The acquisition of argument structure[1]

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1. Introduction

The concept of valency or argument structure is a powerful one in linguistics, although the current volume shows that there is still considerable debate as to how to characterise the valency of any given verb exactly. But if professional linguists and lexicographers encounter difficulties in defining the relationship between a verb's meaning(s) and its syntactic properties, how can a two-year-old manage?

Research on child language has focussed on argument structure or logical and syntactic valency rather than on semantic valency, that is the specification of the semantics of the arguments. This reflects the anglophone dominance in the field, but also emphasises the focus of interest, namely the role of the verb in the clause and the syntactic positions it opens. Consequently, I will follow this tradition and use the term *argument structure* rather than *valency* to refer to the acquisition research.

Argument structure acquisition has been a popular topic for the past 25 years, with shifting focus of attention. In the 1980s, a number of deductive accounts were proposed to explain which kind of knowledge helps children to identify the arguments a verb requires. These approaches relied on conceptual, semantic or syntactic cores, which could be universal and / or innate, and assume modular levels of representation. I will summarise these accounts under "bootstrapping" accounts, a metaphor used to explain how children could use information on one level of representation in order to get started (or to *bootstrap* in the technical sense) onto another level.

More recently, inductive learning accounts have gained popularity. In this view, children accumulate knowledge through usage events and derive generalizations about a given verb's syntactic and semantic properties only gradually. I will discuss such proposals under the heading "usage-based accounts" because they assume that children gain their knowledge about argument structure from observing the concrete usages of verbs in concrete discourse situations. Two types of approaches are of interest here. First, Construction Grammar accounts assume that the construction (a meaningful form-function unit) is the primary source of information, from which

the properties of individual verbs can be derived. Second, there is research on the discourse and informativeness factors which determine argument realization in connected speech. These investigations use the concept of *Preferred Argument Structure.*

Since much research is ongoing, and since new results especially about crosslinguistic differences in argument structure are likely to lead to some modifications of earlier accounts, this paper provides pointers to previous and current research, rather than elaborating one of these aspects and theories in detail.

2. Deductive accounts of the acquisition of argument structure

The concept of argument structure assumes that verbs open up a number of semantically and syntactically specified positions. Typically, a verb like *put* opens positions for the putter, the thing being put and the location where the thing is put, as in *I put the book on the table*, whereas a verb like *see* opens two positions, namely the seer and the object being seen (*I see a boat*), but not a position of the location of the seeing or the object. This entails a relationship between events and the semantics of the verbs that encode these events, as well as a semantics-to-syntax mapping for these verbs.

Because argument structure seems such a logical and systematic concept, it is not surprising that researchers have made use of this concept for language acquisition. If argument structure is systematic, i.e., if there is a predictable relationship between a verb's semantics and the syntactic frames it occurs in, this relationship could provide a stepping stone for language learning because the verb "tells" the child about the linguistic items it goes with. But before observing the systematic syntax-semantics link, children could even make a connection between the event structure they observe in the preverbal phase, and possible argument structure patterns. Thus, if there is a systematic relationship between events, verb semantics and verb syntax, there are three possible entryways into the linguistic system. The assumption of such links leads to so-called bootstrapping accounts that predict that children use knowledge of one level of representation to bootstrap another level.

2.1. Conceptual starting points

Dan Slobin (1985) proposed a conceptual account for the acquisition of early syntactic relations. He argued that children all over the world will construe similar event representations and build up similar concepts, which will serve as the basis for linguistic encoding. That is, children learn to categorise events in the preverbal stage and try to find the linguistic entities that encode the participants in the event. For example, a common event is the so-called *Manipulative Activity Scene* where an agent does something to a patient. Children will form categories of such events and map them onto two-argument verbs.

> The central claim is that LMC [= language making capacity] constructs similar early grammars from all input languages. The surface forms will, of course, vary. What is constant are the basic notions that first receive grammatical expression, along with early constraints on the positioning of grammatical elements and the way in which they relate to syntactic expression. (Slobin 1985: 1161)

Transitive sentences will thus denote Manipulative Activity Scenes, before alternative, language-specific form-function mappings overrule this early alignment. That is, deviant language-specific patterns should be learned only in a second step.

Slobin's view was criticised by Melissa Bowerman, and later withdrawn by Slobin himself. Bowerman (1985) argues that children do not prefer Manipulative Activity Scene in their early transitive sentences. She concludes that there is no semantic basis for the acquisition of grammar. Based on a larger body of typological research and cross-linguistic acquisition studies, Slobin (1997, 2001) criticised his earlier views (Slobin 1985). He argues that there is no evidence for privileged grammatizable notions. Instead, children seem to be able to pick up any form-function relationship.

In a different vein, several authors suggested that children start out with conceptually simple, general-purpose verbs: Eve Clark (1993) formulated the "light verb hypothesis", and Anat Ninio (1999) the "pathbreaking verb hypothesis". These hypotheses claim that children start verb learning with semantically light verbs like *make, do,* and *put,* which can serve as pathbreaking verbs, and acquire semantically specific verbs only later. Thus, children initially only need fairly unspecific conceptual notions that serve a wide range of purposes, and differentiate their early unspecific concepts through extended exposure to a target language. However, this view was criticised from a crosslinguistic perspective because not all languages have a light verb vocabulary; e.g., Tzeltal (Mayan) has a vast array of se-

mantically specific verbs, and it turns out that children from early on make a number of specific distinctions. Brown (1998) shows that children from early on have a rich and semantically rather specific inventory of eating verbs, for example, verbs to mean the equivalent of *eat soft things* versus *eat tortillas* or *eat crunchy things*. In a study of children's early usage of these verbs, Brown (2007) shows that children do not overgeneralise these semantically specific verbs to mean something more general, but use them adequately.

In sum, crosslinguistic analyses suggest that children make use of the affordances of the language they acquire. If a language has light verbs, they tend to be used frequently, although more specific verbs are used as well. But if a language does not provide such verbs, children quickly build up a rich repertoire of semantically specific verbs. To date, there is no evidence for a privileged conceptual starting point for the acquisition of verb syntax and semantics.

In the 1990s, two different approaches were much discussed. These approaches focus more narrowly on the mapping of syntax and semantics (cf. the review by Bowerman and Brown 2007). The so-called "semantic bootstrapping hypothesis" predicts that innate linking rules help the child to map the verb syntax onto already known verb semantics. The "syntactic bootstrapping hypothesis", in contrast, tries to explain how children can acquire and refine their knowledge of verb semantics by paying attention to the syntactic frames a verb is used in.

2.2. Semantic bootstrapping

Pinker (1994: 378) proposed that children use semantics to acquire syntax, because meaning is constrained by semantic factors:

> In the case of learning verb meanings, … not all logically possible constru-
> als of a situation can be psychologically plausible candidates for the mean-
> ing of a word. Instead, the hypotheses that a child's word learning mecha-
> nisms make available are constrained.

In his semantic bootstrapping hypothesis, Pinker (1989: 62) states that syntactic argument structure is predictable from semantic structure via the application of linking rules. The constraints on verb meaning interact with syntax in a systematic way: in the mental lexicon, verbs have rich semantic specifications. They project verb syntax by means of innate linking rules. The verb *hit*, for example, calls for an agent and a patient argument. Link-

ing rules align the thematic roles to syntactically specified subjects and objects as in (1):

(1) *Bert*   *hits*   *Ernie.*
    AGENT   PATIENT   lexical representation
    ↓   ↓   linking-rules
    SUBJECT   OBJECT   syntactic structure

The hypothesis predicts that verbs with high semantic typicality should form the starting point for the acquisition of argument structure. For example, verbs with high semantic transitivity should be most easily aligned with transitive sentence structure.

Bowerman (1990) analysed English children's early transitive constructions and examined these predictions. She found that "best exemplars" are not acquired first. Instead, verbs like *have* and *see* are among children's early transitive verbs. They are high-frequency verbs, but have a non-prototypical linking between theta roles and syntactic structure, since the subjects are not typical agents and the patients are not typical patients. In a subsequent study, Bowerman (1996) examined the predictive power of Pinker's lexical rules for causative constructions. She analysed error patterns in children's encoding of causativity (as in *I disappeared the ball*) and found that the group of verbs that show errors differs from the group for which errors are predicted. In addition, Bowerman addresses the problem of cutting back on overgeneralizations. Some English verbs have alternative valency patterns and can be used intransitively or transitively (2a, b):

(2)   a.   *The stick breaks easily.*
      b.   *John breaks the stick.*

But alternating patterns can also be overgeneralised as in the following examples of non-alternating verbs (3a, b; Bowerman 1996: 454).

(3)   a.   *Button me the rest.*
      b.   *I said her no.*

Pinker (1989) proposed that broad-range linking rules, based on semantic categories, provide the *necessary* conditions for alternation. In order to account for the fact that some verbs do not alternate although they fit the semantic pattern, a set of more specific narrow-range linking rules is invoked which provides the *sufficient* conditions for distinguishing alternating and non-alternating verbs. Bowerman's (1996) summary of the data

makes it seem unlikely that acquisition of argument structure patterns can be explained in terms of the interaction of broad- and narrow-range rules, especially since there is no evidence that children adhere to strict semantic groupings in the early stages of learning argument structure. Bowerman argues that instead children work with overly general assumptions about argument structure and have to learn to cut back on such errors.

One explanation for the low frequency of errors and their eventual disappearance is pre-emption. This means that errors are blocked because another verb or a related construction already occupies the semantic position of the possible alternate. When children know the construction *make disappear*, errors of the type *I disappeared the cake* will not occur because the semantic position is already filled. Pre-emption predicts that verbs for which the child knows the alternate construction should be less error-prone than verbs for which the child does not know the alternate construction. But a longitudinal study of two girls learning English showed that this is not the case (Bowerman 1996: 463–464).

Instead, usage-based factors could account for the relative infrequency of such errors, as well as for the disappearance of such errors, because repeated exposure to intransitive syntactic frames reduces the tendency to use verbs transitively (see also MacWhinney 1987).

The investigation of how the verb meaning can help to narrow down possible syntactic frames is just one side of the coin. If there is a predictable relationship between syntax and semantics, the process should work in the other direction as well such that knowledge of syntax should help to narrow down the possible meanings of a verb.

2.3. Syntactic bootstrapping

The syntactic bootstrapping hypothesis (Gleitman 1990) states that the syntactic frames a given verb occurs in are more informative about its semantics than a linking of the event itself to semantics, because any event is open to several ways of highlighting event participants. We can encode a "shopping" event from the perspective of the buyer (*Peter buys a book*), the seller (*Peter sells a book to Paula*), or the object (*The book cost Paula 10$*). Observation of an event alone does not help us to identify the linguistic perspective taken on an event. Moreover, Landau and Gleitman (1985) showed that blind children acquired the semantics of different verbs of vision, which demonstrates that the acquisition of verb semantics does not depend on the observation of events, but on the exploitation of linguistic structure. Gleitman (1990) predicts that the syntactic frames a given verb

occurs in are systematically linked to verb semantics. For this hypothesis to work there needs to be a close alignment of argument structure and semantics:

> Verbs that describe externally caused transfer or change of possessor of an object from place to place (or from person to person) fit naturally into sentences with three noun phrases, for example, 'John put the ball on the table'. This is just the kind of transparent syntax/semantics relation that every known language seems to embody. It is therefore not too wild to conjecture that this relationship is part of the original presuppositional structure that children bring to the language learning task. (Gleitman 1990: 30)

Subsequent research by Naigles, Gleitman and Gleitman (1993) showed that children (mean age 2;9) can modify the verb meaning of familiar words when they hear it in a novel frame; e.g., they are likely to interpret the sentence *The zebra goes the lion* in a causative reading ('the zebra makes the lion go') in analogy to other cases where this structure encodes causativity. In a literature review on early verb knowledge, Naigles (2002) states that "form is easy, meaning is hard". Infants are good at processing form patterns (segmental, prosodic, structural), less good in handling semantic information. However, Naigles argues, later in development the occurrence of a verb in different formats or syntactic frames helps the child to narrow down the semantics (cf. also Naigles 1996).

Several authors found problems with the syntactic bootstrapping account. Pinker (1994: 382) criticised Gleitman's strong reliance on syntactic structure for the inference of verb meaning, because the other words in the sentence carry meaning as well. He argues that in sentences like *I filped the delicious sandwich and now I'm full*, the meaning of the pseudo-verb *filp* can be inferred from the lexical knowledge of the other words in the sentence without reliance on syntactic structure. This may explain why blind children learn verb semantics without having access to visual information. Furthermore, Pinker takes issue with Gleitman's claim that meaning cannot be learnt from observation of a word's usage in concrete contexts. Rather, for some semantically related verbs with the same argument structure, only the context can disambiguate subtle semantic differences; e.g., real world experience is needed to distinguish the manner of actions (e.g., *open* versus *close, tear* versus *break,* Pinker 1994: 394). Pinker's conclusion is that Gleitman's arguments are void if one assumes that children's word meanings are universally constrained such that they will not come up with nonsensical hypotheses about word meanings. Then, context information will provide sufficient information to derive the meaning distinctions between different verbs.

Wilkins (2007) points out another problem with the Gleitman's assumption that the syntax-semantics alignment of verbs is part of the "original presuppositional structure that children bring to the language learning task", because argument structure patterns are not the same crosslinguistically. Wilkins looked at the equivalents of the verbs *look* and *put* in Arrente, an Australian Aboriginal language. In English, the perception verb *look* is a classic example of a two-place predicate (agent and object), and the transfer verb *put* is a classic example for a three-place predicate (agent, object, location). In Arrente, however, by all linguistic tests, the verbs *arrerne* ['look'] and *are* ['put'] are three-place predicates that open positions for agent, object and location of the object put or seen. In the case of the verb *look*, the resultant meaning can, for example, come close to the English verb *find* (*to see something somewhere* denotes 'find it'). Thus, syntactic bootstrapping accounts would fail with Arrente, because there is no "natural" alignment between argument structure and verb semantics as proposed by Gleitman. Nonetheless, in a corpus analysis of spoken Arrente, Wilkins (2007) found that adults use these verbs in a different fashion: *look* is used as a two-place predicate more often than *put*. For *put*, the locative NP is realised more frequently than for *look*. Children follow this usage, and have particular problems with the third argument for *look*. These findings suggest that while there is no strict alignment between syntax and semantics that would allow children to bootstrap from syntax to semantics, in actual usage some argument structure realizations are more common than others. Children may use such distributional differences to induce verb meaning.

So far, we have seen that both syntactic and semantic bootstrapping do not work in a deductive way: the link between semantics and syntax regarding argument structure is not tight enough to allow full predictability. Consequently, inductive accounts of language acquisition gained ground in the past decade and can now be considered the dominant framework in acquisition.

3. Inductive accounts for language acquisition

The discussion so far has demonstrated that there seems to be little support for theories that assume a tight link between verb semantics and syntax that could be used to predict either syntax or semantics. But then how could children acquire argument structure? Alternative theories known under headings such as usage-based theories (Tomasello 2003) or emergentism (Elman et al. 1996; MacWhinney 1999) focus on the learning and categori-

zation mechanisms itself. These theories assume that complex cognitive patterns can be induced from noticing distributional properties of the input language (Elman 2003). In addition to being able to use such probabilistic cues as early as in infancy (Saffran 2003; Gomez and Gerken 2000), humans also demonstrate the ability to perceive the intention of others in a concrete situation (Tomasello and Rakoczy 2003). If children are aware of other people's intention, however, this will help them to narrow down the possible meaning of what is being said. That is, the concept of the child as an intention reader replaces the Generative Grammar concept of the child as an hypothesis tester. Several studies have shown how intention reading contributes to early word learning; e.g., in an experiment a child and his/her mother played with three novel and unnamed objects. The mother went out and the child received another novel and unnamed object. When the mother came back in, she looked at the four objects and exclaimed "Oh look! A modi! A modi!". 24-month-old children significantly associated the word *modi* with the fourth object. They could not have done so by simple association but must have used social cognition, in this case their understanding that people get excited about new things (Akthar, Carpenter, and Tomasello 1996).

3.1. Usage-based models of syntax

Usage-based accounts of acquisition assume that learning takes place by generalising over concrete usage events (see Tomasello 2003 for a summary). They do not draw a distinction between universal and innate core grammar, which is acquired by deduction, and the periphery, which has to be learnt by induction. Instead, it is supposed that all properties of languages can be acquired from the input by powerful generalization abilities in connection with social cognition. The plausibility of usage-based learning is supported by a growing body of research which shows that even infants have a remarkable capacity for pattern recognition and statistical learning, regardless of whether the patterns are semantically motivated or not (see Saffran 2003 and Gomez and Gerken 2000 for a general introduction, and Newport and Aslin 2004 for more detail). Furthermore, research in computational linguistics shows that grammatical categories as well as information about constituency can be gained by data-driven parsing, without supplying "rules" to the computer (Redington, Chater, and Finch 1998; Keibel et al. 2006; Klein and Manning 2004). Finally, comparisons between child and input data show a close alignment between input patterns and the structures attested in children, which suggests that children pay

close attention to the distributional properties of language use in the ambient language (Behrens 2006).

If acquisition is based on the evidence children get from the input, a number of predictions follow. First, acquisition should be item-specific because children have no access to a priori verb-general categories. Second, cross-linguistic differences are expected: if different languages show different alignments of syntax and semantics in language use, this should be reflected in acquisition.

3.1.1. Crosslinguistic variation

Recent investigations into "exotic", non Indo-European languages revealed that there is considerable variation both in terms of argument structure proper and in terms of argument realization. In general, high and/or substantial variation makes deductive account less plausible, because phenomena with large variability call for inductive learning processes.

Typological research has pointed out that semantic specificity has an impact on argument realization, because in lexically-specific verbs, the verb meaning may already incorporate some arguments. Compare, for example, the verb *kick* with the construction *push with foot*. In *kick*, the instrument *foot* is incorporated in the verb meaning and need not be specified as an extra argument. For *push*, in contrast, agent, object and instrument need to be specified. Consequently, languages with a richly specified verb lexicon tend to show more argument ellipsis than languages where the verb lexicon is rather small and semantically more general (cf. Bowerman and Brown 2007).

3.1.2. Item-specificity

In usage-based accounts for acquisition, the notion of verb-specificity has become very relevant. It is argued that the syntax of early child language is item-specific rather than abstract. This hypothesis has led researchers to reconsider the units children operate with: rather than to assume that verbs project syntactic structures based on their semantics, it is suggested that children work out form-function alignments based on individual verbs, and generalise over groups of verbs only later.

Tomasello (1992) analysed his daughter's development of verb syntax on a verb-by-verb basis. He did not find groups of transitive or intransitive verbs that show similar syntactic behaviour, but rather that each individual

verb started out with its own, lexically-specific frame. At a given point in time, the child used the verb *cut* only in the frame *cut X*, while the syntactically similar verb *draw* was used in a wider range of frames (*draw X, draw X on Y, draw on X, draw X for Y*; Tomasello 2003: 117). These findings led Tomasello to propose the verb island hypothesis. It states that the best predictor for a given verb's use is not the use of other related verbs at the same time, but the child's previous use of that particular verb (Tomasello 1992: 256).

The item-specificity of early child language is related to the non-productivity of these utterances: if a child uses direct objects only with particular verbs, but not with all kinds of verbs that take direct objects, this may indicate that these early constructions are frozen or (semi-)formulaic concrete lexical units, rather than represented in an analytic or abstract fashion. Indeed, Pine, Lieven, and Rowland (1998) found that in the speech of twelve children learning English, the five most common slot-and-frame-patterns like *mommy X* or *want X* accounted for an average of 70% of all utterances containing verbs.

In the usage-based framework, the lexical robustness of early child utterances is considered as evidence that children operate with prefabricated "chunks" and do not generate utterances from scratch (Tomasello 2000). Similar conclusions can be drawn from the behaviour of individual verbs: Theakston et al. (2002) studied the used of word-forms of *go* (*go, goes, going, gone, went*) in eleven British children. They found little evidence for overlap of arguments across word forms. Instead, each word form seemed to have its own frames. In addition, children's use highly correlated with adult usage.

But what is the advantage of analysing child language in such a pattern-based approach? First, it directs the attention to the communicative function of the utterance, not to the syntactic or semantic representation of words in isolation. It is assumed that early formulae or patterns are linked by the same communicative function. Second, pattern-based approaches assign a different role to verbs. Rather than seeing verbs as the core elements that project syntax, verbs constitute just one, albeit important, aspect of communicative units. It is in this respect that recent acquisition theory draws a close connection to Cognitive Linguistics in general and Construction Grammar in particular (Tomasello 1998).

3.2. Constructions as predictor for language learning

In Construction Grammar, constructions are defined as entities of variable size, which are fixed pairings of form and meaning (see Fillmore and Kay 1993; Goldberg 1995 and 2006 for theory; Tomasello 1998 for acquisition). Tomasello (1998) claims that early acquisition is more adequately described in terms of constructions because the linguistic knowledge underlying early child language is tied to lexical items rather than being abstract or verb-general. Different structures need not be linked by rules, but could represent independent schemata, which may be analyzed only partially. There is no distinction between core and non-core-phenomena or between universal and language-specific factors because all of language is acquired bottom-up from language use (Tomasello 1992, 2003).

This approach differs crucially from the bootstrapping accounts described above, because the construction approach does not rely on syntactic or semantic primitives. It neither assumes the availability of abstract syntactic categories like word class or thematic roles, nor the availability of a detailed semantic analysis in terms of primitives that constitute the basis for syntactic acquisition. Instead, children use larger or smaller units to convey their communicative intention. In order to do so, it is not necessary that they have abstracted all the component parts of the construction, just like adults use idioms where the underlying structure remains opaque. What constructivist approaches then have to account for is how and when linguistic knowledge is abstracted. Linguistic creativity in both children and adults shows that at some point in development they are able to go beyond what they have heard and use their knowledge of the meaning of syntactic constructions to use lexemes in new and productive ways (cf. Fillmore and Kay 1993).

In fact, linguistic productivity would break down completely if children relied only on positive evidence and only used those constructions or arguments they had actually registered in the ambient language (Bowerman 1996: 464; Goldberg 1995). Recent experiments from a usage-based perspective therefore focus on generalization mechanisms. Goldberg and colleagues undertook a number of studies that tested how Construction Grammar can be used to predict the acquisition of argument structure (Goldberg and Casenhiser 2005a, b; Goldberg, Casenhiser, and Sethuranam, 2004; for summary and theoretical elaboration see Goldberg 2006). In a training study, 51 5–7 year-old-children were trained with a new argument structure pattern of the form "NP NP novel verb" (e.g., *the spot the king moopoed*) to encode appearance (the corresponding video showed a spot appearing on the king's nose). Within less than three minutes, the chil-

dren saw 16 videos representing five new verbs. One group saw them in a skewed exposure (one video was shown eight times, the remaining four videos twice each). The second group had a more balanced exposure (three videos four times, two videos twice). It turned out that the group that was exposed to a skewed distribution generalised the new pattern best. This result confirms earlier findings from corpus studies that showed that within a particular syntactic construction, the distribution tends to be biased in that one verb represents a large number of tokens of that construction (Goldberg, Casenhiser, and Sethuranam 2004).

Based on these findings, Goldberg (2006) argues that the role of the construction has an important impact on acquisition. But what exactly determines the predictive power of verb-based constructions? At first glance, it seems that within a construction, verbs still have the highest predictive power because verbs are relational elements and therefore entail sentence meaning (i.e., who did what to whom, Goldberg 2006: 104). In a set of experiments, Goldberg and colleagues tried to test the relative contribution of verbs versus constructions in light of the fact that many verbs are polysemous such that their occurrence in different construction types is correlated with different meanings. Thus, under which circumstances are verbs better predictors, and under which circumstances are constructions the better predictor of sentence meaning? Goldberg argues that this is a matter of *cue validity*, a concept adapted from the competition model by Bates and MacWhinney (1987). This model hypothesises that all linguistic structures represent different formal and functional cues. Acquisition sequences are determined by the *cue cost*, the effort it takes to detect and process this cue (e.g., affixes are easier to detect and to segment than stem changes) and *cue validity*, the degree to which this cue is a reliable cue for this phenomenon (e.g., morphological paradigms with a 1:1 form-function correspondence have higher cue validity than paradigms with a high degree of syncretism and ambiguity). Regarding verb semantics, highly polysemous verbs like *get* have low cue validity regarding meaning. Here, the construction type can help to disambiguate possible readings and thus has a higher cue validity for meaning (see example 4; Goldberg 2006: 106).

(4)   a.   Pattern VOL: (Subj) V Obj OBl$_{path/loc}$ → caused motion
           Pat got the ball over the fence.
      b.   Pattern VOO: (Subj) V Obj Obj → transfer
           Pat got Bob a cake.

Based on corpus analyses and experiments, Goldberg and colleagues conclude that for early acquisition, verb-argument constructions (compatible to

the verb-island constructions or slot-and-frame patterns discussed above) are better predictors of sentence meaning than the verb in isolation. This also holds for generalization in later stages of acquisition: the argument frame is at least as good a predictor of sentence meaning as the verb itself in isolation, because many high-frequency verbs are polysemous and have low cue validity for meaning (see Goldberg 2006: 105–126 for a summary of the results).

In sum, constructivist accounts point to the primary nature of the construction as the main conveyor of meaning since we talk in utterances, not in isolated words. These accounts also tend to be inductive, because they assume a usage-based vantage point where general learning mechanisms as well as social cognition regarding the intention of the other speaker allow children to induce linguistic knowledge on increasingly complex and abstract levels.

The impact of language use on argument structure is also studied in a different research tradition that investigates the influence of the discourse context on argument structure.

4. Preferred Argument Structure (PAS)

The studies reported so far focussed on a "context neutral" perspective of argument structure: which arguments does a given verb with a particular semantics call for? But in concrete connected speech or discourse, arguments can be dropped or provided for a number of reasons. First, there are language-specific structural reasons because some languages like Chinese show the phenomenon of topic drop: a topic once established needs not be encoded again, unless the topic changes. Second, there are various factors that influence context-dependent ellipsis. An argument can be assumed as "given", for example, because it is visible and can be pointed to or looked at. Furthermore, arguments need not be realised lexically, but can be encoded as pronouns or affixes on the verb. These factors determine argument realization. Discourse studies have shown that "givenness" in previous discourse is likely to lead to ellipsis or pronominal realisation, whereas "newness" is more likely to lead to encoding by a full NP. Several researchers are interested in "Preferred Argument Structure" and look at the structural (DuBois 1987) and discourse-pragmatic factors (Clancy 1997) that determine the number and nature of arguments that are realised in a particular language or a particular genre.

The concept of Preferred Argument Structure can be applied to child language. What is the effect of ellipsis, or pronominal versus lexical encod-

ing in the adult language on acquisition? How does a child learn which arguments to provide and when? It is a common feature of early child language that arguments are omitted. For example, utterances often lack the subject as in *want milk*. Allen (2000: 484f.) identifies three explanations for this phenomenon. The first comes from a Generative Grammar perspective and hypothesises that children's grammar is consistent with adult grammar. In a parameter-setting version of Generative Grammar, children may assume that arguments are dropped unless positive evidence in the adult language tells them that they should be provided. Thus, the innate state would be that the child is equipped with knowledge about the circumstances under which arguments may be dropped (e.g., Hyams 1986). Second, performance factors are held responsible for argument omission. Researchers assume that children know the argument structure of a verb, but that their processing capacities are insufficient to handle all arguments. Thus, their representation of argument structure is adult-like, but provision of arguments is hindered by performance restrictions (e.g., Valian 1991). Thirdly, discourse-pragmatic accounts investigate which situational factors lead to the provision of arguments, without assuming that children's knowledge is adult-like (Clancy 1993).

Allen (2000) examined eight features of discourse-pragmatic prominence which contribute to the relative informativeness of arguments in the speech of four Inuktitut-speaking children aged 2;0 to 3;6. The "informativeness features" include knowledge features as well as confusion factors. For example, if one wants to talk about an object that is absent in the physical context, it must be realised as an argument unless it has already been established as the discourse topic. Likewise, one needs to realise arguments that one asks questions about. But "confusion features" also lead to the provision of arguments; e.g., if there are two or more possible referents in the discourse context, the intended referent has to be encoded overtly.

Inuktitut, a Inuit language spoken in Northern Canada, allows for massive argument ellipsis, and children between 2;0 and 3;6 years of age only provide about 18% of all arguments (Allen and Schröder 2000). When they do, their provision of arguments follows the predictions of DuBois' *Preferred Argument Structure* in that there is no more than one new argument per clause, and in that lexical arguments (as opposed to demonstratives or affixes) tend to encode new arguments (Allen and Schröder 2000). But the rampant omission of arguments in adult language raises the question why children provide arguments at all. Logistic regression analyses showed that argument provision by Inuktitut children is not random (Allen 2000). A model containing all eight features of pragmatic prominence is significantly more accurate at predicting which arguments will be overtly represented

than a model containing none of these features. The presence of informativeness features also explains the overproductions of some types of arguments in early child language, as well as the omission of uninformative arguments by children where adults provide pronouns.

5. Summary and discussion

Generally speaking, inductive and deductive accounts can be distinguished by their vantage point: inductive accounts see linguistic categories as probabilistic concepts. For example, the "usual" case is for verbs with a transitive meaning to take two arguments, and for verbs of transfer to take three arguments. Deductive accounts assume that linguistic categories have a semantic or symbolic core, which is considered to be absolute such that children could make use of the link between the semantic and syntactic core in order to bootstrap another level of linguistic representation.

The semantic bootstrapping account comes closest to the traditional notion of *valency*. Valency in its core is a "projection" account: the verb exercises control over the arguments it occurs with. Consequently, there should be a systematic link between verb semantics and verb syntax that could be exploited in language learning since it would allow the child to predict the properties of semantically or syntactically similar verbs. The semantic bootstrapping account strives for full predictability of syntax on the basis of semantics (e.g., narrow and broad range linking rules) because it is assumed that learners are hypothesis-testing, thus grammar and semantics needed to be constrained in order to protect the learner from generalizing overly general grammars.

The syntactic bootstrapping account focuses on how children can use their syntactic knowledge for possible verb semantics. Syntactic bootstrapping cannot be the starting point for acquisition because it requires that children have built up some lexical as well as structural knowledge in order to deduce semantics based on structure.

More recently, the role of the construction has been emphasised in another framework, usage-based models of language. These inductive models are more lenient because they rely on probabilistic, not absolute cues. Since learners are assumed to be conservative, not hypothesis-testing, they will only generalise on the basis of positive evidence. They start out with lexically-based utterance schemas in order to encode their intentions and abstract semantic and syntactic components only gradually. It is important to note that constructions are defined as form-function units, thus form and function are equally important. The starting point need not be the semantic

or syntactic "core" from which the periphery is acquired; instead, the core components would be the results of generalization over repeated experience. Research in this tradition focuses more narrowly on the exact learning processes that lead to more schematic and later fully abstract representations.

In usage-based models we observe a shift of attention from the role of the verb to the role of the syntactic frame or construction. This is psychologically plausible because humans communicate in order to convey intentions, and they do so using utterances, not words (Tomasello 2000). Thus, utterances are the primary source of information from which words and syntactic operations that combine them can be isolated or abstracted. For this to happen, there needs to be repetition *and* variation: repeated exposure leads to the entrenchment of that particular structure. However, without variation this structure would be unanalyzed and frozen, and productivity would break down. Variation in the structure is needed to acquire more general and abstract schemata; e.g., if a given verb is only used with prepositional phrases denoting location, the learner will probably not generalise this frame to manner information as well. Thus, a model that integrates both entrenchment and variation leads to more sophisticated mental models that allow for (frequency-based) generalisations and help to explain developmental as well as diachronic language change (cf. Bybee 2005).

One of the key problems is to determine in more detail how repetition and variation interact. Bybee (2005) alludes to exemplar-based models of language, which assume that each usage-event is an exemplar that acts on our representation because it leaves a memory trace. This theory thus relies on concrete (= substantial) usage that is stored. It is as yet not known whether we simply store more and more tokens upon repeated usage, or whether we store more repeated information on a more general and abstract level when available, or whether we do both. The latter is conceivable since first results suggest that we have access to multiple levels of specificity (Bybee and Scheibman 1999).

And finally, research on the exact nature of storage in the mental lexicon is required. Elman (2004) refutes the classic perspective of the mental lexicon as that of a "dictionary" in long-term memory with a passive storage for semantic and structural information. Alternatively, he proposes a dynamic model of the mental lexicon based on previous experience. With each new experience with words, the mental space of the lexicon is refined and redivided; e.g., each new exposure to the word *child* in context acts on our existing representation of the concept 'child'. We do not simply retrieve a fixed word meaning from memory in order to process the new sentence. Elman (2004: 305) proposes that there is a continuum from learning

words to learning constructions: "Thus, knowledge of constructions is a straightforward extension, by generalization, of knowledge of groups of words that behave similarly". From a usage-based perspective, children's and adult's representations can be seen as a dynamic mental inventory of lexical items and constructions.

Notes

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