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Gradual development of constructional complexity in German spatial language

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Abstract: In this paper, we assess the developmental trajectories by which children approach adult levels of complexity and informativeness in the linguistically and conceptually challenging domain of spatial language. To this end, we look at three types of spatial relations (localization, spontaneous and caused motion) in spontaneous German child speech (age 2;6 to 2;11 and 4;6 to 4;11), and in elicited *Frog Story* narratives from German child and adult speakers (3-, 5-, 9-year-olds, and adults. Children are generally sensitive to typological preferences. From early on, their productions reflect target-language-specific lexicalization patterns. Our analyses show that they still approach adult-like levels of information complexity and density only gradually. This concerns the *local* complexity (structural repertoire for the conceptual slots figure, verb, path/ground), as also established in previous research, but in particular the *global complexity*, as investigated in this study. Global complexity measures the structural integration of information, or the combinatorial complexity that surfaces at the utterance level. As predicted by usage-based theories, adult-like degrees of informativeness and information density are only reached gradually, although the component parts at the local level are available earlier in development.

Keywords: spatial language, first language development, construction complexity, information density, usage-based

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1 Introduction

From a cognitive point of view, spatial language is a highly relevant domain of language development. Spatial language is highly frequent in child speech, covering about 30 % of preschoolers' vocabulary (cf. Augst et al. 1977), and present in about 30 % of their spontaneous speech in our data (see below). Moreover, spatial language is essential in academic language, where spatial metaphors and comparisons are pervasive (Fleischman 1991).

Cross-linguistic variation in the spatial language domain is well documented (e.g., Slobin 2003; Slobin 2004), and leads to effects of learned selective attention in linguistic encoding (e.g., *Thinking for Speaking*, Slobin 1996). Previous research has shown that children tune in to the target-language lexicalization patterns quite early (see below), but both typological research in the spatial language domain and usage-based research on language development in general have shown that language development is gradual in several respects. Usage-based research in particular shows that early language use is highly item-specific, tied to knowledge of individual lexical items within low-level constructional patterns (cf. Behrens 2009; Tomasello 1992). Hence, for most constructions it is a long way from (early) emergence to full mastery in later development where a speaker can, for instance, flexibly and productively use specific and more abstract constructions in varying and complex contexts and combinations (Berman and Slobin 1994a).

This paper brings together two research perspectives on developing information density and complexity. First – in line with previous crosslinguistic research – we look at the development of information packaging: the way in which spatial information is encoded in child and adult German. In Section 2 we will briefly characterize the crosslinguistic differences in the encoding of spatial events and review the existing literature on the acquisition of spatial language, with particular focus on German. While there seems to be unambiguous evidence that children identify the language-specific patterns even at the earliest stages of language development, our study focusses on the emergence of information density and complexity at the utterance level, because most previous research focused on individual conceptual slots, in particular verbs and path expressions. To this end, we will analyze narratives produced by three-, five-, and nine-year old children and adults (n = 48), as well as longitudinal spontaneous child language data from three children at ages 2;6–2;11 and 4;6–4;11. In a first step, we will look at the local complexity of the

conceptual slots in a spatial event (Section 4), in a second step we analyze the complexity at the utterance level by looking at the combinatorial patterns (Sections 5 and 6). We will spell out our hypotheses and predictions in more detail in Section 3.

2 Spatial language development

The languages of the world differ with respect to their preferred lexicalization patterns (Talmy 1985), that is, as to which information is routinely selected for the verbalization of specific types of events (Slobin 1996; Bryant 2012: 37) and to the corresponding linguistic structures that encode this information. Regarding event types for spatial relations, three different spatial concepts are distinguished: localization, spontaneous motion, and caused motion. They involve a combination of (a selection of) the following conceptual components: *figure* (the moving or located entity), *path* (the trajectory of the movement), *ground* (the relevant landmarks, source, and/or goal), *motion* (or localization), and *manner of motion* (or posture). German is a so-called satellite-(S-)framed language, where the finite main verb expresses motion/localization, which is often conflated with manner of motion (or posture). The path and ground elements are typically expressed in additional satellite elements such as adverbs, particles, or prepositional phrases. This results in the following basic constructional patterns in German spatial language (optional components are indicated in brackets):

Localization

	FIGURE	LOC(+MAN)	PATH	GROUND
(1)	*Der Mann*	*sitzt*	*auf*	*dem Sofa*.
	The man	is sitting	on	the couch.
(2)	*Das Sofa*	*ist/steht*	*im*	*Wohnzimmer*.
	The couch	is/stands	in	the living room.

Spontaneous motion

	FIGURE	MOT(+MAN)	PATH	GROUND
(3)	*Der Mann*	*schlendert*	*raus (in*	*den Garten)*.
	The man	strolls	outside (into	the garden).
(4)	*Er*	*klettert*	*auf*	*den Apfelbaum*.
	He	climbs	up	the apple tree.

Caused motion

	AGENT	MOT(+MAN)	FIGURE	PATH	GROUND
(5)	*Der Mann*	*legt*	*die Äpfel*	*auf*	*den Tisch.*
	The man	puts/lays	the apples	on	the table.

Note that in spontaneous motion events (3, 4), the (self-propelled) figure is conflated with the agent of the motion event, whereas these are separate entities in caused motion events (5). In contrast to these general German lexicalization patterns, motion and path are conflated in the main verb in so-called verb-framed or V-languages, whereas manner of motion may but need not be expressed in additional satellites such as gerunds as in the following French spontaneous motion sentence (6):

Spontaneous motion

	FIGURE	MOT+PATH	GROUND	(MAN)
(6)	*La dame*	*traversa*	*la rue*	*(en dansant).*
	The lady	crossed	the street	(dancing).

The distinction between S- and V-framed languages is well established in the research literature, but has to be understood as an abstraction: The contrast does not imply that these are exclusive or even contrastive distributional patterns. Rather, languages prefer one or the other pattern to a certain degree, such that languages can be sorted on a cline between the S- and V-poles, with languages like Mandarin Chinese in the middle as equipollently-framed, where manner and path receive equal weight (Slobin 2004: 227–228). Motion-path conflation in the main verb is possible in S-framed languages, too (e.g., German *Er überquert die Strasse* 'he crosses the street'), but very infrequent.

2.1 Acquisition of satellite-framed languages

Slobin posits that, as "S-languages allow for an economical expression of manner of motion in the main verb of a clause [...] these languages make habitual use of manner verbs" and have "developed large lexicons with many fine-grained distinctions of manner" such that "the semantic space of manner of motion is 'highly saturated' in S-languages" (Slobin 2003: 163; see also Berman and Slobin 1994c). In addition, Berman and Slobin (1994c: 118–119) point out that S-framed languages "allow for detailed description of paths within a clause, because the syntax makes it possible to accumulate path satellites to a single verb". S-framed languages thus permit high levels of

structural complexity and semantic specificity with respect to path/ground information as well as verb semantics.

The *Thinking for Speaking Hypothesis* (Slobin 1996) predicts that speakers develop habitual, language-specific patterns of information packaging through selective attention to those aspects of events that are routinely explicitly encoded in a given language (Slobin 2004: 220; cf. Cadierno 2008; Ochsenbauer and Engemann 2011: 107). For instance, empirical research shows that "[c]hildren learning high-manner-salient languages develop a large and differentiated manner lexicon in the preschool years [...] and pay attention to manner of motion in experimental tasks" (Slobin 2004: 251).

So far, crosslinguistic research has mainly focused on whether developmental trajectories reflect language-specific typological patterns of information packaging (see below). With respect to the distinction between S- and V-framed languages, the encoding of (manner of) motion has received particular attention (Slobin 2006). There is less research on the more detailed development of children's constructional repertoire for specific conceptual slots, even if most studies point to some degree of gradual development of slot-filler complexity. In addition, most studies tend to focus on just the one slot in isolation, such as the verb lexicon or prepositional phrases.

2.2 Typological bootstrapping

If the languages of the world fall into typologically distinct groups of information packaging, the child's task is to attune to the language-specific preferences regarding both *information focus* (which aspects of information need to be expressed, which aspects of information may optionally be expressed) and *information locus* (which are the utterance slots and linguistic means used for the expression of specific aspects of information). Usage-based acquisition theory predicts that learners memorize (or entrench) and generalize over the attested frequent constructional schemas, and use them as templates for their own language use. As Gentner and Bowerman (2009) propose in their *Typological Prevalence Hypothesis*, languages differ as to the frequent and preferred distributional patterns, such that some information is more prominent (i.e., more perceptually salient as well as semantically more specific) in a given set of languages as compared to typologically different languages. The frequency of a pattern across languages may be an indicator that this particular aspect is more "natural" or easy to access than others. The prevalent patterns can thus lead to a kind of "typological bootstrapping" (Slobin 2001: 441), where the more accessible concepts are acquired first (see Gentner and Bowerman 2009, for prepositions).

Based on child and adult *Frog Story* narratives (Mayer 2003 [1969]), Bamberg (1994: 219) shows that German has "a rich collection of verbs of motion and caused motion, most of them simultaneously expressing manner", which are combined with a large range of verb particles that encode path/ground information. Even three-year-olds "command a large number of verb-satellite combinations" (Bamberg 1994: 220). Bamberg (1994: 238) concludes that even "[t]hree-year-olds have almost full command of this complex, satellite-framed system".

These findings are confirmed by Ochsenbauer and Hickmann (2010: 217) based on language productions by children of three to six years of age. This study uses an elicited production task with video stimuli depicting upward and downward motion events. With regard to the overall typological question of preferred lexicalization patterns, information focus, and information locus, the authors find that, as expected, children learning a highly manner-salient S-framed language such as German have no difficulty combining manner and path/ground information in complex spatial language utterances from early on: German three-year-olds adequately express manner in the main verb and path in particle satellites (e.g., *Der Frosch hüpft runter* 'The frog jumps downwards'). The authors conclude that, in the spatial language domain, the basic lexicalization patterns are the same for children and adults. Hence, typologically speaking, German children are target-like spatial language users: "from the earliest age tested onward (three years), German speakers express MANNER and PATH in compact utterances, encoding MANNER in the finite verb and PATH mostly in verbal particles" (Ochsenbauer and Hickmann 2010: 234).

Ji, Hendriks, and Hickmann compare spatial language development between English- and Chinese-speaking children aged three to ten (and corresponding adult speaker control groups). The study focuses on caused motion events in elicited descriptions of short video clips. The two main findings are: Firstly, Chinese-speaking children produce denser utterances (operationalized as frequencies of maximally informative utterances which explicitly encode three or more conceptual components) earlier than English children (Ji et al. 2011: 1806). According to the authors, this result is due to the fact that Chinese has prevalent high-frequency constructions that encode several spatial concepts, which children acquire and use early on (Ji et al. 2011: 1810). Secondly, irrespective of their native language, younger children produce less dense spatial language utterances than older children and adults (Ji et al. 2011: 1807–1808). This is explained by younger children's restricted processing capacities and/or their restricted repertoire of formal means of expression (Ji et al. 2011: 1804, 1808; cf. also Ochsenbauer and Hickmann 2016: 122–123). Note that information or utterance density are defined here from a typological perspective, hence in terms of the number and types of conceptual building blocks that are explicitly expressed, regardless of the actual

degree of complexity of the linguistic means of expression put to use. Note also that this study takes into account only the densest/most complex of a participant's utterances in response to each stimulus/video clip (Ji et al. 2011: 1802) and none of the other productions. The study thus tracks the levels of maximal complexity displayed by the different age groups in response to the stimuli, but does not provide information as to what the preferred and typical patterns are for each age group, nor the exact course of development. These issues will be addressed in our analyses (see Sections 4–6 below).

2.3 Gradual development

Most previous studies report some degree of gradual development of the structural complexity of spatial language in satellite-framed languages. For instance, Bamberg (1994) found that younger children aged three and five used a wide range of motion verbs, but that not all of them encoded manner of motion. He also found that children fluently combined different verbs with a range of directional verb particles to express paths, whereas specifications of ground elements such as goal or source, as expressed by more complex prepositional phrases, only become routinely available in the later preschool years (Bamberg 1994: 238).

With regard to children's early verbs, Ochsenbauer and Hickmann (2010: 227) report that, as is typologically expected, "[m]ain verbs expressed MANNER more frequently than PATH at all ages (77 % vs. 23 % overall)" in their study. This proportion changes with the children's age: the three- to six-year-olds produced substantial amounts of light verbs which only encode spontaneous motion, but not manner of motion. In 34 % of their utterances (compared to only 8 % of 10-year-olds and 2 % of the adult utterances, cf. Ochsenbauer and Hickmann 2010: 226), the unspecific motion verb *gehen* 'to go' was used as the main verb. This results in "PATH-only responses in which [children] express sheer motion in the verb and PATH in satellites (e.g., *to go up/down*)" (Ochsenbauer and Hickmann 2010: 233). This is in line with findings for English-speaking children who frequently use "'light' verbs in combination with satellites" (Gentner 1979; Ochsenbauer and Hickmann 2010: 223; cf. also Ji et al. 2011; Lange 2007; Ninio 1999).

Regarding the acquisition and expression of path and ground elements[1], Slobin (2004: 238) argues that "languages differ with regard to the canonical segmentation of paths as well as the relative ease of building complex-path

1 Adverbs and simple verb particles such as *rauf* 'upwards' only encode a path component, whereas, for instance, prepositional phrases encode path and ground. For the sake of simplicity, we will refer to this conceptual building block as the *path* slot.

constructions", that is, with respect to the degree of granularity of the verbal expression of paths and to the relative tightness of packaging of ground elements. Ochsenbauer and Hickmann (2010: 232) find that, overall, their German participants "used a great number of different verbal particles, most of which expressed different aspects of PATH" and that "speakers encoded PATH information not only in particles, but also in many other linguistic devices, such as prepositional phrases or adverbs, thereby producing very detailed PATH descriptions" (as illustrated by an adult speech sample). The number and type of path elements per event description changes with age, starting from 1.14 and 1.21 for the 3- to 6-year-olds, increasing to 1.42 for the 10-year-olds, and to 1.75 for the adult speakers (Ochsenbauer and Hickmann 2010: 228). Like Bamberg (1994), Ochsenbauer and Hickmann conclude that there is a remarkable

> increase in the semantic and syntactical complexity of children's utterances. For instance, the complexity of linguistic devices encoding information outside the main verb increased with age. As expected, young children most often used adverbs [...] to locate the motion event and simple particles [...] to describe path. It is only around six years that prepositional phrases [...] are used more frequently and with relative ease. (Ochsenbauer and Hickmann 2010: 234)

Bamberg (1994) suggests that, starting from the most basic deictic expression *da* 'there', German children's repertoire for the expression of path gets increasingly complex during the preschool and early school years. Bryant (2012) followed up on this research and investigated the acquisition of the structure and the semantics of prepositional phrases in German. Based on picture descriptions and spontaneous speech data, Bryant (2012: 29) posits that German children start out with monovalent spatial relations expressed by verb particles such as *rauf* 'upwards', which do not make the ground element explicit. Children start expressing ground elements through unspecific deictic adverbs such as *da* 'there', which enhance children's understanding that there is a possible ground slot to be filled in the bivalent path relation. German parents seem to help their children with this task as, at the relevant age, they produce many constructions with redundant or pleonastic[2] double coding such as *leg das mal da drauf* 'put this one there on top' (deictic ground + particle path) or, somewhat later, *leg das mal auf den Tisch drauf* 'put this one on the table on top', which illustrate the target pattern (path + ground) while also containing the simpler child pattern

2 So-called pleonastic paths are structurally complex but conceptually simple (Olsen 1996). They combine a prepositional phrase and a path particle that encode the same spatial relation, e.g., *aus dem Glas raus* 'out of the bowl outwards', whereas conceptually complex paths combine different path and/or ground elements, e.g., *aus dem Fenster in den Garten* 'out of the window into the garden'.

(path only). Bryant (2012: 217) shows that, around age 5;4, monolingual German children routinely express spatial relations through prepositional phrases, reaching 88 % of target-like uses (as compared to 47 % at age 3;3, 61 % at age 3;8, and 73 % at age 4;4). She proposes a developmental stage before age 5, where children are able to produce targetlike bivalent path/ground relations in the form of prepositional phrases, but tend to fall back on the simpler, more automatized *da drauf* 'on top there' constructions, for instance, in cognitively challenging picture description tasks (Bryant 2012: 233). In terms of semantics, at age 5;4, monolingual German children correctly differentiate between the five basic relations IN (*in*), ON (*auf*), UNDER (*unter*), OVER (*über*), and CONTACT (*an*), while possibly still working on the sagittal axis (*in front of, behind*) for canonical and non-canonical figures and relations (Bryant 2012: 217; see also Nachtigäller et al. 2013 for the acquisition of *under* by younger children).

Ochsenbauer and Hickmann (2016) address gradual development of information density in the verbalization of localization and placement events (in picture and event description tasks respectively) by four- and six-year-olds. The study compares German- and French-speaking children's event descriptions with respect to their preferences regarding information focus (which conceptual building blocks are expressed?) and information locus (by which linguistic means and in which constructional slot?). For the German children, Ochsenbauer and Hickmann's (2016: 131, 133) data show a substantial increase in terms of information density between four and six years of age: The proportion of utterances that express specific information both in the verb and in the satellite – in other words, utterances that contain both a semantically rich manner verb and a specific prepositional phrase – increases between four and six years of age for localization events (13 % for the four-year-olds, 30 % for the six-year-olds, and 33 % for the adults) and between child and adult speakers for placement events (43 % for the four-year-olds, 54 % for the six-year-olds, and 89 % for the adults). This indicates that, per utterance, young children express less specific information through structurally less complex linguistic means than adults, and that their responses "become increasingly specific and semantically dense with age" (Ochsenbauer and Hickmann (2016: 126).

2.4 Interim summary and open questions

The studies reviewed here have come up with two main findings: First, that children acquire language-specific information packaging strategies with respect to the required information focus and information locus from early on, regardless of whether the language type is verb-framed (e.g., French), satellite-framed

(e.g., English, German), or equipollently-framed (e.g., Mandarin Chinese). Consequently, German children routinely express manner in the verb (albeit not in all verbs!), and express paths (mostly as verbal particles) from three years onwards. Given the input patterns they hear, they get "manner for free", as Slobin (2003: 162) put it.

Second, most studies have shown some degree of gradual development regarding the structural complexity of spatial language utterances in satellite-framed languages. For instance, even if children learning S-framed languages do express manner in the main verb from early on, initially, they still use substantial proportions of semantically light, multi-purpose verbs without manner specification, such as *be, come, go*, or *put* (e.g., Ochsenbauer and Hickmann 2010). Various studies also point to increasing slot-filler complexity for the path satellites in German (e.g., Bamberg 1994; Bryant 2012). A certain limitation is that most studies focused on individual slots only (but see Ochsenbauer and Hickmann 2016), predominantly verb and satellites (see also Bryant 2012 for related criticism), and ignored the figure slot.

This leaves open the question of whether and when children display adult-like structurally complex and semantically dense constructions in the spatial language domain. In other words, what is the actual proportion of younger children's use of rather 'light' options such as copulas and unspecific lexical verbs (lacking manner information expected in S-languages) or adverbs and particles (instead of more informative prepositional phrases), and how exactly does this proportion change over time? And how do children acquire the ability to encode complex information in all slots across all spatial language events? If we assume that, from early on, children learning S-framed languages such as German are able to "express the MANNER and PATH of motion together in one single clause because their language possesses very compact structures allowing them to do so easily" (Ochsenbauer and Hickmann 2010: 222), how exactly does the actual usage of these patterns develop in spontaneous and elicited speech across early and middle childhood? Taking into account all constructional slots, is there evidence that "[d]ue to the impact of general developmental factors, the semantic information expressed in children's responses should increase with age" (Ochsenbauer and Engemann 2011: 108; cf. also Ji et al. 2011; Ochsenbauer and Hickmann 2016)?

3 Hypotheses and predictions

The main focus of this paper is to investigate the precise nature and timing of the development of constructional complexity in German spatial language. In particular, we are interested in how the individual conceptual slots are filled,

and what combinations are attested. To this end, we cover three types of spatial events and relations: localization, spontaneous motion, and caused motion events. We see them as distinct constructions that are interconnected in the constructional network through the conceptual slots they share (figure, verb, path/ground). Importantly, our analysis focuses on the interactions between different spatial language building blocks and on the integration of various knowledge components. The analyses are carried out at two levels: (i) the local one, where we look at the repertoire and complexity of the slot fillers for all conceptual units (see Sections 3.1 and 4 below), and (ii) the global one, where we look at the constructional repertoire at the utterance level and at the combinatorial complexity across the relevant slots (see Sections 3.2, 5, and 6 below).

3.1 Gradual development at the local complexity level

In line with findings in the typologically grounded research tradition focusing on (the acquisition of) the expression of manner of motion in S- and V-framed languages (see Section 2 above; cf. Bamberg 1994; Cadierno 2008; Ochsenbauer and Engemann 2011; Ochsenbauer and Hickmann 2010; Slobin 2003, 2004), we expect to find early competence in the encoding of the prevalent and basic language-specific spatial constructions: which information (figure, ground, motion, path, manner etc.) speakers routinely encode, and where this information is encoded (manner in the verb, for example) (cf. Ochsenbauer and Engemann 2011: 113).

In addition, we expect gradual development with respect to more fine-grained semantics and to the complexity of the linguistic means that are routinely recruited in each conceptual slot, as predicted by the usage-based assumption of extended learning trajectories from *emergence* to *mastery* (cf. Berman 2016: 461): "linguistic forms may **emerge** early on, typically in the preschool years, but they take a long time to develop from acquisition to **mastery**" (boldface in the original). Note that this entails two processes: automatization and routinization on the one hand, such that an element is provided more often and/or in an increasing range of new contexts, and elaboration on the other hand, such that the conceptual and constructional complexity increases. Typically, complexity increases gradually as new forms are coined for old functions, and familiar means get used for new functions (Berman 2016). Increasing complexity at some point in the system (e.g., inflection or clause length) may also interact with developing complexity at other points in the system (e.g., subordination or global narrative skills), either in supportive or in competing ways (cf. Berman 2016; Verspoor et al. 2008). Children thus acquire increasingly more tightly

cohesive syntactic packaging abilities (Berman 2016: 475ff; cf. Berman and Slobin 1994b: 80–81). In the same vein, Ochsenbauer and Hickmann (2010: 224) posit that primarily children's "uses of devices outside of the verb root should show some change with age as a function of grammatical complexity" without further pursuing this issue in their study.

3.2 Gradual development at the global complexity level

Complexity can be measured at the structural and at the conceptual level. Structural complexity can be measured in terms of phrase, clause, utterance, or turn length (e.g., Hsu 2017: 12–13; Pallotti 2015: 123–124; Verspoor et al. 2008; see Bhat and Yoon 2015: 46 for an overview), degrees of irregularity (cf. Culicover 2014: 148–149), and/or levels of hierarchical structure (e.g., mean number of modifiers per noun phrase or mean number of higher level constituents per sentence, controlling for number of words, cf. Graesser et al. 2004; see also Rescher 1998; for constitutional, taxonomic, organizational, and hierarchical complexity). However, as Juola (2008: 89) points out, "[a]ny claim about 'complexity' is inherently about processing, including an implicit description of the underlying cognitive machinery". Hence, structural complexity is related to conceptual complexity (because the verbalization of cognitively more complex concepts possibly needs structurally more complex language), as well as processing complexity (because complex linguistic means tend to be less frequent, and hence more difficult to access and to process).

We thus expect gradual development of constructional complexity in the conceptual *and* structural domain (cf. Pallotti 2015: 118), and predict significant developmental changes in information density and complexity across the individual conceptual slots *and* across the network of spatial language constructions in German. In other words, it may still be a rather long way from utterances such as *He went outside* and *He walked home* to *The little pony jumped over the fence* or *The smart little frog sneaked out of the window down to the lawn into the garden*. Our analyses track this development combining quantitative and qualitative perspectives.

We expect younger children to differ from older children and adults in terms of their abilities and preferences with respect to the combination and compression of spatial information into globally dense spatial language utterances. Even after the individual building blocks are conceptually and structurally available to them, young children will tend to tiptoe into the spatial language system, producing fewer spatial language utterances that include maximally informative and complex slot-fillers in all constructional slots in one utterance (cf.

Ochsenbauer and Hickmann 2016 for related findings). These initial restrictions on the preferred level of combinatorial complexity are expected to decrease and disappear with age, and eventually even to reverse for adult speakers. Note that from a usage-based perspective, it is still not a given that adult speakers should always prefer maximally information-dense and complex spatial language utterances (cf. Dąbrowska 2012 on individual differences in native language attainment); it is an empirical question to what extent adult language users tend to compress spatial information into complex utterances in, for instance, specific genres or interactional contexts (or, for instance, distribute different aspects of information across various sentences); adult data will therefore also be under scrutiny in the following sections.

3.3 Hypotheses

In line with prior findings on spatial language (e.g., Bryant 2012; Gentner 1979) and with usage-based approaches that show gradual or "piecemeal" (Bowerman 1982) development in general (cf. Behrens 2009; Tomasello 2003), we expect gradual development in the spatial language domain. At the level of local complexity, where we look at the complexity of slot-fillers in individual constructional slots (figure, verb, path/ground), gradual development will be reflected in younger children's significantly larger preferences for locally less complex slot-fillers (as compared to older children and adult speakers):

Hypothesis 1: Slot-filler complexity (local complexity)

1. Younger children will have a preference for 'light' slot fillers in the individual constructional slots. Overall, when compared to older children and adults, they will produce significantly
   - more simple path/ground elements such as deictic adverbs and verb particles and fewer more complex path/ground elements such as prepositional phrases and (conceptually and structurally) complex paths including more than one path satellite
   - more semantically light verbs such as copulas and modal verbs and fewer semantically complex verbs such as manner-of-motion verbs and lexical verbs specifying figure orientation for localization and placement.
2. With age, slot-filler complexity will increase, resulting in a preference for more complex slot-fillers in adult speakers. With age, we will see
   - a significant decrease of deictic path/ground element proportions and a significant increase of prepositional and complex path/ground proportions

– a significant decrease of semantically light verb proportions and a significant increase of the proportions of usage of semantically complex verbs, specifying manner of motion or orientation of localization/placement.

Hypothesis 1 is tested in Section 4. The analyses at the local complexity level then form the basis for the analyses of global complexity, where we look at how various locally complex slot-fillers may be integrated into globally complex constructions at the utterance level. Here, we predict larger global trade-off tendencies for younger children (as compared to older children and adult speakers). A trade-off is understood as a negative correlation between variables (cf. Sinnemäki 2008: 71). If such a trade-off tendency is found in the younger children while decreasing for the older children and disappearing or even reversing for adult speakers, this will indicate processes of gradual development or refinement with respect to the routinization of (locally complex) lower-level slot-filler constructions and to the automatization of their integration into higher-level constructions of increasing complexity at the global level, as expected in usage-based approaches. Our second hypothesis is as follows:

Hypothesis 2: Combinatorial complexity (global complexity)

3. Younger children will display a preference for 'light' combinations across the constructional slots of spatial language utterances.
   Pairwise partial correlations between verb and path, verb and figure, and path and figure components will tend to be negative for younger children, indicating that – all other things being equal – if one slot-filler is locally complex, the second one will tend to be light, thus resulting, by trend, in globally rather light constructions.
4. With age, combinatorial complexity within spatial language utterances will increase, possibly resulting in unrestricted combinatorial flexibility or even a preference for precise and globally complex spatial language utterances for adult speakers.
   Pairwise partial correlations between verb and path, verb and figure, and path and figure components will not reach statistical significance for older children and adults, indicating the absence of combinatorial restrictions in older speakers.

These expectations contrast with assumptions on the development of complexity in narrative competence. Strömqvist and Verhoeven (2004: 9) posit that younger children take fewer expressive options and that their narratives are less complex than older children's and adults' narratives because, "linguistically, they do not command the full range of formal devices". In the spatial

language domain, by contrast, monolingual German children from age three on are expected to display command of a range of complex constructions at the local complexity level (noun phrase, prepositional phrase, manner-of-motion verbs, etc.). However, the routinized integration of various locally complex slot-fillers at the global constructional level will only develop gradually over the preschool and early school years, giving rise to the expected trade-off for combinatorial complexity in the younger children. Hypothesis 2 is tested in Sections 5 and 6 below.

4 Gradual development of local complexity in elicited narratives

In our first analysis, we investigate how monolingual German speakers express static and dynamic spatial relations when narrating a picture story, and how the local complexity of slot fillers develops with age. Hypothesis 1 predicts an early emergence of the full slot-filler repertoire, but smaller proportions of complex slot-filler types for preschoolers than for older speakers.

4.1 Method: data and coding

4.1.1 Data

We reanalyzed 48 German Frog Stories (Bamberg 1994) elicited from monolingual three- (n = 12), five- (n = 12), and nine-year-olds (n = 12) as well as adult speakers (n = 12), which are very rich in spatial language. The data are available in the CHILDES data base (MacWhinney 2000). We identified 2243 utterances that encode localization, spontaneous motion, or caused motion (out of a total of 3514 utterances).

Coding Scheme

We coded all of the 2243 utterances (i) for the basic event type (localization (n = 910), spontaneous motion (n = 1165), caused motion (n = 167), unclear (n = 1)) and (ii) for the complexity of the corresponding slot fillers in the localization and motion event constructions. We distinguish the following levels of local complexity for each conceptual slot (Table 1):

Table 1: Local complexity levels.

	FIGURE	VERB	PATH/GROUND
Low Complexity	**Pronoun**	**Copula**	**Deictic Adverb**
↕	*Der* 'he'	*ist* 'is'	*da* 'there'.
	Noun Phrase (NP)	**Modal Verb**	**Adverb/Particle (a/p)**
	Der Frosch 'the frog'	*will* 'wants'	*oben* 'on top' / *runter* 'downwards'.
		Lexical Verb	**Prepositional Phrase (PP)**
		geht 'goes'	*aus dem Glas* 'out of the bowl'.
	Complex Noun Phrase	**Manner Verb**	**Complex Path**
	Der schlaue kleine	*klettert* 'climbs' /	*aus dem Fenster runter in den*
High Complexity	*Frosch* 'the smart little frog'	*hüpft* 'jumps' / *sitzt* 'sits'	*Garten* 'out of the window downwards into the garden'.

In the following, we explain the rationale for establishing these complexity rankings. Regarding the verbs, four levels of complexity are distinguished:

- copula verbs (e.g., *sein* 'be')
- modal verbs (e.g., *wollen* 'want', *können* 'can' – note that in German modal verbs can be used in isolation to encode intentionality and modality)
- lexical verbs without manner specification (e.g., *gehen* 'go'[3], *kommen* 'come', *tun* 'put')
- lexical verbs with manner specification (e.g., *sitzen* 'sit', *hüpfen* 'jump', *legen* 'lay')

This order reflects both frequencies of occurrence (e.g., copula verbs are more frequent than lexical verbs, and lexical verbs without manner specification, such as *come* and *go*, are more frequent than those with clear manner specification, such as *climb* and *crawl*, cf. Lange 2007: 143) and the number of relevant semantic features of the verbs (cf. Ochsenbauer and Hickmann 2010: 226; see also Hofmeister 2011: 380 on feature-based complexity). For instance, modal verbs or lexical verbs without manner specification represent semantically light, neutral passe-partout verbs that are unspecific as to how or why the event takes

3 One reviewer raised concern with regard to our categorization of the verb *gehen 'go'* as a path verb and not as a manner verb. It is true that *gehen 'go'* can be used to specifically denote motion on foot, that is, walking. We thus checked all occurrences of *gehen 'go'* within our data set (n = 122 in the elicited narratives, n = 161 in the spontaneous speech data) and found that none of them specifically referred to motion on foot/walking as contrasting with other manners of motion. Instead, *motion on foot* is typically referred to as *laufen 'walk'*. See also Ochsenbauer and Hickmann (2010) for coding of *gehen 'go'* as path verb without manner specification.

place, whereas lexical verbs with manner specification such as *stand*, *run*, or *drive* include more relevant semantic information regarding, for example, the orientation of a figure's localization or the manner and/or instrument of motion (Lange 2007: 143; cf. Ochsenbauer and Hickmann 2010: 226).

As for the path elements, there are a number of linguistic options in German (cf. Haggblade 1994). Our complexity ranking primarily reflects structural complexity (words, phrases, combinations; see Table 1). Path and ground may be subject to ellipsis if they are recoverable from the context or have been established at a prior point in time, for example, in a preceding question (e.g., *Was macht der im Garten?* 'What is he doing in the garden?' – *Der hüpft*. 'He is jumping.'). Path/ground slot-fillers can be realized as

- deictic adverbs (e.g., *da* 'there')
- non-deictic local adverbs (e.g., *oben* 'on top') and directional verb particles (e.g., *runter* 'downwards')
- prepositional phrases (e.g., *in den Garten* 'into the garden').

The order of complexity reflects the numbers of (i) components, (ii) component types, and (iii) components of these components (cf. Fenk-Oczlon and Fenk 2008: 44–45). In an S-framed language, different path/ground elements can also be combined to form structurally even more complex path descriptions such as *aus dem Fenster runter in den Garten* 'out of the window downwards into the garden') within one utterance. Such structurally complex paths may be conceptually complex (actual multi-stage paths), as illustrated in the preceding example, or just pleonastic and conceptually simple (e.g., *aus dem Glas raus* 'outside out of the bowl').

Finally, the figure slot is either encoded as the subject in localization and spontaneous motion events or as the object of caused motion events. In coordinated constructions, the figure can be omitted (e.g., *Der rennt und hüpft* 'He is running and jumping.'). If the slot is filled with a nominal element, this element can be (see Table 1)

- a pronoun (e.g., *er* 'he')
- a simple noun phrase (e.g., *der Junge* 'the boy')
- a complex noun phrase (e.g., *das Auto mit dem grünen Dach* 'the car with the green roof').

4.1.2 Coding

Four trained coders annotated the data. About half of the coding was done by the first and second authors, who also resolved any ambiguous cases highlighted by the other coders in discussion with them. About 10 % of the data

were recoded blindly by a different coder, yielding corrected κ values (Brennan and Prediger 1981) of 0.93 for interrater agreement concerning the basic event type; of 0.87 for verb type; of 0.86 for path type; and of 0.82 for figure type.

4.2 Results: local slot-filler complexity

We expected speakers from the youngest age on to display command of the language-specific constructional patterns for the verbalization of localization and motion events, including a repertoire of relevant slot-fillers of varying levels of (local) complexity, for instance, pronouns and noun phrases for the figure slot, particles and prepositional phrases for the path/ground slot, and copula/modal as well as lexical verbs. However, we hypothesized that the younger children would display, for each of these constructional slots, a preference for structurally and/or semantically light(er) elements such as deictic adverbs (*da* 'there') and semantically neutral, lexically unspecific verbs.

Our analyses at the local level are carried out across event types (localization, spontaneous motion, caused motion). Even though there are different verbs to encode the different event types, they are generally comparable because German is manner-dominant across all event types. In addition, we assume that the different event types are connected in perception and representation through their three shared conceptual slots. Also, a separation of the event types would lead to considerably smaller numbers of tokens such that statistical analyses do not reach significance. However, all separate analyses for each of the event types converge upon the trends described here and in the following sections.

4.2.1 Verb slot: Motion/localization and manner/orientation

We present findings for the verb slot first. Figure 1 shows token frequencies, that is, raw numbers of occurrences of the different slot-filler types (verb categories) in the individual age groups. Slot-filler complexity (see Table 1 above) increases from the left-most (*no verb*) to the right-most plot panel (*lexical verbs with manner specification*). For each category, development is plotted from left (3-year-olds) to right (adults). We analyze development across the four age groups with Kruskal-Wallis tests, a non-parametric alternative to a one-way ANOVA. All tests were computed with the software R, version 3.3.0 (R Core Team 2015) and Bonferroni-corrected for multiple comparisons.

As expected, the full verb repertoire is actually available to the youngest age groups (left-most bars), but the younger children still do not produce many of

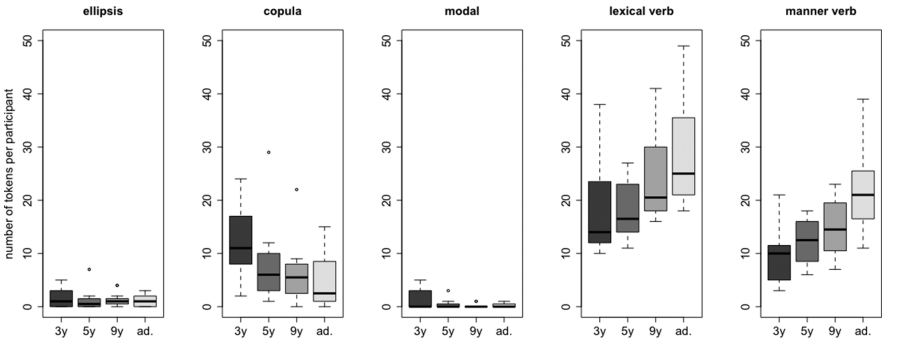

Figure 1: Gradual development of slot-filler complexity in the verb slot. The x-axes in each panel show development for each of the verb types (from the 3-year-olds [to the left] to the adults [to the right]). The y-axes plot token frequencies, that is, raw numbers of occurrences for each verb category (medians by participant per age group). The whiskers range over 1.5 interquartile range.

the more complex options (i.e., lexical verbs without and with manner specification). In line with Hypothesis 1, we find gradual development of local, slot-filler complexity. With age, speakers come to produce significantly more semantically rich, complex lexical verbs, both without (Kruskal-Wallis chi-squared = 13.09, df = 3, p = 0.0222, panel "lexical verb") and with manner specifications (Kruskal-Wallis chi-squared = 16.953, df = 3, p = 0.0036, panel "manner verb").[4] As expected, none of the other, less complex categories yield significant development (*ellipsis/no verb*: Kruskal-Wallis chi-squared = 1.242, df = 3, p = 1; *copulas*: Kruskal-Wallis chi-squared = 8.1069, df = 3, p = 0.22; *modals*: Kruskal-Wallis chi-squared = 3.5846, df = 3, p = 1).

4.2.2 Path slot

We now look at the path slot. Figure 2 shows the token frequencies of the different path slot-filler types (categories) in the individual age groups. Slot-filler complexity (see Table 1 above) increases from the upper left-most (*ellipsis*)

4 Note that adults use 37,8 % lexical verbs with manner specification (either posture or manner of motion) in the elicited *Frog Story* narratives (258/683 adult spatial language utterances: 78/251 localization descriptions; 157/382 spontaneous motion events; 23/50 caused motion events). This proportion is somewhat smaller than that reported by Ochsenbauer and Hickmann (2016: 135, 138) for adult usage in a controlled experiment (86 % manner specification for localization, 46 % for caused motion), where manner/posture contrasts were probably more salient; taken together, these data show that the conceptual component manner/posture is routinely but not obligatorily expressed (in the main verb) in S-framed German.

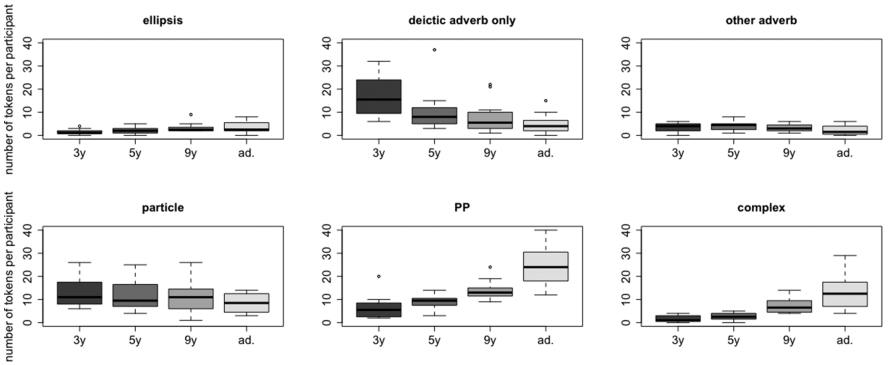

Figure 2: Gradual development of slot-filler complexity in the path slot. The x-axes show development for each of the path types (from the 3-year-olds [to the left] to the adults [to the right]). The y-axes plot token frequencies, that is, raw numbers of occurrences for each path category (medians by participant per age group). The Whiskers range over 1.5 interquartile range.

to the lower right-most plot panel (*complex paths*). For each category, development is plotted from left (3-year-olds) to right (adults). As in Section 4.2.1, we analyze development across the four age groups using Bonferroni-corrected Kruskal-Wallis tests.

As expected, we find that slot filler complexity increases with age in the path slot, too: Figure 2 shows that the use of semantically unspecific and structurally very simple deictic adverbs significantly decreases with age (Kruskal-Wallis chi-squared = 16.917, df = 3, p = 0.0044). At the same time, the use of more informative and structurally more complex prepositional phrases increases significantly with age (Kruskal-Wallis chi-squared = 31.88, df = 3, p < 0.0001). In other words, older children and adults are more likely to specify the ground element in a prepositional phrase. Token numbers of complex path descriptions, consisting of at least two (non-deictic) path/ground elements, also significantly increase with age (Kruskal-Wallis chi-squared = 33.903, df = 3, p < 0.0001). None of the other categories yield significant development (*no path/ellipsis*: Kruskal-Wallis chi-squared = 10.357, df = 3, p = 0.0946; *particles*: Kruskal-Wallis chi-squared = 2.636, df = 3, p = 1; *adverbs*: Kruskal-Wallis chi-squared = 6.1543, df = 3, p = 0.6258).

It is interesting to have a closer look at the development of the complex paths here. An in-depth analysis of all complex path productions (n = 303) reveals additional evidence for gradually increasing constructional complexity: younger children not only produce fewer complex paths, but they also produce less complex complex paths (Table 2): Younger children's complex paths consist of two elements at most, with a maximum of one prepositional phrase

Table 2: Structurally complex path productions (tokens per age group). Columns 3–5 further specify the degree of complexity of those paths that are both structurally and conceptually complex, indicating how many of the overall tokens (as indicated in column 2) combine either two (2 comp.) or three (3 comp.), or four and more distinct path/ground elements (4+ comp.).

	pleonastic	conceptually complex	2 comp.	3 comp.	4+ comp.	part of prepositional phrases (PP)
3-year-olds	9	8	8	0	0	6 × 1 PP
5-year-olds	19	17	17	0	0	11 × 1 PP 4 × 2 PPs
9-year-olds	52	37	31	6	0	26 × 1 PP 8 × 2 PPs
adults	74	84	57	22	5	50 × 1 PP 21 × 2 PPs 4 × 3 and more PPs

involved (e.g., *rein ins Wasser* 'into in the water'). Nine-year-olds sometimes encode a third element (6/37), but still very rarely combine two prepositional phrases (e.g., *den Abhang hinunter genau ins Wasser* 'down the cliff directly into the water'). Adults routinely combine three or more elements into one complex path (27/84), all of which may be prepositional phrases (e.g., *aus dem Fenster auf den Boden in den Garten* 'out of the window down to the floor into the garden'). However, in contrast to prior assumptions (e.g., Bryant 2012), the overall proportion of structurally complex but semantically simple pleonastic paths does not decrease with age. Rather, their frequency increases with age, just as the conceptually complex paths that involve the encoding of several path elements.

4.3 Interim summary

Our results regarding gradual development of local complexity in the relevant verb and path slots confirm our first hypothesis, as well as previous research. Monolingual German children respect the language-specific lexicalization patterns for their native language from early on, but prefer structurally and/or semantically rather light elements such as verb particles (instead of full prepositional phrases) or copula and path verbs (but not manner-of-motion verbs) as slot-fillers. We now turn to the crucial question of systematicity in younger children's complex slot-filler combinations at the global utterance level.

5 Gradual development of global complexity in elicited narratives

The following analyses show how mastery of complexity in the individual constructional slots (figure, verb, path) is interrelated in development. While adults can be expected to freely combine several locally complex slot-fillers within information-dense, globally complex spatial language constructions, we expected the younger speakers to display preferences for lower levels of global complexity at the utterance level. Younger children's avoidance of maximally condensed and complex spatial language utterances should be reflected in partial trade-off tendencies between pairs of slot-fillers such that, if one slot is filled by a relatively complex element, the other slot will likely be filled by a structurally and/or semantically light(er) element. These initial global complexity trade-off tendencies were expected to gradually decrease and finally disappear with age.

5.1 Method: data, coding, and analysis

5.1.1 Data

Our analysis is based on the reanalysis of the same 48 German *Frog Stories* (Bamberg 1994) elicited from monolingual three-, five-, nine-year-olds, and adult speakers. For general data description and coding procedures see Section 4.1. In the following analysis on utterance complexity, we only include those utterances where all relevant slots – figure, verb, and path/ground – are overtly filled and interpretable. Elliptical utterances are thus excluded from the analysis, as there are numerous factors that lead to the omission of elements that are not at stake here and would require further analyses at the text level. Incomplete utterances and utterances containing inintelligible parts as well as utterances encoding figurative motion and embedded spatial language constructions were also excluded from the analyses presented here. After the exclusion of all incomplete, elliptical, embedded, and figurative utterances, our data set consists of 1669 utterances (n = 437 for the 3-year-olds; n = 409 for the 5-year-olds; n = 384 for the 9-year-olds; n = 450 for the adult speakers).

5.1.2 Data analysis

We report evidence from partial correlations, computed with the software R, version 3.3.0 (Kim 2015; R Core Team 2015). Partial correlations not only measure

the degree of association between two variables, but they estimate such associations whilst controlling for other factors. We report more conservative correlational rather than predictive statistics (e.g., ANOVA, regression models), because from a sentence processing perspective, the order of constituents does not necessarily reflect the order of speech planning. Since we do not know for sure that the first element is planned before the following one(s), a particular spatial element cannot be treated as the dependent variable of the other element(s). Path complexity, for example, cannot be predicted from the combined figure and verb complexity.

Specifically, we computed partial correlations between (1) figure and verb complexity (see Section 5.2.1), (2) figure and path complexity (see Section 5.2.2), and (3) verb and path complexity (see Section 5.2.3). As two variables may be correlated just because both are associated with a third variable, we control, in each case, for degrees of complexity in the third constructional slot as well as for relevant background variables (the individual speaker and the event type [i.e., localization, spontaneous motion, caused motion]). Therefore, partial correlations between the verb and path slots, for instance, estimate the unique degree of association between the corresponding slot-filler complexity in each of these two slots, when all other variables – the complexity of the third constructional slot (figure), the basic event type, and the individual speaker within the age group – are equal, that is, they are controlled for or partialed out. The partial correlation coefficient is thus meant to reflect the degree of association between the verb and the path complexity *only*, excluding any spurious effects due to possible additional correlations with and between the other variables. Since we use ordinal coding scales, we report Spearman's rank correlation coefficients.

5.2 Results: combinatorial complexity

As stated in our second hypothesis (see Section 3.3 above), we expect that younger children will tend to show a complexity trade-off in the form of negative partial correlations between local complexity levels in the individual constructional slot. If one of the slots is filled by an element ranging high on the complexity scale (e.g., a manner-of-motion verb), the other element will tend to be light (e.g., a pronoun). Positive correlations are possible when children prefer light slot-filler elements across the different constructional slots. We expect that these combinatorial restrictions will decrease over time, such that the adult speakers will display unrestricted combinatorial flexibility or even a preference for globally highly complex combinations of various locally complex slot-fillers.

5.2.1 Figure – verb correlations

Figure 3 shows the total numbers of occurrences (combined for all participants per age group) of the different combinations of figure and verb types across the age groups. From left to right, the four panels plot the combinations in the individual age groups (3-year-olds to adults). The individual panels illustrate how many tokens of the different combinations are attested per age group. If we take the left-most panel as an example, the overall height (y-axis) of the three stack bars indicates the number of pronouns, noun phrases, and complex noun phrases produced by the three-year-olds in the figure slot. The dark grey parts at the bottom of these stack bars indicate the respective numbers of copula verbs occurring with pronouns, nouns, and complex noun phrases in the figure-slot, whereas the beige parts at the top of the bars indicate the respective numbers of combinations with manner verbs.

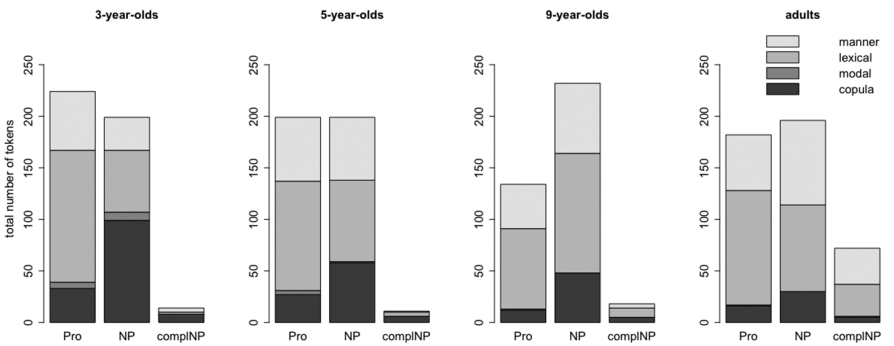

Figure 3: Figure-verb correlations in the *Frog Stories*. The x-axes plot the three categories of slot-fillers in the figure slot, in increasing order of complexity from pronouns (*Pro*, left-most stack bars) to noun phrases (*NP*, middle stack bars) and complex noun phrases (*complNP*, right-most stack bars). The y-axes plot token numbers of combinations of each of the three figure categories with the four different verb categories; slot-filler complexity for the verb slot increases from the bottom (copula verbs) to the top of the stack bars (lexical verbs with manner specification).

Figure 3 shows that, for the three-year-olds, the proportion of copulas occurring with pronoun figures (e.g., *he is*; bottom area of the left-most stack bar) is clearly smaller than the proportion of copula verbs occurring with more complex figures (e.g., *the frog is, the little frog is*; bottom area of the middle and right-most stack bar). In contrast, the proportion of semantically rich manner verbs (top area of each stack bar) is clearly larger in the left-most stack bar (representing the combinations with 'light' pronoun figures, e.g., *he sits*, *he*

jumps) than in the stack bars representing the combinations with more complex figures (e.g., *the frog sits, the little frog jumps*) as produced by the three-year-olds. Comparison with the other plot panels shows that these preference biases decrease with age and even show the reverse pattern for the adults (right-most panel).

In sum, the *Frog Story* data show that, as expected, younger children disprefer combinations of more complex slot fillers within the same utterance (e.g., semantically rich manner verbs and structurally complex figures), resulting in highly significant negative partial correlations between figure and verb complexity at ages three ($r_s = -0.32$; $p < 0.001$), five ($r_s = -0.13$; $p < 0.001$), and nine ($r_s = -0.11$; $p < 0.001$).[5] In other words, there is a substantial complexity trade-off between the figure and verb slots primarily for the younger children (aged three). All other things being equal, if one of the slots is filled by a comparatively complex element, the other slot will tend to be filled with a comparatively light element. So for instance, if younger children use a full or complex noun phrase as the figure, the verb will tend to be lighter (e.g., ***die Eule*** *war da* '**the owl** was there') within this same utterance than when the figure is realized through a simple pronoun (e.g., ***der*** *sitzt im Wasser* '**he** is sitting in the water'). With age, these initial restrictions on information complexity decrease and even reverse, resulting in lower negative correlation coefficients for the five- and nine-year-olds, and in positive correlations for adults ($r_s = 0.11$; $p < 0.001$). The adults show a higher clustering of complex figure and verb elements; they routinely combine full and complex noun phrases with semantically specific lexical verbs, and they are even more likely to produce a semantically rich manner-of-motion verb if the figure is also structurally more complex.

In a second step, we look at the amount of individual variation within the age groups. Table 3 depicts the token frequencies of the more complex combinatorial possibilities as well as the number of individual participants in each of the four age groups ($n = 12$ each) for whom this specific combination is attested. While most of the three- and five-year-olds are able to produce globally relatively complex combinations with a full noun phrase in the figure slot and a lexical verb without or with manner specifications in the verb slot, neither the three- nor five- nor even nine-year-olds routinely produce the most complex possible combinations (including a complex noun phrase and a lexical verb with or without manner specification), whereas these are common patterns in adult speech.

5 Note that all correlation coefficients refer to comparisons within the individual age groups, not between age groups.

Table 3: Token frequencies of the individual combinations of figure and verb categories across age groups and numbers of individual participants for whom the specific combinations are attested.

	3-year-olds		5-year-olds		9-year-olds		adults	
	tokens	participants	tokens	participants	tokens	participants	tokens	participants
noun phrase + lexical verb	60	12	79	12	116	12	84	12
noun phrase + lexical verb with manner specification	32	10	61	12	68	12	82	12
complex noun phrase + lexical verb	2	2	4	3	9	8	31	10
complex noun phrase + lexical verb with manner specification	4	4	1	1	4	4	35	11

5.2.2 Figure – path correlations

Similar complexity trade-offs are found between the figure and path slots. Figure 4 follows the same logic as Figure 3 above; again, the x-axes (individual bars in each panel) plot figure complexity (in increasing order from left, pronouns, to right,

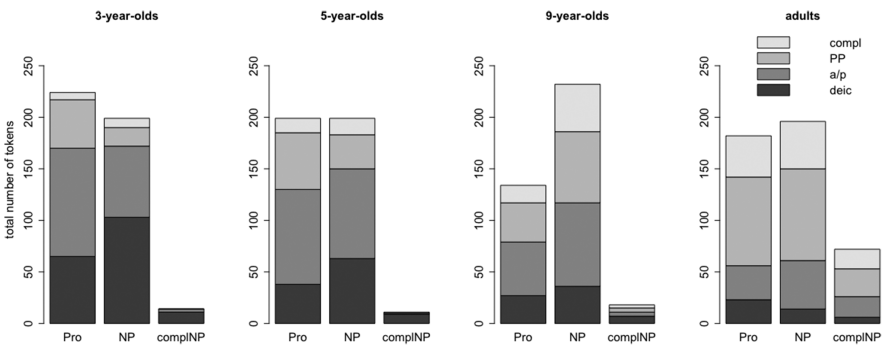

Figure 4: Figure-path correlations in the *Frog Stories*. The x-axes plot the three categories of slot-fillers in the figure slot, in increasing order of complexity from pronouns (*Pro)*, simple noun phrases (*NP*) and complex noun phrases (*complNP*). The y-axes plot token numbers of combinations of the three figure categories with the four different path categories. Slot-filler complexity for the path slot increases from the bottom to top: deictic adverbs (*deic*), other adverbs and particles (*a/p*), prepositional phrases (*PP*), and complex paths with several path elements (*compl*).

complex noun phrases). The y-axes (stack bar heights) now plot the number of combinations (combined for all participants per age group) with the respective path categories (in increasing order of complexity from bottom [deictic adverbs] to top [complex paths]).

Again, we find preference biases with respect to the combinations across the two slots. For instance, the three-year-olds produce a larger proportion of more complex path types (i.e., prepositional phrases or complex paths) in combination with 'light' pronouns (cf. top areas of the left-most stack bar in the left-most panel) than with more complex figure types. In return, a larger proportion of the (light) deictic paths is combined with more complex figure types (than with simpler pronoun figures) by the three-year-olds (bottom area of the bars); complex noun phrases in the figure slot are almost exclusively combined with light deictic paths by three- and five-year-olds.

In sum, Figure 4 shows that younger children significantly avoid globally highly complex combinations between locally complex figure and locally complex path elements within one utterance, although they are clearly able to produce all slot-filler types for both constructional slots in isolation or in less complex global utterance-level contexts. We find significant negative correlations at ages three ($r_s = -0.25$; $p < 0.001$) and five ($r_s = -0.17$; $p < 0.001$). Younger children are thus more likely to produce more complex path/ground elements, such as prepositional phrases or complex paths, if the figure element is light, that is, a pronoun. If the figure element is more complex, such as a full or even complex noun phrase, the younger children's path/ground elements tend to be lighter (e.g., deictic, adverb, or particle). With age, the initial combinatorial restrictions on global complexity disappear, indicating full combinatorial freedom for the older speakers ($r_s = 0.06$, $p = 0.12$ n.s. for the 9-year-olds; $r_s = 0.01$, $p = 1$ n.s. for the adults).

Again, we add a second analysis to study individual variation. Table 4 below lists, for each combinatorial possibility of the more complex figure and verb categories, the number of occurrences as well as the number of individual participants in each of the four age groups ($n = 12$ each) for whom this specific combination is attested. The data show that a substantial proportion of the younger children (66 % of the three-year-olds, 83 % of the five-year-olds) and all older participants produce relatively complex combinations of a full noun phrase in the figure slot and a prepositional phrase in the path slot. In contrast, only five three-year-olds and seven five-year-olds produce globally complex combinations with full noun phrases in the figure slot and structurally complex paths, even if pleonastic paths – which are structurally complex, but conceptually simple – are included. As expected, the younger children virtually never combine maximally complex figure slot-fillers with the more complex path

Table 4: Token frequencies of the individual combinations of figure and path categories across age groups and numbers of individual participants for whom the specific combinations are attested.

	3-year-olds		5-year-olds		9-year-olds		adults	
	tokens	participants	tokens	participants	tokens	participants	tokens	participants
noun phrase + prepositional phrase	18	8	33	10	69	12	89	12
noun phrase + complex path	9	5	16	7	46	12	46	9
complex noun phrase + prepositional phrase	0	0	0	0	4	4	27	9
complex noun phrase + complex path	0	0	1	1	3	3	19	7

types. These patterns seem to be challenging even for the nine-year-olds (33 % and 25 % of the participants) and are not attested for all adult speakers either (75 % and 58 % of the participants), even though adults clearly master the component parts.

5.2.3 Path – verb correlations

Path-verb correlations in the *Frog Story* narratives pattern differently from two previous correlations, but they still support our hypotheses. There are no negative correlations for the younger speakers in this case, but the correlations turn out to be positive and similar for all age groups (3-year-olds: $r_s = 0.23/p < 0.001$; 5-year-olds: $r_s = 0.31/p < 0.001$; 9-year-olds: $r_s = 0.25/p < 0.01$; adults: $r_s = 0.19/p < 0.001$). However, Figure 5 strongly suggests that the positive correlations for the younger children result from different preferences than those of the adults': For the younger children, the plot shows a clear bias to the left and to the bottom categories, that is, towards combinations of light elements – deictic or adverbial/particle paths in combination with semantically unspecific verbs such as copula verbs. In contrast, the adult data cluster to the right and to the top categories, that is, towards combinations of comparatively complex path/ground elements – prepositional phrases and multi-stage complex paths – as combined with semantically specific, rich lexical verbs with manner specifications.

Again, there is individual variation especially in the youngest age group: Table 5 lists the number of occurrences for each combinatorial possibility of the

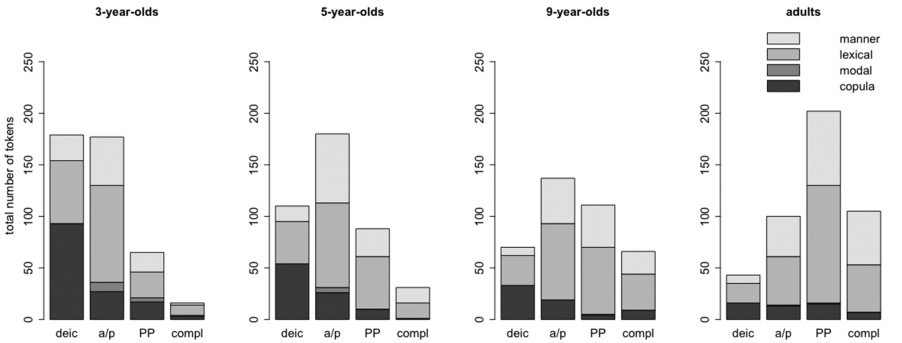

Figure 5: Verb-path correlations in the *Frog Stories*. The x-axes plot the slot-fillers in the path slot, in increasing order of complexity: deictic adverbs (*deic*), adverbs and particles (*a/p*), prepositional phrases (*PP*), and complex paths (*compl*). The y-axes plot token numbers of combinations of the four path categories with the four different verb categories in increasing complexity from bottom to top.

more complex figure and verb categories, as well as the number of participants per age group (n = 12) for whom this specific combination is attested. Table 5 shows that verb-path combinations with lexical verbs and prepositional phrases are attested for all participants. In contrast, the next complex constructions (lexical verbs with complex paths or lexical verbs with manner specification and prepositional phrases) seem to be more of a challenge for the three- and five-year-olds (attested for 50 %/75 % of the 3-year-olds and 75 %/83 % of the 5-year-olds respectively). The most complex verb-path combinations with manner verbs and complex paths are virtually unattested in the youngest age group and still less common with the five- and nine-year-olds than for the adults, for whom this seems to be a regular and readily available pattern (attested for 11 out of 12 adults).

5.3 Complexity across all three constructional slots

In addition to the preceding quantitative correlational analyses focusing on slot pairs, we round off our data inspection with a qualitative look at the combinatorial potential across all three constructional slots. This also constitutes a rough approximation to the question which of the slots drives younger children's trade-off (being encoded as more specific, at the cost of the other slots). Our corpus data do not allow us to answer this question straight away, as we are dealing with coherent discourse data, where discourse constraints interact with combinatorial constraints (complexity trade-offs), such that it is not possible to

Table 5: Token frequencies of the individual combinations of path and verb types across age groups, and numbers of individual participants in each of the four age groups for whom the specific combinations are attested.

	3-year-olds		5-year-olds		9-year-olds		adults	
	tokens	participants	tokens	participants	tokens	participants	tokens	participants
lexical verb + prepositional phrase	25	12	51	12	65	12	114	12
lexical verb + complex path	10	6	15	9	35	11	46	12
lexical verb with manner specification + prepositional phrase	19	9	27	10	41	11	72	11
lexical verb with manner specification + complex path	2	2	15	9	22	9	52	11

decide for each and any individual sentence within the narrative which constraint drives the speaker's production (see Berman 2016 for syntactic effects like contextual ellipsis and means to encode connectivity when children learn to package the information of several clauses or sentences into complex sentences). Investigating the question which slot is inherently most prominent for the younger children and drives their trade-off would need a tightly controlled experimental setting targeting isolated sentence productions, whereas our contribution focuses the structural and conceptual patterns and constructions attested in child and adult speech.

Table 6 depicts how many participants (out of 12) in each age group produced *globally highly complex utterances* where all three slots are filled with comparatively complex slot-filler types. These utterances consist of a (complex) noun phrase in the figure slot, a lexical verb with or without manner specification in the verb slot, and a prepositional phrase or a complex path in the path/ground slot.

Table 6 shows that such globally highly complex utterances such as (1) to (5) are readily available for adult speakers; however, even though the most complex patterns (6) to (8) are spontaneously produced by around half of the adult participants, they do not seem to be a very common option. The developmental pattern shows clear age and complexity effects: only between 25 % and 33 % of the three-year-olds spontaneously produce globally complex utterances, and only of the less complex types (1) to (3); they do not combine highly complex

Table 6: Token frequencies (TOK) of globally complex three-way combinations across age groups and numbers of individual participants (PAR) in each of the age groups for whom these combinations are attested. Cells are shaded light grey if the pattern is attested for 2 to 4 out of 12 participants; a middle grey tone if the pattern is attested for 5 to 6 participants; and dark grey if the pattern is attested for more than 50 % of the participants.

	3-year-olds		5-year-olds		9-year-olds		adults	
	TOK	PAR	TOK	PAR	TOK	PAR	TOK	PAR
(1) noun phrase + lexical verb + prepositional phrase	3	3	20	9	42	11	45	12
(2) noun phrase + manner verb + prepositional phrase	6	4	11	6	24	11	36	11
(3) noun phrase + lexical verb + complex path	4	3	8	5	25	11	18	7
(4) noun phrase + manner verb + complex path	1	1	7	5	14	8	25	9
(5) complex noun phrase + lexical verb + prepositional phrase	0	0	0	0	2	2	15	8
(6) complex noun phrase + manner verb + prepositional phrase	0	0	0	0	2	2	10	6
(7) complex noun phrase + lexical verb + complex path	0	0	1	1	3	3	7	4
(8) complex noun phrase + manner verb + complex path	0	0	0	0	0	0	12	7

figures with more complex slot-fillers in the verb and path slot simultaneously (although Table 4 suggests that this follows from the absence of combinations featuring complex noun phrases in the figure slot and prepositional phrases or complex paths, and is not an effect of the semantical richness of the verbs involved). Interestingly, however, verb complexity seems to play a role in pattern (4), which differs from pattern (3) in terms of semantic density in the verb slot: whereas three-year-olds occasionally produce complex utterances featuring a full noun phrase in the figure slot, a lexical verb without manner specification, and a complex path, they very rarely produce structurally similar utterances where the verb additionally encodes manner information.

The five-year-olds seem to master pattern (1) and begin to master patterns (2) to (4), but they still do not reliably produce utterances including complex noun phrases in the figure slot (again, Table 4 suggests that this is due to the absence of combinations featuring complex noun phrases in the figure slot and prepositional phrases or complex paths). No verb semantics effect is observed for pattern (3) vs. (4) in this age group, but verb semantics may explain the differences between patterns (1) and (2): whereas 75 % of the five-year-olds

produce complex utterances with a full noun phrase in the figure slot, a lexical verb without manner specification, and a prepositional phrase in the path slot, only 50 % produce structurally similar utterances where the verb additionally encodes manner information.

Such a verb semantics effect is also visible in the production patterns of the nine-year-olds, creating thresholds between patterns (3) and (4), which are produced by 92 % vs. 66 % of the participants, and between patterns (7) and (8), produced by 25 % vs. 0 % of the participants.

These observations contrast with the assumption that children learning S-framed languages such as German should get "manner for free" (Slobin 2003: 162). The younger children certainly master lexical verbs with manner specifications, but when they are faced with the challenge of integrating various complex slot-fillers into globally highly information-dense spatial language utterances, some level of complexity reduction may take place at the expense of the manner component. Note, however, that both for the nine-year-olds and the younger children, the largest effect is in the figure slot (noun phrase vs. complex noun phrase).

5.4 Interim summary

Hypothesis 2 is confirmed by the data analyses. Younger children produce fewer if any globally complex combinations with several locally complex slot fillers. They display a trend towards either low global utterance complexity, preferring combinations of locally rather simple slot-fillers (see verb-path correlations in Section 5.2.3), or else they display a clear global complexity trade-off (see figure-verb and figure-path correlations in Section 5.2.1–5.2.2). If one slot-filler is complex, the other(s) will significantly tend to be light, that is, low in structural complexity (such as deictic adverbs or verb particles) or semantically neutral (such as copula or modal verbs). In contrast, older children and almost all adults prefer globally complex combinations with several locally complex slot-fillers within one utterance. In sum, younger children use fewer locally complex slot-fillers than adults, as rightly observed in prior research; but importantly, our data additionally show that if they produce such locally complex slot-fillers, this tends to be in overall less complex utterances.

As indicated before, it is beyond the scope of this paper to investigate text or discourse effects that may lead to complexity reduction, since we limit our analyses to the utterance level. However, it is possible that there are task-effects due to the high cognitive load of the narrative *Frog Story* task for the preschool children (cf. Becker 2011; Berman and Slobin 1994b). We will therefore perform the same analyses for spontaneous speech data.

6 Gradual development of global complexity in spontaneous speech

We thus turn to a further set of data in order to show that these results, and primarily the trade-off effect found for the younger children, is not a task effect. The following analyses will show if the same trade-off tendencies are found in spontaneous child speech, taken from longitudinal monolingual German corpora for the age ranges two and a half to three and four and a half to five.

6.1 Method: data, coding, and analysis

6.1.1 Data

Our argument draws on the analysis of longitudinal German corpus data of spontaneous child speech including 3149 spatial language utterances. This data set covers one transcript per month from the dense *Leo* corpus (Behrens 2006) and from two children, Pauline and Sebastian, from the *Rigol* corpus. We study the age ranges 2;6 to 2;11 and 4;6 to 4;11 that are most compatible to the three- and five-year-olds studied above (since the Leo corpus does not have data for age 5, we decided to take the period before the fifth birthday and a second sample two years earlier). Data from the three children's transcripts were collapsed for each of the two age ranges. For data coding procedures, see Section 4.1. All data are available from the CHILDES archive (MacWhinney 2000).

6.1.2 Data analysis

Again, we report partial correlations (see Section 5.1) for those spatial language utterances where all three relevant slots were filled and analyzable, and consequently excluded partially incomplete and elliptical utterances. We also excluded non-spontaneous speech such as rhymes and songs, which can have special status as high-frequency chunks (Bybee 2006). After the exclusion of all non-spontaneous, incomplete, and elliptical utterances, the final data set consists of 1306 analyzable utterances ($n = 681$ for the age range 2;6 to 2;11 and $n = 625$ for the age range 4;6 to 4;11).

Four trained coders annotated the data. Around half of the coding was done by the second author. The first and second authors resolved any ambiguous cases highlighted by the other coders in discussion with them. Around 10 % of the data were recoded blindly by a different coder, yielding corrected κ values (Brennan and

Prediger 1981) of 0.93 for interrater agreement concerning the basic event type; of 0.94 for verb type; of 0.86 for path type; and of 0.79 for figure type.

6.2 Results: combinatorial complexity

The following analyses parallel our preceding analyses in Sections 5.2.1–5.2.2. We report pairwise partial correlations, measuring the degree of association between two variables whilst controlling for other, possibly confounding factors. In particular, we report partial correlations between (1) figure and verb complexity (see Section 6.2.1) and (2) figure and path complexity (see Section 6.2.2), controlling, in each case, for degrees of complexity in the third constructional slot as well as for relevant background variables, namely the individual speaker and the event type (i.e., localization, spontaneous motion, caused motion). We report separate analyses for the two age ranges. Since we use ordinal coding scales, we report Spearman's rank correlation coefficients. The evidence from the spontaneous speech data confirms the findings from the elicited narratives reported in Section 5.

6.2.1 Figure – verb correlations

The spontaneous speech data confirm the complexity trade-off between the figure and verb slots as well as its gradual leveling for the youngest age range. Figure 6 plots the numbers of combinations of different figure and verb

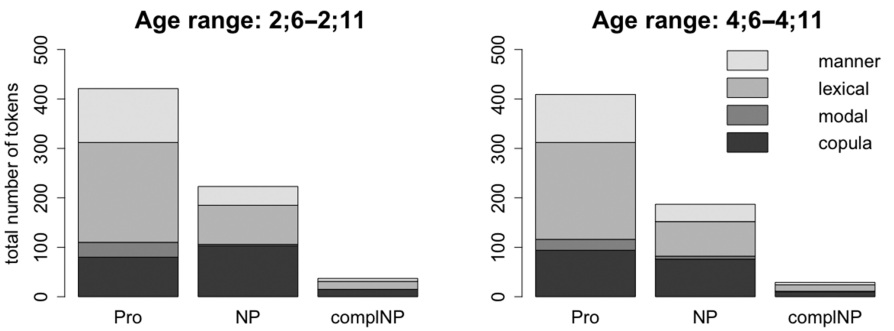

Figure 6: Figure-verb correlations in spontaneous child speech. The x-axes plot the three categories of slot-fillers in the figure slot, in increasing order of complexity from pronouns (*Pro*, leftmost stack bars) to noun phrases (*NP*, middle stack bars) and complex noun phrases (*complNP*, right-most stack bars). The y-axes plot token numbers of combinations of each of the three figure categories with the four different verb categories; slot-filler complexity for the verb slot increases from the bottom (copula verbs) to the top of the stack bars (lexical verbs with manner specification).

categories attested for the two- and four-year-olds. The overall height (y-axes) of the three stack bars in each panel indicates the number of pronouns (*Pro*), noun phrases (*NP*) and complex noun phrases (*complNP*) produced in the figure slot. The different shades indicate the respective numbers of combinations with the different very categories (in increasing order of complexity from bottom [copula] to top [lexical verbs with manner specification]).

Like Figure 3 for the *Frog Story* data, Figure 6 shows that the younger children significantly disprefer globally complex utterances, that is, combinations of structurally complex figure components with semantically rich(er) verbs. The two-year-olds' trade-off in spontaneous speech is highly significant ($r_s = -0.22$; $p < 0.001$), although somewhat less pronounced than that of the three-year-olds in the narratives ($r_s = -0.32$; $p < 0.001$, cf. Section 5.2.1), probably due to the higher cognitive load of the narrative task as compared to natural dialogic interactions with the children's familiar caretakers, as documented in the spontaneous speech data. The four-year-olds' figure-verb trade-off in spontaneous speech ($r_s = -0.14$; $p < 0.001$) replicates the results for the *Frog Story* narratives elicited from the five-year-olds ($r_s = -0.13$; $p < 0.001$, cf. Section 5.2.1).

6.2.2 Figure – path correlations

Finally, Figure 7 plots the numbers of combinations between the different figure and path categories attested in the two age groups (two- vs. four-year-olds). The

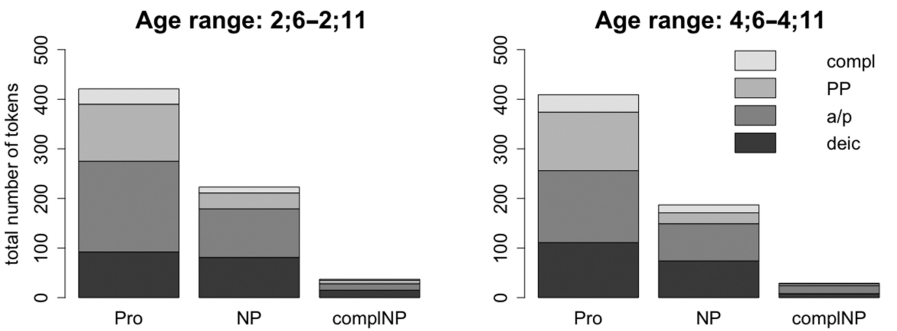

Figure 7: Figure-path correlations in spontaneous child speech. The x-axes plot the three categories of slot-fillers in the figure slot, in increasing order of complexity from pronouns (*Pro*; left) to noun phrases (*NP*; middle) and complex noun phrases (*complNP*; right). The y-axes plot token numbers of combinations of each of the three figure categories with the four different path categories; slot-filler complexity for the path slot increases from the bottom (deictic adverbs [*deic*] such as *da* 'there') to the top of the stack bars (complex paths [*compl*], beige), see Table 1 above. On the y-axes, *a/p* stands for the category of other adverbs or particles, *PP* stands for prepositional phrases.

panels reflect the numbers of occurrences of the different combinatorial possibilities as attested per age group. The overall height (y-axes) of the three stack bars in each panel indicates the number of pronouns (*Pro*), noun phrases (*NP*) and complex noun phrases (*complNP*; in increasing order of complexity, see Table 1 above) produced in the figure slot. The different shades indicate the respective numbers of combinations with the different verb categories (in increasing order of complexity from bottom [copula] to top [lexical verbs with manner specification]).

Again, we find highly significant negative correlations for the two-year-olds ($r_s = -0.18$; $p < 0.001$) and for the four-year-olds ($r_s = -0.15$; $p < 0.001$), replicating our findings for the elicited narratives ($r_s = -0.25$ and $r_s = -0.17$ for the three- and five-year-olds respectively). For instance, younger children are significantly more likely to produce complex path types (i.e., prepositional phrases or complex paths, the two top categories in each stack bar) if the figure component is light (i.e., a pronoun, left-most stack bar) than if the figure is more complex (e.g., a noun phrase, middle stack bar).

6.3 Summary

Our findings based on the analyses of spontaneous child speech support our earlier findings based on the elicited *Frog Story* narratives as well as our second hypothesis. Development of constructional complexity in the spatial language domain is gradual, and the development at individual slots is interrelated to the extent that two- and four-year-olds display highly significant restrictions with regard to their ability of integrating various locally complex slot-fillers into globally complex utterance-level constructions: All other things being equal, if one slot-filler is comparatively complex, the other(s) will in turn be comparatively light, that is, structurally simple and/or semantically neutral.

7 Discussion

Our analyses of both the elicited *Frog Story* narratives and the spontaneous speech data confirm the basic findings from prior studies with regard to both typological bootstrapping (e.g., Ochsenbauer and Hickmann 2010; Ochsenbauer and Engemann 2011; Slobin 2003, 2004) and gradual development (e.g., Bamberg 1994; Bryant 2012; Ji et al. 2011; Ochsenbauer and Hickmann 2016), but go beyond. Regarding typological variation in lexicalization patterns, our analyses confirm that as early as age 2;6, German children verbally encode the relevant conceptual building blocks of spatial language utterances – the figure, the path and ground,

the motion and manner of motion components – in language-specific, S-framed conflation patterns of information packaging. However, within these patterns, they use more semantically light verbs without manner specification and less complex path types than older children and adults.

Our data also show that figuring out these general typological preference patterns of information packaging is not the whole story. In order to display fully adult-like information density and complexity, children need not only know which information to explicitly encode and where in the utterance, but they also need to master increasingly complex structural means of expression within the constructional repertoire for each of the constructional slots and to integrate the various slot-fillers into complex, informative utterances. Our respective analyses show that, with regard to constructional complexity and information density in the German spatial language domain, development is gradual and extended over the preschool and early school years. Prior studies, such as Bryant (2012) and Ochsenbauer and Hickmann (2016), have already, but still rather cautiously, pointed to various aspects of gradual development. Our two-level data analyses clearly establish gradual and highly systematic development in the spatial language domain over the preschool and early school years. Even though the full slot-filler repertoire for each conceptual slot actually emerges early on (including more complex slot-filler types such as prepositional phrases and manner verbs), when compared to older children and to adult speakers, younger children display

(i) significant preferences for light(er) slot-filler types, that is, a trend to reduced local complexity (see Section 4)
(ii) initial restrictions in terms of global complexity, that is, a significant trade-off with regard to the combination of various locally complex slot-fillers into globally complex utterances (see Sections 5 and 6).

These preferences and restrictions gradually decrease over time. Adults even tend to display reverse patterns, preferring globally highly informative, dense, and structurally complex combinations of locally complex slot-fillers across the constructional slots within one utterance. Younger children's trade-off trends thus show that with age, speakers do not just come to use *more* semantically rich, structurally complex slot-fillers such as manner verbs or prepositional phrases (that is, more of them), but they actually use them *differently* and more freely, in globally more complex contexts and combinations.

A comparison between children's and adults' complex path productions – where complex paths include at least two non-deictic path/ground elements – illustrates this point particularly well. Firstly, the overall number of complex paths significantly increases with age at the local complexity level. Although at

least some of the younger children aged three to five are well able to produce such complex path descriptions, they only rarely do (see Section 4.2.2). In addition, younger children's complex paths are structurally still less complex than older children's and adults', as they are limited to a maximum of two path/ground elements, only one of which may be a prepositional phrase. With age, both the possible number of components (up to four or five for adult speakers) and the proportion of prepositional phrases within complex paths increase (see Section 4.2.2). Secondly, younger children are significantly more likely to produce complex path types in less dense, less complex utterance contexts at the utterance level (global complexity). Thus, there are fewer combinations of more complex path types with other complex slot-fillers within one utterance, as shown, for instance, by substantial and highly significant negative figure-path correlations for the younger children (see Sections 5.2.2 and 6.2.2).

The nature of our non-experimental data does not allow us to pin down the exact reason for younger children's initial combinatorial restrictions and for subsequent gradual development as described in Sections 5 and 6. Growing working memory capacities, as suggested by one reviewer, as well as increasing levels of entrenchment of some of the smaller building blocks and increasing social interactional competences, including aspects of pragmatic adequacy in terms of explicitness (e.g., Fernández 2011), likely conjointly drive this development. This question, however, is beyond the scope of the present contribution.

Interestingly, though, our analyses point to a prominent role of the figure slot. All other things being equal, younger children (1) do not combine complex noun phrases in the figure slot with rather complex slot-fillers in the other slots (see Section 5.3 for a summary), and (2) they are more likely to produce both structurally more complex path types (see Sections 5.2.1 and 6.2.1) and semantically richer verb types (see Sections 5.2.2 and 6.2.2) if the figure is light, that is, a pronoun. This ties in nicely with findings from earlier experimental research in the usage-based paradigm, which points to a crucial facilitatory role of pronoun frames in (early) language learning (e.g., Childers and Tomasello 2001). Our findings from the German spatial language domain confirm Childers and Tomasello's (2001: 739) assumption that younger children may indeed "build many of their early linguistic constructions around certain specific lexical or morphological items and patterns, [...] especially around particular pronoun configurations". It will thus make sense for further research to take the figure slot into account, in addition to the verb and path slots, when investigating spatial language constructions in S-framed languages.

In sum, the long way from emergence to mastery (Berman 2016: 461) involves the elaboration of the individual conceptual slots, as well as their integration into more complex utterances. In this study, we focused on the utterance level where a

statistically significant trade-off in complexity was observed. Thus, the complexity of the slot fillers was not random, as expected if there were global performance limitations constraining the length and complexity of utterances, but predominantly affected the figure and the manner component. Note also that tighter information packaging does not necessarily lead to higher syntactic complexity, but can be obtained by using semantically richer vocabulary, while at the same time reducing complexity by eliding elements that are contextually given. What we have shown in this article is how children manage to produce denser, more informative, and thus more context-independent utterances based on global and already well-established constructional schemas.

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