input and output. If there is no CS in the input, how is it possible that children produce it in their own speech? Also, given that usage-based studies of monolingual acquisition have provided quite extensive evidence for this close input-output relationship, should we then assume that bilingual acquisition is different, and perhaps even subject to different mechanisms than monolingual development?

Monolingual children have long been shown to tap into the language they hear from their primary caregivers (for a review see Ambridge & Lieven, 2011; Theakston & Lieven, 2017; Tomasello, 2003). There are many aspects of linguistic input which encourage acquisition, including the attention that children and their caregivers share in their conversations (Clark, 2015; Tomasello, 2008), or a high degree of repetition in the speech directed at very young children (Cameron-Faulkner et al., 2003; Stoll, Abbot-Smith, & Lieven, 2009), to mention but two factors. The bottom-up factors which have been crucial to explaining how children tap into caregiver speech, and subsequently start to produce their own are two: word *frequency*, which facilitates segmentation, productivity, and automation of constructions (Theakston & Lieven, 2017; Walsh et al., 2010), and *priming* which prompts the recycling of words and constructions in a given situation (Koch et al., 2020). Despite the fact that these phenomena are universal, each and every case of language acquisition is subject to input-driven *variation* in the pathways children take to reach the fairly similar adult states of linguistic knowledge they end up with, because each child is exposed to slightly different language, focuses on slightly different aspects of it, and approaches its use in slightly different ways (Lieven et al., 1992; O'Grady, 2008; Pine et al., 1997). Crucially, input is not just the language heard passively from caregivers; it is also the language children produce themselves, their own 'output', which impacts the processing of any new language heard (Lieven et al., 2009). It is this third key aspect of input that we focus on specifically in our paper, showing *how* it affects the way that children switch between their two languages and explaining *why* they do so.

Child CS has attracted keen interest of those studying bilingualism for a number of reasons. One is that it tells us something about creativity in child language: CS is often the result of the productive use of syntactic constructions. The second is that child CS allows investigating to what extent input determines output during language acquisition, telling us to what extent children produce something they do not hear in the input, so about the limitations of imitation as an explanation. Third, CS shows that language acquisition is dynamic: as mixed utterances continue to change with different patterns of language exposure, they can inform us about the degree to which a child is dominant in one of the languages. Child CS patterns often undergo changes in quick succession, which means studying it adds to our understanding of how language repertoires and their use change over time. Fourth, most bilingual children at some point must learn to keep their languages separate, and the understanding how they do so tells us something about how social rules get adopted, and how this is responded to by the bilingual brain. Finally, in the wider community, research on child CS helps speech and language therapists to normalise patterns of bilingual speech in typically developing children and to disambiguate them from any suspicion of language delay or speech disorders (e.g., Gross & Kaushanskaya, 2022). Their subsequent first-hand contact with bilingual families helps to shape public perceptions of bilingualism and to ensure that parents neither under- nor over-refer their children for speech and language therapy (Stow & Dodd, 2005; Winter, 2001).

Over the years, studies of CS have shown that even at the earliest stages bilingual speech tends to conform to a set of 'constraints', or rules that explicitly state where in an utterances and which elements may or may not be switched (for a review see Cantone, 2007). For example, in their earliest combinations children tend to use functional words (e.g., *More* and *No*) in the same language as that addressed at them, but switch to their 'other' language for content words, such as nouns (e.g., Lanza, 1997). Studies have also shown, however, that it is difficult to find constraints that are never violated (for a review see Müller & Cantone, 2009): child speech violates the rules at rates which may be low (up to 10 % in the children studied) but constant, regardless of age (Cantone & Müller, 2005; Paradis et al., 2000). Gradually, this search for universal grammatical constraints on how languages can be mixed has subsided, partly because unless there is an unlimited number of constraints, the identification of yet another constraint cannot significantly limit the hypothesis space (Deak, 2000), and partly because sociolinguistic and usage-based studies have approached the problem as being more a matter of establishing which patterns are common and why. As such, they have addressed the issue of abstract patterns being posited too early in development.

Most CS studies adopt a strict distinction between grammar and lexicon, portraying the phenomenon, at least in its insertional

guise, as the insertion of words from one language in sentences generated by the syntax of the other language (the other major type of switching, usually referred to as 'alternation', concerns alternating monolingual utterances in both languages) (e.g., Deuchar & Quay, 2000; Lanza, 1997; Petersen, 1988). Direct comparisons between the formalist and input-driven approaches are not without their own issues as CS studies conducted within the context of different frameworks dictate different questions that get asked. The purpose of the discussion presented here is to take stock of the usefulness of UB theory in explaining why child CS has the characteristics that it has, focusing especially on the way it provides evidence for the storage of 'units', which are of lexical, multiword, and constructional nature; this way we can contribute additional explanations to our understanding of why CS occurs, and why it has the features that it has. The presence of multiword units in CS has been signalled by researchers for a long time (see 'habitualised segments' in Poplack, 1980 and 'embedded islands' in Myers-Scotton & Jake, 2001) and it has been the subject of specific contributions (e.g., Backus, 2003; Hakimov, 2016; Namba, 2012; Wray & Namba, 2003). We will argue that the study of such units in children's CS is particularly useful because to such data we can apply UB corpus analysis methods, such as Traceback, that are dedicated to identifying them.

In this article, we review a strand of recent studies in bilingual children aged two to three who were exposed to German-English, Polish-English, Finnish-English, and French-Russian. We discuss these children's own bilingual utterances in light of the language they had produced before, thus capturing frequency-based variation and priming effects, and arguing that these processes describe bilingual productions just as well as they apply to monolingual speech. We demonstrate that CS is actually a logical outcome of bilingual acquisition, and that it says something about the entrenchment of morphemes, lexemes, and constructions, about constructional productivity, and creativity, and about the growing impact of the sociolinguistic constraints implicitly (and explicitly, perhaps) conveyed through the OPOL strategy. The main contribution of this paper lies in its summative value: it brings together the findings from the various studies that share similar theoretical and methodological orientations which are, moreover, quite different from the bulk of studies into children's CS. This makes it possible to start evaluating the value of this approach in general. For that reason, the paper focuses extensively on recommendations for future research.

2. Usage-based linguistics

2.1. On the development of usage-based linguistics

The debate on what triggers language acquisition has long been defined by polarised arguments, marked at one end by nurture-based, and at the other by nature-based views. The former have been referred to as bottom-up to reflect the conviction that language acquisition proceeds from concrete language heard and used, to more abstract linguistic representations formed as a result (Theakston & Lieven, 2017; Tomasello, 2003); the latter have been referred to as top-down to reflect the assumption that the child is born with a mind endowed with the full underlying representations needed to parse concrete linguistic input (Chomsky, 1965, 1993). Obviously, these factors are likely to be related, and theoretical models differ in the extent to which they articulate that relation as tightly integrated or not. Gradually, a usage-based model of how children acquire language, combining the employment of domain-general learning mechanisms and the processing and practicing of concrete language use, has been articulated. In the study of bilingual language acquisition, however, relatively little work has been characterised by a usage-based perspective. In this paper we discuss some of the work that has been done and examine to what extent this work supports the idea that bilingual proficiency is a fairly direct result of exposure and experience, at least early in development.

A great bulk of usage-based studies focus on children aged two to three years because usage-based linguistics (UBL) emerged in the context of justifying such young children's limited language productivity in response to the well-established tradition of research in generative grammar. The earliest such accounts reach back to Braine (1963, 1976) and Slobin (1966, 1970), who saw child language as constrained by simple mechanisms of three-rule pivot grammar, through Schlesinger (1971) and Bowerman (1973) who argued there were no grounds for claims that at the onset of speech children used a verb phrase, the key component of some rule-based models of acquisition. However, these early discussions of pivot grammar did not make it clear how children could in fact arrive at an adult grammar from their early pivot constructions. Although some evidence started to emerge about the effects of input on child language development (see e.g., Forner, 1979; Moerk, 1974), rule-based models of language acquisition continued to prevail until the late 1980s. It was only then that new suggestions were put forward as to how children may come to derive rules from the input they receive (Bates & MacWhinney, 1989; Lieven et al., 1992, 1997; Ninio, 1999; Tomasello, 1992), leading to an increased interest in the possibility that language acquisition may largely be a cognitive learning process.

In its current form, UBL has developed mostly through theoretical, corpus and experimental work in 'Cognitive Linguistics' (Goldberg, 1998; Langacker, 1987), human anthropology (Tomasello, 2000), and developmental psychology (Ambridge & Lieven, 2011; Theakston & Lieven, 2017; Tomasello, 2003). Perhaps especially in the field of language acquisition, UBL has gained impetus since it became possible to empirically show links between child-directed input and child speech on the one hand (Cameron-Faulkner et al., 2003; Lieven et al., 2009) and early and later child language on the other (Lieven et al., 1992; Lieven et al., 1997; Dąbrowska & Lieven, 2005). The approach is referred to as 'usage-based' due to its central tenet: it posits that "*the speaker's linguistic system is fundamentally grounded in 'usage events',* i.e*., a speaker producing or perceiving language*" (Barlow & Kemmer, 2000, p. VIII, also Bybee, 2010, Croft, 2001, Langacker, 1987). The process of acquisition proceeds from fully lexical phrases to deduction of patterns and, thus, the onset of productivity (Tomasello, 2003). This process is seen as gradual, although theoretical models differ in their accounts of how soon productivity is achieved (see e.g., Abbot-Smith & Tomasello, 2006 versus Keren-Portnoy, 2006).

Universal trends which seem to govern language acquisition are seen as the result of all children sharing the same learning mechanisms, the same domain-general mechanisms for speech perception and production and operating within similar sets of social interaction and conventions (Bates & MacWhinney, 1989; Street & Dąbrowska, 2010). Among these are the skills of PATTERN FINDING,

shared by all mankind and probably in some form by all primates (Tomasello et al., 1997), and INTENTION READING, likely unique to humans and recent in terms of evolutionary legacy (Tomasello et al., 1999). In finding patterns, several aspects of linguistic input are of importance. The first, *frequency* in the input, is tightly linked to frequency in the output, and it drives the processing of the language chunks which children come to adopt in their early speech, and which form the basis of pattern detection. The second, *priming*, is the use of words and units in the input (or output), which become immediately reused in the subsequent output; priming serves as a 'lifeline' for children who want to communicate but whose words and units are otherwise insufficiently entrenched to allow immediate recall.

2.2. Different types of language chunks

One of the most revolutionary aspects of UB theory is that it rejects modularity, and that this comes with the commitment to construct a new theory about what the building blocks of language are. From a UB perspective, no a priori distinction should be made between grammar and lexicon. The basic unit of language use is the concrete utterance, produced in the course of communication, and which is made possible by what is already stored in the speaker's mind, the basic units of language knowledge: specific and schematic units that may be either simple or contain multiple components (Bybee, 2010; Langacker, 1987). As knowledge consists of representations that are constantly updated as a response to usage, it is in a constant state of flux. This emerging new model comes with implications for how we should evaluate the data we have, and how we should design future studies.

Producing a unit is a cognitive routine, a recurrent pattern of mental activation which is part of human processing activity. For any specific speaker, child or adult, an utterance like *Gimme that* may have been produced in several ways. It may be the result of the retrieval of a fully *frozen chunk* (*Gimme-that*). If a unit is a frozen chunk, it is not necessarily connected to any schematic units in the speaker's mental representation that represent its syntax, and it is stored holistically, easing its retrieval the next time it is used. However, as a function of the frequent use of this particular verb and this particular indirect object with other elements, the utterance may also be the result of the activation of a *partially schematic construction*, *Give me X*, combined on the spot with the also stored lexical unit 'that'. Finally, since on the basis of similar patterns with other verbs and other pronouns a *fully schematic* ditransitive unit may have formed in the speaker's mind (VERB + PRONOUN + NOUN), the utterance could potentially also have been assembled from scratch, much like traditional linguistic accounts argue. However, any combination of words used repeatedly in the same form (*Give me that*) is expected to become entrenched as a chunk; psycholinguistic studies have often demonstrated that such multiword forms enjoy a retrieval advantage (e.g., Bybee, 2010; Schmid, 2020; Wray, 2002).

This is evident already in monolingual toddlers aged 1;0–3;0: Lieven et al. (1997) report that among their first 400 multiword constructions on average 60 % (ranging from 51 % to 72 %) are such frozen chunks with an empty slot, including *Put in X, I want to X* and *Go to X*. This shows that much of child language is formulaic, a tendency that continues into adulthood (Walsh et al., 2010). As the actual representations used by a particular speaker to produce a particular utterance can be anywhere between frozen (a 'fully specific complex unit') and productive (or at least 'partially' schematic), the boundaries between grammar and lexicon are porous: patterns are extracted and stored alongside automated lexicalised chunks with or without productive slots. Partially schematic units, also referred to as 'slot-and-frame schemas' (as they contain *slots* open to a range of new items, and *frames* which are recycled in speech) may well dominate language use and in acquisition they seem to function as a gateway to more complex syntax.

2.3. Input frequency, grammatical acquisition, and variation in use

Input frequency plays a complex role in language development. In simple terms, the role of frequency is at least twofold. On the one hand, TOKEN frequency (the number of times that the same word, word combination or construction is heard and used) leads to its holistic *entrenchment*: cognitive routinisation affects its *automation* and future processing ease. On the other hand, *type* frequency is crucial to the acquisition of grammatical constructions. The higher the number of different word types (e.g., *apple, banana*) that are heard and used in the same position of otherwise similar expressions (e.g., *Give me X*), the sooner the underlying construction becomes segmented and apparently productive (Bybee, 2010). While each new item used in a particular construction seems to accelerate the pace of its acquisition (Keren-Portnoy, 2006; Ninio, 1999), the semantic range of words used in an open slot in a construction tends to remain restricted during language acquisition, and in the case of many constructions into adulthood. This justifies the claim that grammatical acquisition is *piecemeal*, and for many grammatical constructions full schematicity might never be reached.

The pathways taken to reach a fairly similar adult state of linguistic knowledge, or at least syntactic knowledge, are open to variation, some of which can be linked to children's input (Pine et al., 1997), others to the manner in which children break into structure. For example, some children start creating multi-word combinations by joining two or more individual words (Lieven et al., 1992): the word *no* may be produced first on its own and then in a combination with another word (e.g., *No pasta*). At this stage, the phrase is still considered unsegmented, or 'frozen', with *pasta* lexically bound to that specific construction. Once *no* is recorded with another word in place of *pasta*, it develops into a frame which gives rise to a construction *No X*. If *no* recurs regularly with one specific word (e.g., *No more*), the two words are bound in use, and their bonds are strengthened for ease of access and retrieval. Other children tend to break into structure by gaining productive control over parts of previously unsegmented phrases (Lieven et al., 1992). For example, the phrase *I don't want it yoghurt* may first be recorded as an unsegmented construction but once the word *cheese* is produced in place of *yoghurt*, the phrase *I don't want it* is recognised as a frame followed by a slot to be filled with types of food. Here, a construction that has been segmented in speech is used productively, and it is assumed to have been stored in memory as a schematic pattern. In fostering connections between newly encountered exemplars and stored ones, children depend on *analogy*: similarities that are established facilitate categorisation (Lieven, 2010), leading to the generalisation, for instance, that if a particular slot in a particular

pattern is often filled with a nominal that refers to an animate being, that slot is indeed subcategorised for a noun high on the animacy scale.

2.4. Repetitive input and priming

In some theoretical perspectives, input has been seen as inadequate for the acquisition of a complex language system; it has been considered too impoverished for children to extract linguistic knowledge from it (Chomsky, 1965). Under the UB approach, however, input is hypothesised not to be imperfect at all: it is instrumental in gradually building up a child's linguistic knowledge, both its 'lexical' and 'grammatical' manifestations. In fact, comparisons of children's input with their own output suggest that much, if not all, of early child language can be linked to repetitive caregiver speech: the frames used by children (e.g., *Give me X, Where's X, Let's X*) correspond with a limited set of highly repetitive utterance initial chunks used by caregivers, both in English (Cameron-Faulkner et al., 2003) and in languages with a less fixed word order (Stoll et al., 2009).

One mechanism that may play an important role in linking input to output, and thus to acquisition, is *priming*. Priming is a pervasive feature of speech production and has been extensively studied in experimental psycholinguistics. It can also be seen, by its very nature, as a basic learning mechanism, based on the propensity to store memory traces from immediate discourse. Both caregiver speech and child's own prior discourse stimulate subsequent use of the same words, phrases, and constructions, suggesting the storage of recently encountered units. For example, Kirjavainen and Theakston (2011) demonstrated that discourse priming affects infinitival 'to' omission errors of two relevant constructions. Rowland et al. (2012) investigated constructional alternations, showing that a structural priming effect applies across different age groups, and is the largest with the youngest children. Koch et al. (2020) examined the speech of German-speaking children aged two in terms of priming effects and demonstrated that children emancipate themselves from the input the longer their utterances become, and the more they start to use constructions productively. These results confirm that priming eases the processing of structures which have been activated before, especially those less entrenched in the speaker's memory (e.g., Schmid, 2020), and more generally helps to build up proficiency (Savage et al., 2006), at least in monolingual acquisition. These findings also seem to suggest that at a younger age children rely more on the immediate input which helps to bridge their own proficiency gaps as well as easing processing issues. In the following sections, we will pick up on the issues of frequency and priming, showing how they apply to bilingual utterances.

3. Bilingual children and their code-switching

The question of input is central to the study of acquisition in contexts of bilingualism as well, with the complication that the child's two languages are in a constant competition for input volume. We claim this because we can only assume that bilingual acquisition is no different from monolingual acquisition as far as its cognitive characteristics are concerned. Bilingual children have similar cognitive skills to those of their monolingual peers, but deal with input duality, a feature which is absent from the input to monolingual children. As research in monolingual acquisition has provided the vast majority of the data for theories of language acquisition, findings about bilingual acquisition have the potential to correct blind spots in those theories, as we have suggested above.

Along with the question of why children switch despite hearing their two languages in fairly separate contexts with mostly monolingual speakers, UB approaches to CS are also faced with the task of finding out to what degree the units which pervade the children's monolingual acquisition also show up in CS, demonstrating their links with parental input and children's own prior speech, and showing how they evolve over time. We present an overview of such studies, which should be read keeping in mind that all the children discussed come from families whose observance of OPOL was verified through access to transcripts (rather than the parental reports earlier reviews had to rely on, e.g., Genesee et al., 1995). All these contributions explore *input frequency* as a key factor contributing to the construction of mixed utterances; some of them also investigate *priming* as a specific type of input children hear before the mixed utterances.

3.1. Frequency-based segmentation

One way to show how units emerge and develop in speech is to follow their emergence longitudinally through diary data and video recorded speech in order to capture their *segmentation* – the gradual realisation that longer stretches of speech, which are used holistically to start with, are made up of individual words and morphemes. Gaskins et al. (2019a) began their analysis from the very first multi-word combinations produced by a child raised with Polish and English and traced their development forward between the ages of 0;10.10–2;3.22. This allowed them to establish which parts of constructions were recycled (and therefore could be referred to as frames) and which were not (and could thus be referred to as slot fillers). The cumulative data for the whole period captured:

1) 4 % lexically fixed chunks, e.g., *Bath time, Wait for me*.
2) 87 % partially-schematic units, e.g., *Daj me X* 'give me X'.
3) 9 % utterances which could not be traced and were considered novel, e.g., *Red car*.

As a next step, all the constructions which were always monolingual were separated from those which were sometimes bilingual to examine whether there were any systematic differences between them, which would then point to characteristics that perhaps hold especially for constructions that host CS. It became apparent that the frames of monolingual combinations (e.g., *I*, and *My*) emerge in use as parts of frozen chunks (e.g., *I want it,* and *My mummy*) in which parts become productive with time (e.g., *I X,* and *My X*), and that

they often remain monolingual. What this suggests is that words which emerge in speech with others do so because they do not provide central semantic content; as a result, they form bonds with the co-occurring words and become resistant to CS. By contrast, the frames of bilingual combinations often emerge in use as individual words (e.g., *No,* and *More*), and only later enter in combination with other words (e.g., *No milk, More milk*). These words seem to carry much more semantic content on their own and they continue to be used holistically without their complements. They get entrenched as individual words, and they become structurally and semantically more autonomous, which makes them more open to being combined with words from another language.

Following the concept of structural segmentation, Quick et al. (2021a) examined the acquisition of article noun phrases (ANPs) in four children exposed to English-German, French-Russian and English-Polish. In light of Gaskins (2019a), articles carry relatively little semantic content and are structurally dependent on the ANPs, so they should not be open to CS, but this is not always the case. The authors examined the properties of each language pair as a possible explanation for cross-linguistic differences in the children's use of mixed ANPs. By calculating type-token ratios for frames, they demonstrated that the frames of such underlying constructions were the most productive in the acquisition of English-German (0.09) because both English and German use articles, and thus the constructional frame becomes segmented readily by the high combined frequency of different article types used phrase-initially in both languages. Additionally, as German articles are inflected (e.g., *Der* Hund*, Des* Hunds*, Dem* Hund*, Den* Hund), German uses more article types than English (*The* dog), so in early bilingual acquisition, the article slot becomes productive in German before it does in English. This, in turn, may explain why German articles entered in combination with English nouns earlier than English articles did with German nouns (see also Jorschick et al., 2010). By comparison, in the acquisition of French-Russian and Polish-English, the frames are less processed (0.07 and 0.03 respectively) which explains why there was less CS within the French-Russian ANPs and no CS within the English-Polish ANPs. Output was crucial to the two issues captured in these studies: the manner in which frames had been used by the children determined whether or not they were combined with slot fillers from another language. As all ANPs were comparable in terms of semantic content, cross-linguistic variation in CS was explained by their structural autonomy.

The two studies mark the onset of research on structural autonomy resulting from segmentation. Gaskins et al. (2019a) showed that such autonomy can be attained if words are used on their own; Quick et al. (2021a) demonstrated that it can be also achieved if slots become productive as they host a wide range of different word types within them. The concept of structural autonomy is key to UB studies: as they capture a route for abstract patterns to emerge, they challenge the claims that children need abstract patterns at the onset of acquisition.

In bilingual development, this opens up a potentially vast area for future research. For one, it is important to apply the concept of segmentation to other language pairs, comparing languages which are fusional with those which isolate grammatical morphemes in separate words. Such longitudinal research should control for the presence of mixed ANPs in the input to disambiguate the effects of segmentation from those of acquiring readily assembled mixed combinations. Second, the effects of segmentation on CS need to be studied on a broader array of constructions to ensure that our findings hold more broadly across all language. A third issue addresses a potential paradox: if segmentation plays a role in CS, how come the rates of CS tend to decrease with age (Cantone & Müller, 2005)? The answer lies probably in the manifold nature of frequency, which helps to segment constructions and automate them at the same time, while at the same time top-down factors start to impact at least some CS. However, the interaction between segmentation and automation, as well as the emerging top-down factors, would need to be verified through longitudinal research, ideally on a small set of comparable combinations.

3.2. *Frequency-based automation*

Another way of showing how constructions develop in speech is to demonstrate their levels of *automation*, i.e., their recurrence within the same, or similar, recyclable chunks. In order to reliably identify these chunks, and to avoid postulating them whenever convenient, UBL requires a reliable and consistent approach - a taxonomy of a sort - for a range of CS phenomena. The idea behind the 'Traceback method' (Table 1) is to identify words, chunks and schemas as entrenched in children's speech only if they can be related ('traced back') to their verbatim antecedents in the recordings. As such, it supports the idea that children's utterances are tightly linked to what they have said and heard before. In order to do so, a child corpus is usually split into two parts: the *test corpus* (the last recording sessions) and the *target corpus* (the rest of the corpus). Utterances in the test corpus are then traced back to potential precedents in the target corpus (Lieven et al., 2009, p. 583). If the utterance has been used by the child in exactly the same form in previous speech (the typical criterion is 'twice' but some studies raise it to 'four times'), it is analysed as a frozen chunk (see point 1); if only a part of it has been used in exactly the same form and is accompanied by a range of different items filling the slot, it is considered a slot-and-frame schema (point 2); if the slot is filled by a combination which has recurred in exactly the same form previously in speech, it is considered a chunk + chunk combination (point 3). The Traceback approach is a strictly bottom-up approach which looks only at the child's own output.

In the area of childhood bilingualism, Quick et al. (2018a) used a variant of the method to account for the remarkably high degree

Table 1
The Traceback method.

Language used	Was any part used previously?	Category
Give-me-that	Yes, the whole construction	Chunk
Give-me-a kiss	Yes, '*Give me a* X'	Slot and frame schema
Give-me my-mummy	Yes, '*Give me*' and '*my mummy*'	Chunk + chunk

of formulaicity in their corpus of a German-English speaking child aged 1;10–3;1. All mixed utterances were isolated from the rest of the speech as test corpus and traced back to all previous utterances. For example, the utterance *Ich bin not* "I am not" from a three-year-old German-English bilingual child could be traced back partially to the same child's previous utterances that also contained the chunk *Ich bin* "I am" with an open slot X (e.g., *Ich bin read head, Ich bin the crumb monster*). All mixed utterances were divided into four categories:

1) 18 % were unprocessed 'frozen' chunks (e.g., *Hilf me* 'help me').
2) 11 % were partially schematic units with chunks in the open slot (e.g., *Let's* + *kaput machen* 'Let's break it').
3) 60 % were partially schematic units with single words in the open slot (e.g., *Ich bin* + *not* 'I am not').
4) 11 % did not fit in within the other categories (e.g. *Ein open Mama* 'one open Mama').

A follow-up study with children exposed to German-English, and languages which are typologically further apart, such as Polish-English and Finnish-English, revealed very similar patterns (Gaskins et al., 2019b): There were, respectively:

1) 12 %, 32 % and 25 % frozen chunks.
2) 9 %, 1 % and 10 % partially schematic units with chunks in the open slot.
3) 54 %, 63 % and 55 % partially schematic units with single words in the open slot.
4) 25 %, 3 % and 10 % of other types of mixed utterances.

These results support the claim that regardless of their language type children recycle highly entrenched patterns, and they confirm that examples of real language use can be accounted for by psycholinguistic processes also demonstrated in bilingual contexts. They also suggest that even in creative utterances, i.e., 'output', children rely on material they have acquired and used before, which acts as a sort of 'input'. This is turn supports the idea that language use is highly formulaic, even in CS and even when children do not hear mixed utterances in child-directed speech.

Empirical evidence for such accounts helps to demonstrate how the child sees boundaries between their two languages. A switch placement usually occurs in places where frozen chunks are combined with slot fillers: in partially schematic units of all three children there was a clear preference for using monolingual frames (93 %, 98 % and 94 % respectively) and combining them with slot fillers from another language (Gaskins et al., 2019b). When all mixed utterances were examined, both partially schematic, fully frozen chunks or other, slot productivity could also account for the majority of CS, but its impact was considerably lower: 50 %, 53 % and 58 % of data respectively (Gaskins et al., 2019b).

The remaining utterances could be explained in two ways. Most of them were frozen bilingual chunks (12 %, 32 % and 25 %), with no apparent similarities in the way they were used, and only a temporary presence in the children's lexicons, as evidenced through their low frequencies. Judging by their fleeting character, we concluded that they were produced with lower levels of attention. Very few of them (7 %, 2 % and 6 % respectively) were subsequently reused in longer stretches of speech and appeared in places where the children's languages displayed both structural and phonological equivalence. In the speech of the German- and English-speaking child, in a schema *X for mir*, for example, the slot was followed by the English word *for* and the German word *mir* 'me'. We argued that CS occurred due to the phonological proximity between the words *for* and *für* 'for' and possibly *mir* and *me* which could explain the repeated processing of the mixed frame in this case. However, the hypothesis about the qualitative difference between CS in chunks and bilingual frames is limited to only one study and needs to be verified with reference to language combinations with different levels of structural and phonological proximity.

Chunking effects can also explain CS at the level of individual words. As long as word markings are frequent in use and used with a range of words, there is no reason why they should not be applied to stem forms from another language. Such switches have indeed been reported by a range of crosslinguistic studies (see e.g., ***top****fino* 'little (Italian) pot (German)' in Cantone, 2007, ***sill****ito* 'little (Spanish) silly (English)' in Liceras et al., 2008, **re**sucht 'has looked for (German) again (French)' in Veh, 1990 and kaczki**s** 'ducks (Polish) + s (English)' in Gaskins et al., 2019a). While no studies have thus far compared the frequency of CS within single words versus multi-word units, the former do seem to be extremely rare, presumably because words recur in the input in their monolingual form, strengthening their ties, and meanwhile automating their holistic retrieval. However, such claims are currently a matter of speculation and awaiting future investigation.

In terms of future research, first and foremost, studies should thus examine the likelihood of CS in languages characterised by differing levels of inflection. In English, for example, regular nouns take only three types of plural inflections: /s/, /z/ and /iz/, only one reserved for each noun type. In languages such as Polish, Finnish, or Hungarian, each noun can take many types of markings, depending on the context, and different nouns follow different inflectional paradigms, meaning the rules are highly irregular. It should be determined how high versus low type/token frequency of markings affects CS rates within nouns, and other word types, to confirm the extent to which slot productivity plays a role in CS at the level of single words.

Second, future research should consider methodological innovations as the Traceback method is not without its shortcomings. It is fairly conservative: when a low-scope construction can be traced back, it is hypothesised to have been responsible for the observed output, but that does not mean that a fully schematic syntactic construction cannot have been used. Experimental studies of monolingual adult speakers show a preference for using low-scope patterns which are automated as they are cognitively less costly to activate (Walsh et al., 2010). As automation is a bottom-up process, there is no reason why children should not prefer using low-scope patterns as well, but this is yet to be determined by studies with children. Third, as the Traceback method is labour intensive, it has involved only single- and multi-case studies. The Traceback has been automated (Quick et al., 2019) and subjected to experimental design (Bannard & Matthews, 2008) but it remains to be more widely applied to bilingual data to address the issues of generalisability of findings and to verify the importance of low-scope schemas for CS. Fourth, CS patterns should be examined in children beyond the age of three to test if low-scope schemas continue to play a role in their CS.

More specifically, research should investigate how such schemas interact with other contact phenomena, such as transfer which

occurs at the level of more abstract representations. Some language contact phenomena reported in our studies are instances of pure CS (e.g., *Where's my mleko* 'milk'), with items from one language inserted into the slot of a schema from another language (Gaskins et al., 2019a). Others are instances of pure transfer, where the higher scope representations in one language dictate word order in the other. For example, in the construction *When Tim little boy is*, a German verb-final word order is transferred into an otherwise English construction (Quick et al., 2018a). But there are also bilingual utterances which involve both CS and transfer. An utterance *When Tim little boy ist* would be a case in point (Quick et al., 2018a), with the child activating a German word order in a mostly English utterance while also using a German word. This is consistent with the observation that CS may bring along contact-induced language change by affecting morphosyntax of the base language (Backus, 2005). Such instances show that CS is not an exclusively lexical phenomenon, and that lexicon and morphosyntax are connected. A switched word "drags along" grammatical patterns from the language of insertion, therefore, word order or argument structure of the base language may change in a bilingual utterance. Utterances like the last one need to be studied systematically, linking specific low-scope constructions to their antecedents, examining the emergence of word order and phonological effects on CS.

3.3. Bilingual constructions and utterance length

Access to slot fillers in both languages has also been examined as a potential factor contributing to the reported observations of bilingual utterances being longer than their monolingual counterparts (Pert & Letts, 2006; Quay, 2013). Quick et al. (2018b) confirmed this phenomenon in their study of children acquiring German and English, and Quick et al. (2020) in a follow up study with children acquiring English-German, Polish-English, French-Russian, and Finnish-English. In the majority of the literature, the MLU analysis has not been previously done this way, with MLU measured for mixed utterances separately, so that it is difficult to say for sure whether this has always been hidden in the data, or whether it reflects something relatively unique to the data we analysed. Greater length of bilingual MLUs is explained as a bilingual advantage: if a child cannot fill the lexical gap using a word from the 'right' language, either because it is not available or not sufficiently entrenched, the attempt to fill the slot will be aborted, the utterance will stay monolingual, and its length will lower the overall monolingual mean utterance length. However, if a child can fill the slot with a word or phrase from the 'other' language, the attempt to communicate fully will be successful, and it will support the count of non-aborted mixed utterances (Quick et al., 2018b). Output is key to this: the opportunity for children to engage in different linguistic situations allows them to exercise the entirety of their linguistic resources. Access to words and constructions from two languages grants them an ability to express themselves in a more complex manner, with CS a reflection of the growing ability to match elements from both languages which fit the emerging categories. Whereas in most societies and in the children we study, language separation is enforced, there are also cultures and sociolinguistic situations which engage in multilingual language use, where switching back and forth is common. In both types of contexts, speakers have to adapt to their social norms to communicate successfully, and studies show that children can do so even at a very early age (Comeau et al., 2003).

Having noted this communicative advantage in bilinguals, first we urge researchers to examine when and how bilingual children use it to negotiate speech planning difficulties and to mitigate production difficulties, such as communication breakdowns (see Beatty-Martinez et al., 2020). While it offers some benefits, these may not be obvious to young speakers who are only starting to develop top-down approaches that will steer them through the challenges of everyday communication. Second, as our findings focus on a specific type of bilingual communities, which are perhaps not the norm (e.g., OPOL families from middle-class backgrounds), research should include other communities and family constellations where bilingualism is practised in a different way.

3.4. Input, priming and variation

The child's output is, however, not the full story behind their use of CS: some of the patterns observed can be explained by the properties of child-directed speech, albeit indirectly (i.e., it is other properties of parental input than CS that translate into child CS). Quick et al. (2021a) show, for example, that there is variation in the types of constructions bilingual children develop in their early speech and that it is attributable to frequency-related properties of their input. The three children examined in the study, who acquired English and German, differed in terms of the proportions of utterances they used in each language, their mean utterance length in each language and both languages combined, and the proportions with which they applied their two languages to chunks, and frames of partially schematic units. All of these factors were strongly linked to the imbalance of their two languages in the input. For example, a child who heard less English than German, used less English overall, and had shorter English utterances, while the frames of their mixed partially schematic constructions, as well as their chunks, were mostly German. The children also differed in terms of the five constructions which they used most frequently, a pattern which changed with age, and which reflected the shifts in the children's input situations. This approach is exactly what makes comparisons between UB and formalist studies impossible: what was identified here as a German frame, for example, on the criterion that function words are grammatical morphemes, may well have been coded by others as a CS for a German function word.

More specifically, input serves as a source of monolingual and bilingual utterance-initial chunks which supply the frames for children's own slot-and-frame schemas (Quick et al., 2021b). In a study of a German-English child aged 2;3–3;11, 74 % of the frames used by the child are shown to correlate with chunks in the parental input (Quick et al., 2021b). If the child's prior speech is considered as input, the links between input and CS rates become even more pronounced: 211 of the 277 (76 %) utterances contain frames or slot fillers which had been primed, i.e., which had occurred in the previous 20 utterances (Quick et al., 2021b). This reliance decreases with age, showing that the more proficient the child becomes in the language, the less she needs to rely on the language material provided in the input (but as a bottom-up process, priming continues to affect CS in adult speech (see, e.g., Fricke & Kootstra, 2016; Kootstra et al.,

2010).

A similar observation has been made in children exposed to Polish and English, and Finnish and English. The following extract illustrates how a Polish-English speaking child recycles the English frame she used in prior speech (in bold capitals), while at the same time inserting into the slot a Polish filler primed through the immediate discourse (in bold lower case) (Quick et al., 2021b):

Child: More monkeys, MORE monkeys!

Mother: To jest małpa. 'This is monkey'

Child: MORE **małpa**!

This example shows precisely how CS is derived from the input, at least in settings where there is no continuous CS in the input. Presumably, if the child continues to hear Polish chunks, she might attempt to use Polish words in chunks rather than individually; as a result, she will store them holistically, encouraging their future holistic retrieval. Meanwhile, if Polish input is erratic, and the child has few priming opportunities, her English chunks might become more entrenched and 'win out' against their less entrenched Polish counterparts when language is activated. These two situations could explain why CS rates decrease with age (Cantone & Müller, 2005), with children becoming progressively more, or progressively less, bilingual. However, this would need to be confirmed through systematic UB research, ideally such that compares CS in communities which address CS at their children with those that do not.

In terms of input-based variation in child CS, the scope of UB research is vast. A good starting point is to study those examples from the literature on child CS across different languages which do not seem to conform to the universal constraints on CS (Müller & Cantone, 2009) and to apply UB methods to verify if they can explain such deviant forms. For example, bilingual speech could be examined in light of the importance attached to word order, and in particular the violations that inevitably happen when the word orders of two languages in contact clash. Like other approaches, UBL predicts that CS is most likely in those constructions which are reinforced in use by both languages (Poplack, 1980). For example, mixed instantiations such as *Un schwarze capello* 'a black hat' (Taeschner, 1983) are possible due to the fact that adjectives are used before nouns in both German and Italian, giving rise to a highly entrenched and highly processed **ADJECTIVE + NOUN** schema to be filled with items from either language. However, UBL can also explain why CS occurs in phrases with no structural overlap between the two languages. For example, an utterance such as *Ci mettiamo una cosa schwer* "there put we a thing heavy" (Cantone, 2007) is possible despite the fact that Italian places adjectives after nouns (*una cosa pesante* 'a thing heavy') while German adjectives before nouns (*eine schwere Sache* 'a heavy thing'). Here, the prediction would be that the German adjective (*schwer* 'heavy') is inserted into a slot which follows a frozen Italian sequence (*Una cosa X*), which could be identified through the Traceback method given sufficient data. Other instances found in literature may also be explained by reference to units identified through the Traceback method, given adequate data. These include violations of the Italian adjective-noun word order predicted by the language of the frame (as in 'the word order constraint': Chan, 2003), such as *Un lustiges gesicht* 'a funny face' (Cantone, 2007). We believe that such formations are possible if the construction is considered a partially-schematic unit (*Un X*) in which the slot filler is a frozen chunk in German (*lustiges gesicht*) with, therefore, a German word order. Potentially, language pairs with different word order may yield particularly relevant findings.

On one last note, while this has not been explicitly investigated in child language, variation may also apply to the manner in which the same constructions in the same language pair are used by different children. It is possible, for example, that collocation bonds would strengthen at different utterance points depending on individual opportunities to hear and use the given constructions (e.g., *Gimme + a book*, versus *Gimme a* X). This bottom-up factor has been shown to account for CS in the adult speakers of German and Russian and their use of noun phrases: if a specific noun recurs with the given preposition frequently in adult speech, a switch within the prepositional phrase is unlikely but if their frequency of co-occurrence is low, the likelihood grows of a switch within the prepositional phrase (Hakimov, 2016). To the best of our knowledge, this factor has not yet been studied in childhood bilingualism, but it could highlight how output affects the variation in switch placement within comparable constructions.

4. Concluding remarks

Usage-based approaches have enjoyed much attention in the study of child language development, but it is only very recently that they have been tested in relation to bilingual acquisition. In this paper, we have summarised the findings from our own crosslinguistic studies conducted with bilingual children aged two to three, showing that a range of bottom-up processes discussed in the literature on monolingual children also apply to bilingual acquisition. Our research has been driven by the question of how it is possible that these children switch their two languages even though they do not hear CS in their input. The explanation lies in one aspect of input, i.e., the utterances produced by the child in prior speech, which account for the productivity of partially schematic constructions, as outlined above, and testify to children's creativity. Just like adults, bilingual children use their array of partially schematic constructions and their knowledge of words and multiword chunks to convey new meanings.

We have argued for the benefits of applying bottom-up usage-based principles to the study of child code-switching, as they offer a certain freedom to perceive language in a way a child does: as a stream of speech, which is not always fully segmented and often heard in chunks. We have made several recommendations for future UB research in child CS, homing in on several key issues which are yet to be addressed. First, we argued for methodological innovations, going beyond the conservative Traceback method to verify a construction is what it appears to be in the corpus data: a low-scope chunk, activated without a recourse to its underlying representations. Second, we stressed the need to study a broader array of constructions in different language pairs, including inflected languages to

confirm to what extent our findings can be seen as generalisable. Third, we argued that a ocus on patterns rather than words can shed some light on the variation in the use of word order and the switch placement. Last, to clear some blind spots in acquisition, we argued for a need to test not just pre-schoolers and adults but also school-age children. Testing such an age group could fill several other gaps, capturing an interaction between segmentation and automation, between the bottom-up and top-down strategies and between CS and transfer.

The patterns discussed in this paper look noteworthy to us because they violate the language choice conventions the children grow up with. Patterns are not only strictly linguistic in nature: co-occurrences of languages with certain people are also patterns, and ones that are important for the early emergence of relatively well-executed 'language choice'. As adults, we recognise languages as separate entities because we have created such a distinction as an important category in the Western society. However, for the children, pre-sociolinguistic creatures as they are to an extent, co-occurrence relations may be all-important: they use words they associate with particular interlocutors, and such associations can explain the disappearance of CS when the OPOL children grow older and start recognising that individual words and morphemes belong to individual languages. Sociolinguistic competence and reinforcement from the environment makes them filter out the words that do not belong to a given context, leading to monolingual language use. Meanwhile, those exposed to habitual CS continue to be primed in their speech by the use of two languages within a given situation, and often within single utterances (e.g., Montanari et al., 2019). Children thus follow in the footsteps of their linguistic community: perhaps, the family language policy attached to a limited number of speakers at home is less important than making our children understand how our communities communicate and that some do, while other do not, emphasise language separation.

Although bottom-up usage-based processes have bridged the gap between child and adult CS, detailed UB theories of processing, and especially those of child CS, still await articulation. However, our studies have made a start by exploring data from bilingual children who grow up in middle class families characterised by not being embedded in a large bilingual community (such as migrant communities or an indigenous minority). Usually, the parents are in a mixed marriage and practise the OPOL strategy to differing extents of strictness. As a result, these studies have been carried out in environments in which monolingual language output is expected. Future research should extend the usage-based tradition to contexts which accept using two languages in everyday discourse to show how input and output effects are linked in the production of bilingual speech.

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References

Abbot-Smith, K., & Tomasello, M. (2006). Exemplar learning and schematisation in a usage-based account of syntactic acquisition. *The Linguistic Review, 23*, 278–288. https://doi.org/10.1515/TLR.2006.011

Ambridge, B., & Lieven, E. (2011). Child language acquisition. *Contrasting theoretical approaches*. Cambridge: Cambridge University Press. https://doi.org/10.1017/CBO9780511975073

Backus, A. (2003). Units in code-switching: evidence for multi-morphemic elements in the lexicon. *Linguistics, 41*(1), 83–132.

Backus, A. (2005). Code-switching and language change: One thing leads to another? *International Journal of Bilingualism, 9*(3–4), 307–340.

Bannard, C., & Matthews, D. (2008). Stored word sequences in language learning. The effect of familiarity on children's repetition of four-word combinations. *Psychological Science, 19*, 241–248. https://doi.org/10.1111/j.1467-9280.2008.02075.x

Barlow, M., & Kemmer, S. (Eds.). (2000). *Usage-based models of language*. Stanford: CSLI Publications.

Bates, E., & MacWhinney, B. (1989). Functionalism and the competition model. In Brian MacWhinney, & Elizabeth Bates (Eds.), *The crosslinguistic study of sentence processing* (pp. 3–76). Cambridge: Cambridge University Press.

Beatty-Martínez, A. L., Navarro-Torres, C. A., & Dussias, P. E. (2020). Codeswitching: A bilingual toolkit for opportunistic speech planning. *Frontiers in Psychology, 11*, 1699. https://doi.org/10.3389/fpsyg.2020.01699

Bernardini, P., & Schlyter, S. (2004). Growing syntactic structure and code-mixing in the weaker language: The Ivy hypothesis. *Bilingualism: Language and Cognition, 7*(1), 49–69. https://doi.org/10.1017/S1366728904001270

Bowerman, M. (1973). *Early syntactic development*. Cambridge: CUP.

Braine, M. (1963). The ontogeny of English phrase structure. The first phrase. *Language, 39*, 1–14. https://doi.org/10.2307/410757

Braine, M. (1976). Children's first word combinations. *Monographs of the Society for Research in Child Development, 41*(1). https://doi.org/10.2307/1165959

Bybee, J. (2010). *Language, usage and cognition*. Cambridge: Cambridge University Press. https://doi.org/10.1017/CBO9780511750526

Cameron-Faulkner, T., Lieven, E., & Tomasello, M. (2003). A construction-based analysis of child directed speech. *Cognitive Science. A Multidisciplinary Journal, 27*, 843–873, 10.1016/j.cogsci.2003.06.001.

Cantone, K. F. (2007). *Code-switching in bilingual children*. Dordrecht: Springer. https://doi.org/10.1007/978-1-4020-5784-7

Cantone, K. F., & Muller, N. (2005). Code-switching at the interface of language-specific lexicons and the computational system. *International Journal of Bilingualism, 8*, 205–225. https://doi.org/10.1177/13670069050090020501

Chan, B. H.-S. (2003). *Aspects of the syntax, the pragmatics, and the production of code-switching, with special reference to Cantonese-English*. New York: Peter Lang.

Chomsky, N. (1965). *Aspects of the theory of syntax*. Cambridge MA: MIT Press.

Chomsky, N. (1993). *The minimalist program*. Cambridge, MA: MIT Press. https://doi.org/10.7551/mitpress/9780262527347.003.0003

Clark, E. (2015). Common ground. In Brian MacWhinney, & William O'Grady (Eds.), *The handbook of language emergence* (pp. 328–353). London: Wiley. https://doi.org/10.1002/9781118346136.ch15.

Comeau, L., Genesee, F., & Lapaquette, L. (2003). The modelling hypothesis and child bilingual codemixing. *International Journal of Bilingualism, 7*, 113–126. https://doi.org/10.1177/13670069030070020101

Croft, W. (2001). Radical construction grammar. *Syntactic theory in typological perspective*. Oxford: OUP. https://doi.org/10.1093/acprof:oso/9780198299554.001.0001

Dąbrowska, E., & Lieven, E. (2005). Towards a lexically specific grammar of children's question constructions. *Cognitive Linguistics, 16*, 437–474. https://doi.org/10.1515/cogl.2005.16.3.437
Deak, G. O. (2000). Hunting the fox of word learning: Why 'constraints' fail to capture it. *Developmental Review, 20*, 29–80. https://doi.org/10.1006/drev.1999.0494
Deuchar, M., & Quay, S. (2000). Bilingual acquisition. *Theoretical implications of a case study*. New York: OUP. https://doi.org/10.1017/S0047404505230063
Deuchar, M., & Vihman, M. (2005). A radical approach to early mixed utterances. *International Journal of Bilingualism, 9*(2), 137–157. https://doi.org/10.1177/13670069050090020201
Forner, M. (1979). The mother as LAD: interaction between order and frequency of parental input and child production. *Paper presented at the sixth annual University of Minnesota linguistics symposium*.
Fricke, M., & Kootstra, G. J. (2016). Primed codeswitching in spontaneous bilingual dialogue. *Journal of Memory and Language, 91*, 181–201. https://doi.org/10.1016/j.jml.2016.04.003
Gaskins, D., Backus, A., & Quick, A. E. (2019a). Slot-and-Frame Schemas in the Language of a Polish- and English-Speaking Child: The Impact of Usage Patterns on the Switch Placement. *Languages, 4*(1), 8. https://doi.org/10.3390/languages4010008
Gaskins, D., Frick, M., Palola, E., & Quick, A. E. (2019b). Towards a usage-based model of early code-switching: Evidence from three language pairs. *Applied Linguistics Review, 12*(2), 179–206. https://doi.org/10.1515/applirev-2019-0030
Gawlitzek-Maiwald, I., & Tracy, R. (1996). Bilingual bootstrapping. *Linguistics, 34*, 901–926. https://doi.org/10.1177/014272379401404229
Genesee, F. (1989). Early bilingual development: One language or two? *Journal of Child Language, 16*, 161–179. https://doi.org/10.1017/S0305000900013490
Genesee, F., Nicoladis, E., & Paradis, J. (1995). Language differentiation in early bilingual development. *Journal of Child Language, 22*, 611–631. https://doi.org/10.1017/S0305000900009971
Goldberg, A. (1998). Constructions: A construction grammar approach to argument structure. *Journal of Pragmatics, 29*(3). https://doi.org/10.1016/S0378-2166(97)81937-6
Gross, M., & Kaushanskaya, M. (2022). Language control and code-switching in bilingual children with developmental language disorder. *Journal of Speech, Language, and Hearing Research, 65*(3), 1104–1127. https://doi.org/10.1044/2021_JSLHR-21-00332
Hakimov, N. (2016). Effects of frequency and word repetition on switch-placement: evidence from Russian-German code-mixing. In Justyna A. Robinson, & Monika Reif (Eds.), *Cognitive perspectives on bilingualism. Trends in applied linguistics*. Berlin: Mouton De Gruyter. https://doi.org/10.1515/9781614514190-007.
Jorschick, L., Endesfelder, Quick, A. Glaser, D., Lieven, E., & Tomasello, M. (2010). German-English-speaking children's mixed NPs with 'correct' agreement. *Bilingualism: Language and Cognition, 13*, 1–11. https://doi.org/10.1017/S1366728910000131
Keren-Portnoy, T. (2006). Facilitation and practice in verb acquisition. *Journal of Child Language, 33*, 487–518. https://doi.org/10.1017/s0305000906007495
Kirjavainen, M., & Theakston, A. (2011). Are infinitival to omission errors primed by prior discourse? The case of WANT constructions. *Cognitive Linguistics, 22*(4), 629–657. https://doi.org/10.1515/cog.2011.024
Koch, N., Endesfelder Quick, A., & Hartmann, S. (2020). Individual differences in discourse priming: A traceback approach. *Belgian Journal of Linguistics, 34*, 186–197. https://doi.org/10.1075/bjl.00045.koc
Kootstra, G. J., van Hell, J. G., & Dijkstra, T. (2010). Syntactic alignment and shared word order in code-switched sentence production: Evidence from bilingual monologue and dialogue. *Journal of Memory and Language, 63*, 210–231, 10.1016/j. jml.2010.03.006.
Langacker, R. (1987). *Foundations of cognitive grammar. Vol. 1: Theoretical prerequisites*. Stanford, CA: Stanford University Press. https://doi.org/10.1016/0024-3841(90)90017-F
Lanza, E. (1997). Language mixing in infant bilingualism. *A sociolinguistic perspective*. Oxford: Oxford University Press. https://doi.org/10.1017/S0332586500004170
Liceras, J. M., Fernández Fuertes, R., Perales, S., Pérez-Tattam, R., & Spradlin, K. T. (2008). Gender and gender agreement in bilingual native and non-native grammars: A view from child and adult functional-lexical switchings. *Lingua, 118*, 827–851. https://doi.org/10.1016/j.lingua.2007.05.006
Lieven, E. (2010). Input and first language acquisition: Evaluating the role of frequency. *Lingua, 120*, 2546–2556. https://doi.org/10.1016/j.lingua.2010.06.005
Lieven, E., Pine, J., & Dresner Barnes, H. (1992). Individual differences in early vocabulary development: Redefining the referential-expressive distinction. *Journal of Child Language, 19*, 287–310. https://doi.org/10.1017/S0305000900011429
Lieven, E., Pine, J., & Baldwin, G. (1997). Lexically-based learning and early grammatical development. *Journal of Child Language, 24*, 187–220. https://doi.org/10.1017/s0305000996002930
Lieven, E., Salomo, D., & Tomasello, M. (2009). Two-year-old children's production of multiword utterances: a usage-based analysis. *Cognitive Linguistics, 20*, 481–507. https://doi.org/10.1515/COGL.2009.022
Moerk, E. L. (1974). Relationship between parental input frequencies and children's language acquisition: A reanalysis of Brown's data. *Journal of Child Language, 7*, 105–118. https://doi.org/10.1017/S0305000900007054
Montanari, S., Ochoa, W., & Subrahmanyam, K. (2019). A longitudinal investigation of language mixing in Spanish–English dual language learners: The role of language proficiency, variability, and sociolinguistic factors. *Journal of Child Language, 46*, 913–937. https://doi.org/10.1017/S0305000919000278
Müller, N., & Cantone, K. F. (2009). Language mixing in bilingual children: code-switching? In Barbara Bullock, & Almeida J. Toribio (Eds.), *The Cambridge handbook of linguistic code-switching*. Cambridge: Cambridge University Press.
Müller, N., Gil, L. A. Eichler, N. Geveler, J., Hager, M., Jansen, V., Patuto, M., Repetto, V. & Schmeißer, A. (2015). *Code-switching: Spanisch, Italienisch, Französisch. Eine Einführung*. Tübingen: Narr.
Myers-Scotton, C., & Jake, J. (2001). Explaining aspects of code-switching and their implications. In Nicol Janet (Ed.), *One mind, two languages: Bilingual language processing*. Malden: Blackwell Publishers.
Namba, K. (2012). *English-Japanese code-switching and formulaic language: A structural approach to bilingual children's interactions*. Lambert Publishing.
Ninio, A. (1999). Pathbreaking verbs in syntactic development and the question of prototypical transitivity. *Journal of Child Language, 26*, 619–653. https://doi.org/10.1017/S0305000999003931
O'Grady, W. (2008). The emergentist program. *Lingua, 118*, 447–464. https://doi.org/10.1016/j.lingua.2006.12.001
Paradis, J., Nicoladis, E., & Genesee, E. (2000). Early emergence of structural constraints on code-mixing: Evidence from French-English bilingual children. *Bilingualism: Language and Cognition, 3*(3), 245–261. https://doi.org/10.1017/S1366728900000365
Pert, S., & Letts, C. (2006). Codeswitching in Mirpuri speaking Pakistani heritage preschool children: Bilingual language acquisition. *International Journal of Bilingualism, 10*, 349–374. https://doi.org/10.1177/13670069060100030501
Petersen, J. (1988). Word-internal code-switching constraints in a bilingual child's grammar. *Linguistics, 26*, 479–493. https://doi.org/10.1515/ling.1988.26.3.479
Pine, J. M., Lieven, E., & Rowland, C. (1997). Stylistic variation at the "single-word" stage: Relations between maternal speech characteristics and children's vocabulary composition and usage. *Child Development, 68*(05), 807–819. https://doi.org/10.2307/1132034
Poplack, S. (1980). Sometimes I start the sentence in English y termino en español. *Linguistics, 18*, 581–618. https://doi.org/10.1515/ling.1980.18.7-8.581
Quay, S. (2013). Shifting dominance through language mixing: Caregiver input and a preschooler's bilingual discourse. *Paper presented at the international symposium on bilingualism 9, Nanyang Technological University, Singapore, June 10–13, 2013*.
Quick, A., Lieven, E., Carpenter, M., & Tomasello, M. (2018a). Identifying partially schematic units in the code-mixing of an English and German speaking child. *Linguistic Approaches to Bilingualism, 8*(4), 477–501. https://doi.org/10.1075/lab.15049.qui
Quick, A. E., Backus, A., & Lieven, E. (2018b). Partially schematic constructions as engines of development: Evidence from German-English bilingual acquisition. In E. Zenner, A. Backus, & Winter-Froemel (Eds.), *Placing Usage, Meaning and Mind at the Core of Contact-Induced Variation and Change. Cognitive Contact Linguistics: Placing Usage, Meaning and Mind at teh Core of Contact-Induced Variation and Change* (pp. 279–304). Berlin, Boston: De Guyter Mouton.
Quick, A. E., Backus, A., & Lieven, E. (2021a). Entrenchment effects in code-mixing: individual differences in German-English bilingual children. *Cognitive Linguistics, 32*(2), 319–348.
Quick, A. E., Gaskins, D., & Frick, M. (2021b). Priming of Frames and Slots in Bilingual Children's Code-Mixing: A Usage-Based Approach. *Frontiers in Psychology, 12*. https://doi.org/10.3389/fpsyg.2021.726764

Quick, A. E., Hartmann, S., Backus, A., & Lieven, E. (2019). Entrenchment and productivity: The role of input in the code-mixing of a German-English bilingual child. *Applied Linguistics Review, 12*(2), 225–247. https://doi.org/10.1515/applirev-2019-0027

Quick, A. E., Gaskins, D., Bailleul, O., Frick, M., & Palola, E. (2020). A gateway to complexity: A cross-linguistic comparison of child bilingual speech. *International Journal of Bilingualism, 25*(3), 800–811.

Rowland, C. F., Chang, F., Ambridge, B., Pine, J. M., & Lieven, E. (2012). The development of abstract syntax: Evidence from structural priming and the lexical boost. *Cognition, 125*(1), 49–63. https://doi.org/10.1016/j.cognition.2012.06.008

Savage, C., Lieven, E., Theakston, A., & Tomasello, M. (2006). Structural priming as implicit learning in language acquisition: The persistence of lexical and structural priming in 4-year-olds. *Language Learning and Development, 2*(1), 27–49. https://doi.org/10.1207/s15473341lld0201_2

Schlesinger, I. M. (1971). Learning of grammar from pivot to realisation rules. In Renira Huxley, & Elisabeth Ingram (Eds.), *Language acquisition: Models and methods*. New York: Academic Press.

Schmid, H.-J. (2020). The dynamics of the linguistic system. *Usage, conventionalisation, and entrenchment*. Oxford: Oxford University Press. https://doi.org/10.1075/rcl.00112.zha

Slobin, D. (1966). Grammatical transformations and sentence comprehension in childhood and adulthood. *Journal of Verbal Learning and Verbal Behaviour, 5*(3), 219–227. https://doi.org/10.1016/S0022-5371(66)80023-3

Slobin, D. (1970). Universals of grammatical development in children. In G. Flores D'Arcais & W. Levelt (eds.), *Advances in psycholinguistics*. Amsterdam: North Holland.

Stoll, S., Abbot-Smith, K., & Lieven, E. (2009). Lexically Restricted Utterances in Russian, German, and English Child-Directed Speech. *Cognitive Science, 33*, 75–103.

Stow, C., & Dodd, B. (2005). A survey of bilingual children referred for investigation of communication disorders: A comparison with monolingual children referred in one area in England. *Journal of Multilingual Communication Disorders, 3*, 1–23. https://doi.org/10.1080/14769670400009959

Street, J., & Dąbrowska, E. (2010). More individual differences in language attainment: How much do adult native speakers of English know about passives and quantifiers? *Lingua, 120*(8), 2080–2094. https://doi.org/10.1016/j.lingua.2010.01.004

Taeschner, T. (1983). *The sun is feminine: A study in language acquisition in bilingual children*. Berlin: Springer Verlag. https://doi.org/10.1007/978-3-642-48329-5

Theakston, A., & Lieven, E. (2017). Multiunit sequences in first language acquisition. *Topics in Cognitive Science, 9*, 1–21. https://doi.org/10.1111/tops.12268

Tomasello, M. (1992). *First verbs: A case study of early grammatical development*. New York: Cambridge University Press. https://doi.org/10.1017/CBO9780511527678

Tomasello, M. (2000). *The cultural origins of human cognition*. Cambridge, MA and London: Cambridge University Press. https://doi.org/10.4159/9780674044371

Tomasello, M. (2003). *Constructing a language: A usage-based theory of language acquisition*. Cambridge: Harvard University Press. https://doi.org/10.2307/j.ctv26070v8

Tomasello, M. (2008). *Origins of human communication*. Cambridge, MA: MIT Press. https://doi.org/10.7551/mitpress/7551.001.0001

Tomasello, M., Call, J., & Gluckman, A. (1997). Comprehension of novel communicative signs by apes and human children. *Child Development, 68*, 1067–1080. https://doi.org/10.2307/1132292

Tomasello, M., Hare, B., & Agnetta, B. (1999). Chimpanzees, Pan troglodytes, follow gaze direction geometrically. *Animal Behaviour, 58*, 769–777. https://doi.org/10.1006/anbe.1999.1192

Veh, B. (1990). *Syntaktische Aspekte des Code-Switching bei bilingualen Kindern (Französisch-Deutsch) im Vorschulalter* (Unpublished master's thesis). University of Hamburg.

Vihman, M. M. (1985). Language differentiation by the bilingual infant. *Journal of Child Language, 12*, 297–324. https://doi.org/10.1017/S0305000900006450

Vihman, V.-A. (2018). Language interaction in emergent grammars: Morphology and word order in bilingual children's code-switching. *Languages, 3*(40), 1–23. https://doi.org/10.3390/languages3040040

Walsh, M., Mobius, B., Wade, T., & Schutze, H. (2010). Multilevel exemplar theory. *Cogn. Sci., 34*, 537–582. https://doi.org/10.1111/j.1551-6709.2010.01099.x

Winter, K. (2001). Numbers of bilingual children in speech and language therapy: Theory and practice of measuring their representation. *International Journal of Bilingualism, 5*, 465–495. https://doi.org/10.1177/13670069010050040401

Wray, A. (2002). *Formulaic language and the lexicon*. Cambridge: CUP. https://doi.org/10.1017/CBO9780511519772

Wray, A., & Namba, K. (2003). Use of formulaic language by a Japanese-English bilingual child: A practical approach to data analysis. *Japan Journal of Multilingualism and Multiculturalism, 9(1)*, 24–51.