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Acquiring the transitive construction

The development of understanding word order and case marking cues

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Abstract

This dissertation investigates early syntax acquisition, in particular the acquisition of the transitive construction, within the usage based approach (Tomasello, 2000, 2003). In three studies I explored factors that affect how children understand which participant is the agent and which the patient in simple causative sentences (i.e. who does what to whom?).

Verb-specific behaviour has often been found in the production of transitive sentences by English speaking children. However, this may be limited to production and it may be an appropriate strategy only when acquiring a strict word order language such as English. Therefore, in the first study I tested comprehension of the transitive in English and in a case marking language, German, using both familiar and novel verbs in a pointing task. 2;1- year-olds of both languages were skilful in pointing at the correct picture only with the familiar verbs. In contrast, 2;6-year-olds of both languages were skilful in pointing in both verb conditions. Thus, initial verb-specific behaviour is also found in the comprehension of the transitive construction and in the acquisition of a language which does not provide such a strong word order cue. Furthermore, although German children get an additional cue, case marking, they still pass through a verb-based phase.

The second study deals with the issue that most languages, including German, have multiple cues to mark semantic roles. In two comprehension experiments, using an act out and a pointing task, I examined whether German children are able to use the grammatical cues of word order and case marking to correctly identify agents and patients in causative sentences and whether they weigh these two cues differently across development. In addition, I compared the results with data from an input study where I calculated cue availability and cue reliability for the two grammatical markers word order and case marking. Older

two-year-olds correctly understood only sentences with both cues supporting each other - the prototypical form - but not sentences with either cue on its own. Five-year-olds were able to use word order by itself, but not case marking. Only seven-year-olds behaved like adults by comprehending both cues on their own, and also, importantly, by relying on case marking over word order when the two cues conflicted. These findings suggest that prototypical instances of linguistic constructions with redundant grammatical marking play a special role in early acquisition, and only somewhat later do children isolate and weigh individual grammatical cues appropriately in terms of their reliabilities for signalling specific functions.

Using a preferential looking methodology with novel verbs, Gertner, Fisher, and Eisengart (2006) found that already 21-month-old English-speaking children seemed to understand the syntactic marking of transitive word order in an abstract, verb-general way. In the third study I tested whether young German children of this same age have this same understanding. Following Gertner et al. (2006), one group of German children was tested only after they had received a training/practice phase containing transitive sentences with familiar verbs and the exact same nouns as those used at test. A second group was tested after a training/practice phase consisting only of familiar verbs, without the nouns used at test. Only the group of children with the training on full transitive sentences was successful in the test. These findings suggest that for children this young to succeed in this test of syntactic understanding, they must first have some kind of relevant linguistic experience immediately prior to testing - which raises the question of the nature of children's linguistic representations at this early point in development.

All three studies paint a fairly coherent picture about children's early syntactic understanding and how this changes in robustness over development.

Very early in development German children show some weak syntactic knowledge in preferential looking. These results were also found for English-speaking children (Gertner et al., 2006). By 2;6 German children can show an abstract syntactic knowledge in an active behavioural decision making task, such as pointing whereas younger children show verb specific behaviour. Further, German children first interpret correctly sentences in which case and word order converge before they understand word order as a cue alone. English children understand the word order cue alone by 2;6, which is earlier than for German children. However, when German children develop knowledge about word order they even show a word order strategy, that is, they overgeneralize word order. In contrast, the understanding of conflicting cues is acquired very late.

Chapter 1: Where do we get syntax from? Nativist versus emergentist account.

Human's capacity to speak a language differs strongly from communication of other animal species. Most of our linguistic communication is ***symbolic***, i.e., it is based on social conventions. Therefore, human linguistic symbols can be ***arbitrary***, which means that they do not need to share any features with the reference they are referring to. Human linguistic symbols are used to share attention with our conspecifics about things in the world around us. Moreover, we use linguistic symbols by patterning them together into linguistic structures which themselves carry their own meaning. Thus, our linguistic communication is ***grammatical*** (Tomasello, 2003).

As a human with full linguistic competence I can give an utterance a specific meaning by using a specific ordering of the linguistic symbols. The order of linguistic symbols forms the ***syntax*** of an utterance. For example, if I want to talk about two persons doing an action parallel but independent of each other I can use the order "NOUN and NOUN VERB" as in the sentence *the boy and his father are fishing*. However, if I want to talk about two persons but now they are supposed to be involved in a causative action, that is, that one person is doing something to the other person then I can use the order "NOUN VERB NOUN" as in the sentence the *boy is pushing his father*. Abstract syntactic schemas, such as "NOUN VERB NOUN" can be filled with different content words so that we can talk about different events. Nevertheless, all sentences with the same underlying syntax share a similar meaning, e.g., *the father is washing the boy* and *the girl is kicking her classmate* share the meaning "somebody is doing something to somebody else", although both sentences describe completely different scenes. Thus, adult humans possess the ability to use ***abstract syntax***.

1.1 The nativist account

The big debate in linguistic theory is where our competence of abstract syntax comes from. On one side we find the ***nativist approach*** which proposes that the human language faculty is a system of knowledge represented in our minds that belongs to the biological endowment of our species and which has evolved a genetically based ***Universal Grammar*** (UG). On the other side we find ***functionalist approaches*** which claim that language is based on communicative functions and is learned inductively (see section 1.2).

UG is a theory of linguistic principles that claims to hold true for all natural languages and it assumes that a child comes to the language acquisition task equipped with these principles. The nativist model of the organization of grammatical knowledge based on UG is the ***Generative Grammar***, developed mainly by Chomsky (1965, Transformation Grammar; 1981, X-bar Theory; 1995, Minimalism). Generative grammarians basically aim to explain how humans are able to generate a potentially infinite number of utterances from a finite lexicon (***recursion***). Knowing the recursive procedures that generate sentences means that a person has syntactic competence in a particular language and more recent research proposes that the ability to produce recursive pattern is the only uniquely human component of the biologically endowed faculty of language (Hauser, Chomsky, & Fitch, 2002).

Furthermore, generative grammarians aim to search for the generality of syntax: Therefore, they distinguish between ***core*** and ***periphery*** of grammar. The core includes all formal grammar that can be subsumed under a rule (with no exceptions) and these are subject to the principles of UG. The periphery contains everything that must be learned by rote, such as lexical entries, irregular forms, idioms and idiosyncratic constructions. These are not part of UG.

1.1.1 Acquiring language with Universal Grammar

In the generative approach it is assumed that children have the same grammatical categories as adult speakers because the categories they acquire are predetermined by innate Universal Grammar. This approach is called the ***continuity assumption*** (Pinker, 1984) and is mainly based on the ***poverty of the stimulus*** argument, i.e., the impossibility for children to gain such a rich linguistic knowledge given the fragmentary input they are exposed to (Chomsky, 1980). All observable discrepancies between children's and adults' language are said to be due to lack of ***parameter setting*** (see section 1.1.1.1), ***lexical learning*** (see section 1.1.1.2), or ***performance limitations*** which include all language external causes such as processing or memory constraints.

1.1.1.1 Principles & parameter

The principle and parameter theory presupposes for language acquisition that children come to the language task with universally applicable rules – the ***principles*** – which constrain all sentence structuring. These principles apply in all languages except when an enquiry in the child's language demonstrates that a single version of a principle is not achievable.

In this case, the relevant principle is parameterized and takes over one of two (or, in some accounts, more) parametric alternatives. This implies a sudden change in the child's grammar and the triggering of ***parameter setting*** must be empirically distinguishable from the gradual development which one would expect from inductive learning from the input. An example of a parameter is the head direction parameter. It states that every language will have a consistent way of ordering direct objects (O) and verbs (V) and the specific order will be one of two parametric alternatives (OV order or VO order). UG equips the child with an expectancy that there must be a word order in the language s/he learns. Thus, the child simply needs to choose on the basis of positive evidence which of the two

options the correct word order will be. However, people have argued – as an alternative to the continuity assumption – that certain grammatical principles do not become available to the child until a given point in development. This is called the ***Maturational Model*** of language acquisition which claims that the different stages that all children go through are constrained by inherent maturational factors (Radford, 1990). Maturation explains why the setting of a particular parameter occurs later in development than another parameter and is therefore able to account for gradual development. Nevertheless, within a particular grammatical phenomenon (or principle) maturation still leads to a sudden learning because a child either has access to the principle or s/he does not.

1.1.1.2 Lexical learning

Similar to maturation and against the continuity assumption the ***Lexical Learning Hypothesis*** (LLH, Clahsen, 1999; Clahsen, Eisenbeiss, & Penke, 1996) proposes that grammatical development depends on prior learning, namely, lexical and morphological acquisition. This provides an explanation why grammatical development takes time. The lexicon contains everything that must be learned by rote (thus it belongs to the periphery of linguistic competence), whereas grammar contains everything that can be subsumed under a rule and so is part of the generative productive component of linguistic competence. This dichotomy between core and periphery leads to the assumption that a dual process underlies language acquisition, the so-called ***dual mechanism approach*** or words and rules approach (Pinker, 1999).

However, the LLH does not imply that given grammatical properties may be known to a child for some lexical items but not for others, thus, it does not predict lexical specificity (see section 1.2.2). Instead it implies that once children have learnt about the lexical and morphological specificities of their language the

relevant category is fully acquired and they can apply it across the board, e.g. if a child has knowledge about the word order then s/he has it for all verbs.

Since many different approaches propose how to acquire language with UG one problem still remains, namely, how children relate the surface word strings they hear to the innately given grammatical categories? That is, even if we assume innate knowledge of nouns, verbs, and verb complements etc., how does the child know which words in the input belong to which category? Thus, all UG theories share the "***linking problem***".

1.1.1.3 Semantic bootstrapping

People have tried to solve the linking problem by assuming that children have access to innate universal semantic-syntactic ***linking rules***, such as '*all agents are subjects*', '*all patients are direct objects*' and '*all themes are subjects, except if the subject is already linked, then themes are direct objects*' etc. (see Pinker, 1989: 74). The use of these links to determine the phrase structure of input sentences depends on prior knowledge of the semantic structures of verbs. The process which leads from semantic structure to syntax is called ***semantic bootstrapping*** (Pinker, 1982; based on the proposal by Grimshaw, 1981 that syntactic entities are canonical structural realizations of semantic entities) and works as follows: Initially, the child is paying attention to the situation (event) that accompanies an input sentence and builds up a conceptual structure. That means that the child is able to parse the event into basic ***semantic entities*** such as 'thing', 'causal agent', 'path', 'patient' and 'action', for instance, the event 'lion pushes bear' will be divided by the child into 'agent – action – patient'. The semantic entities are then automatically linked via the innate linking rules onto the corresponding ***syntactic universals*** such as 'noun', 'subject', 'preposition', 'direct object' and 'verb' so that the child builds around the input sentence, e.g., '*the lion*

is pushing the bear' the sentence structure 'subject – verb – object'. Hence, children learn language-specific facts like word order by understanding the meaning of sentences and applying innate rules which universally link those meanings to their syntactic expressions.

This appears to be a very explicit solution for the linking problem. However, semantic bootstrapping does not explain why the very first subjects that children produce are often not agents (but rather first person pronoun subjects of verbs such as *see*, *like*, *have*) as spontaneous speech data by Lieven, Pine & Baldwin (1997) have shown. In addition, the acquisition of these non-canonically linked arguments does not need extra developmental time (Bowerman, 1990), i.e., verbs of perception (*see*), emotion (*like*), possession (*have*, *got*) and desire were acquired just as quickly as prototypical agent-patient verbs (*push*). Semantic bootstrapping further is problematic for the acquisition of ergative languages where the agent of an intransitive and the object of a transitive verb pattern together grammatically in contrast to the agent of the transitive. Pinker's solution here is that the innate linking rule can be bent if a child is confronted with consistent contradictory evidence (Pinker, 1989: 253, 281). Similar potential problems arise if children learn passives (they might overapply the 'agent-subject' linking rule) or languages which omit regularly the subject (e.g., Spanish and Italian).

1.1.1.4 Syntactic bootstrapping

The semantic bootstrapping hypothesis attempts to describe how children might use event semantics to bootstrap into the canonical syntactic marking of these events in their language. In contrast, the ***syntactic bootstrapping*** hypothesis – originally formulated by Landau and Gleitman (1985; see also Gleitman, 1990) – is about how children might generalise over the syntactic frames in which they

hear verbs used in order to learn what the verb means. Syntactic bootstrapping is based on the assumption that semantic structures of verbs are essentially of the same kind as conceptual representations by means of which we represent events (Jackendoff, 1990). Both distinguish between relations (predicates) and the entities they relate (arguments). As soon as children become able to identify some familiar nouns in fluent speech and represent these as part of a larger utterance they are also able to build up ***partial representations*** of a sentence consisting of, for example, *lion … bear* (Fisher, 2000a; Fisher, Hall, Rakowitz, & Gleitman, 1994). Those partial sentential representations allow the child to detect a particular event among others which maps correctly the accompanying linguistic stimulus (analogical mapping procedure, Fisher, 1996): Thus, if the child is watching a scene in which a lion is pushing a bear and the bear falls of a cliff and both event participants are mentioned in the linguistic input, the child will assume that the new word *push* refers to a binary relation (pushing) rather than a unitary relation (falling). The main learning mechanism, therefore, is an (innate) tendency to assume that the number of noun phrases in a sentence will match up with the number of semantic arguments of the verb (Fisher, 2002a).

However, the set of nouns in a sentence only estimates roughly the number of syntactic arguments of the sentence's verb (e.g., *the lion and the bear are falling*; *the boy is running with his dad* etc.). Therefore, the syntactic bootstrapping hypothesis predicts that children in some point of development will make errors and systematically misinterpret sentences in which e.g., two noun phrases appear with an intransitive verb.

Furthermore, if a child has established that a relational word (e.g., verb) is a binary relation (causation) it does not tell the child what kind of relation this is, i.e., that the first noun in the sentence is the agent. Fisher (1996) argues that children learn about word order using basic predispositions such as children's bias

to attend to causal relationships, the preference for dynamic subjects (the agent is the dynamic entity in the observed event and the subject occurs in prominent position of the sentences), the tendency for animate objects to occur as surface subjects etc. Thus, the final sentence interpretation is guided mostly by salience factors and subjects of transitive sentences can be characterized by proto-agent entailments, such as causation, perception, volition and movement (Dowty, 1991). However, Fisher also claims that "thematic roles as abstract as agent or theme are not necessary to achieve an initial structure-sensitive interpretation of verbs". Rather, "the result of the process (analogy structure mapping) could be an interpretation in quite specific terms. For example, hearing '*the car hit the fence*' and observing an appropriate event, the child might interpret the arguments of *hit* essentially as HITTER and HITTEE" (Fisher, 1996: 74). This approach is not dissimilar to hypotheses in the usage based account about children's initial understanding of agents and patients (see section 1.2.2). However, Fisher does not clearly outline in her model how children finally come from those lexically-specific mappings to more abstract mappings between subjects/objects and agents/patients.

1.1.1.5 The Coalition Model of language comprehension

Hirsh-Pasek and Golinkoff (1996b, chapter 7) formulated the ***Coalition Model of language comprehension*** as a result of a batch of preferential looking studies (see section 2.2.2). Their theory assumes innate knowledge of syntactic categories and hierarchical structures but besides it relies on domain-general learning mechanisms. They describe their model as a process-oriented view "in which children come to the learning task with some sensitivities to properties in the input that are informed by internal grammatical knowledge" (Hirsh-Pasek & Golinkoff, 1996b: 48). The authors emphasise that children use a coalition of cues

to finally crack the syntactic code which means that they use all aspects of the input, such as prosody, semantics, lexical information, syntax, and social context. The development of language comprehension is then divided into three main phases: Phase 1 (***internalization***) with extraction and acoustic packaging of cues from the input, phase 2 (***internalization and interpretation***) with segmentation and linguistic mapping, and phase 3 (***interpretation***) in which children are able to carry out a complex syntactic analysis.

In phase one up to nine months of age, language helps the child to set up boundaries for real world events. This is to what the authors refer to as ***acoustic packaging***. Three abilities are necessary to use acoustic packaging. First, infants must refine their analysis and form image schemas of the world's (non-linguistic) events. Second, they must attend to acoustic information, i.e., they must extract acoustic correlates of linguistic units from the language stream. And finally, they also must be aware of that language maps onto events, i.e., language describes ongoing events.

In phase two between approximately 9 and 24 months, children move from acoustic packaging to ***linguistic mapping***. They start to extract words and phrases from the acoustic unit and map those onto their referents (objects, events). Hirsh-Pasek and Golinkoff further claim that children of this phase are able to show sentence comprehension when prosodic, social, semantic, and syntactic systems act in concern. Thus, the child relies on redundant cues. If any of these cues is disrupted, e.g., semantics conflicts with syntax as in nonreversible passives the unstable sentence comprehension will suffer.

In phase three from 24 months on, children perform unsupported ***syntactic analyses***. They understand sentential relations that are abstract to what is witnessed. They can now rely solely on syntactic information (structure dependent rules) to build mental models and to glean interpretations from linguistic input.

Thus, during the three phases children focus on different cues in the input – in phase one they are biased to cues from prosody, in phase two to semantic cues and in phase three to syntactic cues – although they always have access to all of them and other aspects of the coalition still influence their interpretation.

The Coalition Model of language comprehension permits a gradual development of sentence interpretation, ranging from a more fragile state (phase two) to a more resilient state (phase three). This is similar to the usage based account. Nevertheless, the Coalition Model still relies on the assumption that children have innate syntactic categories and therefore does not predict early lexical specificity during language development.

1.2 Usage based linguistics

The usage based approach is a functionalist approach, i.e., it is based explicitly in the expression and comprehension of communicative intentions. The usage based approach proposes that language structure emerges from language use. For language acquisition this means that a child hears and stores concrete utterances and then finds patterns in these stored utterances (Tomasello, 2003).

1.2.1 Construction and Cognitive Grammar

Two grammatical theories which provide a background for the usage based approach of language acquisition are ***Construction Grammar*** by Goldberg, (1995; 2006) and Croft (2001; Croft & Cruse, 2004), and ***Cognitive Grammar*** by Langacker (1987; 2000). Both suggest that language structure emerges from language use. The linguistic competence of mature speakers of a language is characterized as a "structured inventory of ***symbolic units***" in the minds of its speakers (Langacker, 1987; Croft, 2001).

1.2.1.1 Construction Grammar

Grammatical constructions in Construction Grammar are fundamentally symbolic units which consist of ***pairings of form and meaning*** and are at least partially arbitrary (see Figure 1). Furthermore, they are language specific. The meaning part of a construction represents all of the conventionalized aspects of a construction's function. The ***symbolic link*** between form and conventional meaning is ***internal*** to a construction (Croft & Cruse, 2004). This assumption is very different from generative grammar approaches in which the symbolic link is proposed to be external and therefore form and meaning must be connected via linking rules (which are assumed to be innate).

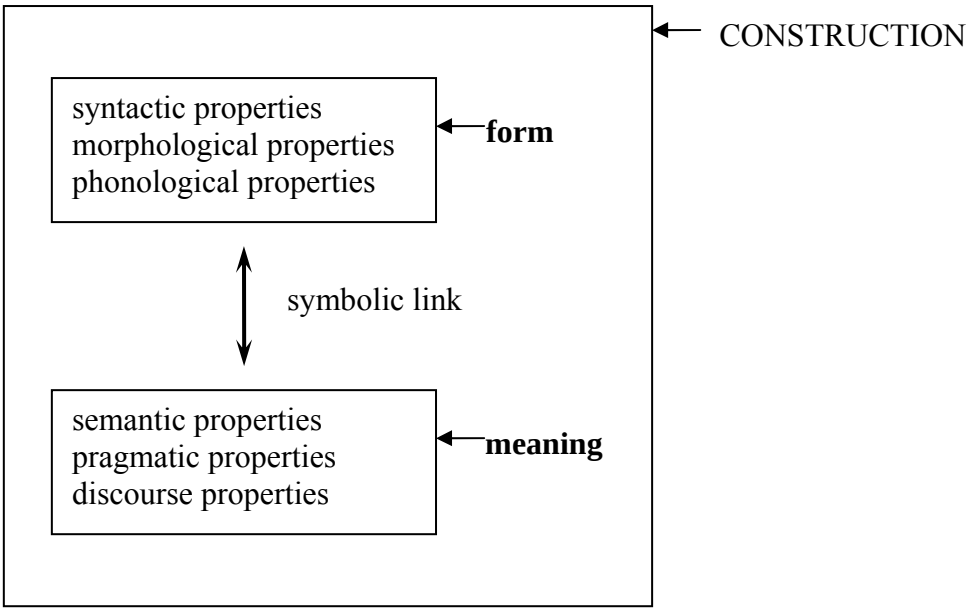


Figure 1: Constructions (adapted from Croft & Cruse, 2004: 258)

Construction Grammar is characterized as follows: Firstly, it is a functional approach, i.e., syntax plays a direct role in meaning. Thus, all postulated elements in an utterance are functionally motivated. Secondly, all grammatical structures, lexical specific items such as words as well as abstract constructions such as the transitive construction, are represented in a uniform

format, i.e., they are all ***learned*** form-meaning-pairings. They only differ in the extent to which the phonological form is specified, i.e., how schematic they are (***specific/schematic dimension***), and in the complexity of the structure (***complex/atomic dimension***). Therefore, construction grammar works with a ***syntax-lexicon continuum*** (Croft, 2001) and no strict division is assumed between lexicon and syntax (see Table 1). Thus, construction grammar can explain speaker's knowledge of idioms, i.e., it classifies all structures of a language and not just the regular pattern.

Table 1: The syntax-lexicon continuum (adapted from Croft, 2001, table 1.3: 17)

Construction type	Traditional name	Example
Complex, schematic	Syntax	SBJ – TRANSVERB-OBJ
Complex, mostly specific	Idiom	Kick-TENSE the bucket
Complex but bound	Morphology	NOUN-s; VERB-TENSE
Atomic, schematic	Syntactic category	DEM; NOUN
Atomic, specific	Word / lexicon	this, green

Thirdly, constructions are not represented as an unstructured list in the speaker's mind but they are organized in a ***taxonomic network*** and build therefore a structured inventory of the speaker's knowledge of the conventions of their language. In this taxonomic network, each construction constitutes a node (Croft, 2001, see Figure 2). This style of grammatical representation allows each construction to inherit from another construction. In doing so, the dominated construction contains all the information that the dominating construction holds and therefore, each construction is fully specified but is also redundant to the degree that information is shared with the dominating construction.

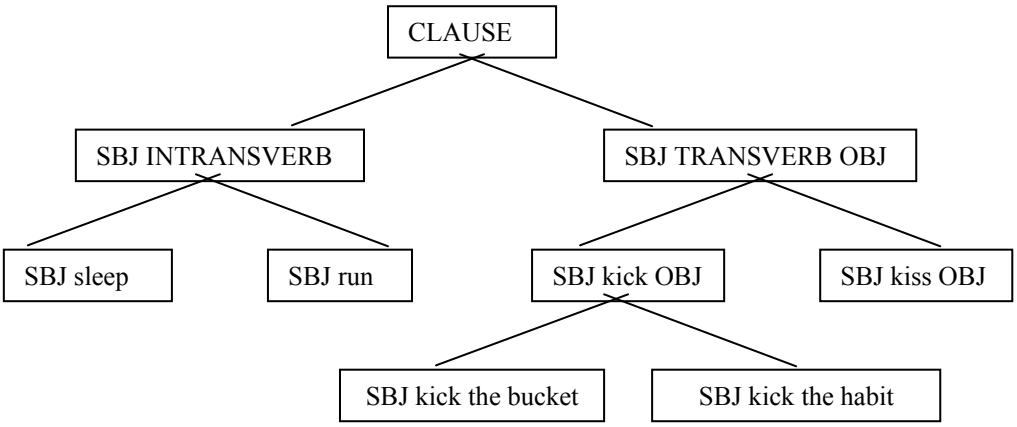


Figure 2: A taxonomic hierarchy of constructions (Croft, 2001, fig. 1.11: 26)

However, if we take into account that constructions can additionally obtain characteristics like tense, aspect, mood or negation it becomes obvious that many constructions do not only inherit from one other construction but can have multiple parents (Croft, 2001, see Figure 3).

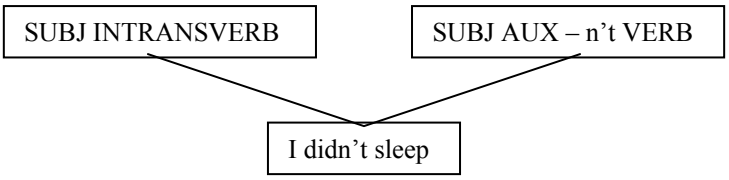


Figure 3: Multiple parents in a construction taxonomy (Croft, 2001, fig. 1.12: 26)

Therefore, different constructions are not seen as being fully independent. Rather, complex multi-dimensional networks organize the linguistic constructions in the speaker's minds. Goldberg (1995) argues that these ***inheritance links*** are based on ***similarity*** between the constructions which means that constructions are syntactically related as well as semantically related and she specifies four different kinds of connections between the symbolic units: One kind of inheritance links are the ***polysemy links*** which capture the nature of the semantic relations between a particular sense of a construction and any extensions from this sense while the syntax of the central sense is inherited by the extensions. For instance, the central

sense of the ditransitive construction is X CAUSES Y to RECEIVE Z (Example: Joe gave Sally the ball) and an extension via a polysemy link from this is X CAUSES Y not to RECEIVE Z (Example: Joe refuses Bob a cookie). A second kind of inheritance links are the ***sub-part links*** which are posited when one construction is a proper subpart of another construction and exists independently. For example, the intransitive motion construction (X MOVES to Z) is related to the caused motion construction (X MOVES Y to Z) by a subpart link. Furthermore, Goldberg defines ***metaphorical extension links*** when two constructions are found to be related by a metaphorical mapping and ***instance links*** which occur when a particular construction is a special case of another construction (Goldberg, 1995, chapter 3: 75 - 81).

All constructions, even very abstract ones such as [SUBJ – VERB – OBJ – OBJ], are meaningful linguistic symbols. Casenhiser and Goldberg (2005) examined this assumption with a recent experiment in which they tested learners' ability to learn to pair a novel constructional meaning with a novel form. They created a novel sentence structure involving known nouns arranged in a non-English word order, e.g., *the spot the king moopos* (NNV). The meaning of they assigned to this phrasal pattern was that of appearance (a novel meaning for English phrasal patterns). Thus, *the spot the king moopos* means the spot appears on the king. The test was a forced choice comprehension task in which children (aged five to seven) and adults saw two film-clips presented side by side, heard a sentence describing one of the clips and were finally asked to point to the corresponding clip. Each test film-clip pair involved the same entity engaged in a similar action, but in only one did the entity appear on the scene within the clip. After only three minutes of training and 16 total examples children (and adults) were able to glean the novel abstract meaning that is associated with a novel

formal pattern involving novel verbs and extend what they have learned to new utterances that use new novel verbs. Further, it has to be noted, that children and adults learned the meaning of the novel construction especially well when they heard this construction with one novel verb having a particular high token frequency (skewed input). Thus, high token frequency of a single general exemplar does facilitate the acquisition of constructional meaning. This fits in well with the fact that children appear to develop the meaning of an abstract syntactic construction based on particular verbs which occur very frequently with this construction (Goldberg, 1999, see section 1.2.2).

1.2.1.2 Cognitive Grammar

Similar to Construction Grammar, in Cognitive Grammar all grammatical structures are claimed to be symbolic. Lexicon and syntax form a ***continuum of symbolic units***, each residing in the association of a ***semantic structure*** and a ***phonological structure*** (meaning and form in Construction Grammar). The learning of grammatical structures is similar to the process of ***schema formation*** in other areas of cognition (Langacker, 1987; 2000; Tomasello, 2000). ***Schemas*** are mental frameworks of knowledge representations and they emerge via defining distinct structures with lesser precision and specificity and via finding similarities among them (a kind of ***abstraction*** process). Langacker (2000) provides a model of ***schematization*** of grammatical structures in connectionist terms: Each time a grammatical structure (including all constructions from words to complex abstract syntax) is used, it activates a node or pattern of nodes in the mind. To the extent that two experiences (e.g., two utterances) are similar they activate similar patterns of nodes. All patterns representing a number of similar structures cluster in the same region of state space (Langacker, 2000: 7). Thus, a symbolic unit can be extended to another similar symbolic unit (process of

extension). From this emerges gradually (depending on the number of similar structures) the abstract structure (schema). A schema is still immanent in its instantiations, which means, that the abstract structure will not be stored separately from the individual utterances. Thus, schematization relies on systematic variation within a consistent frame to create a more abstract schema. ***Generalizations*** are then embodied by schematic symbolic units which are characterized at varying levels of abstraction (see Figure 4)

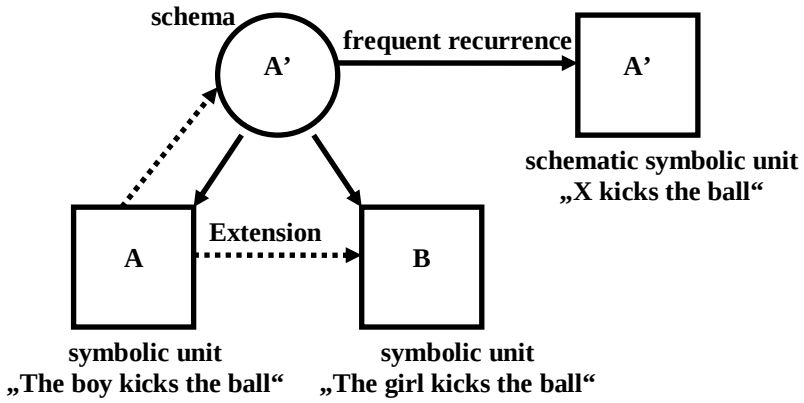
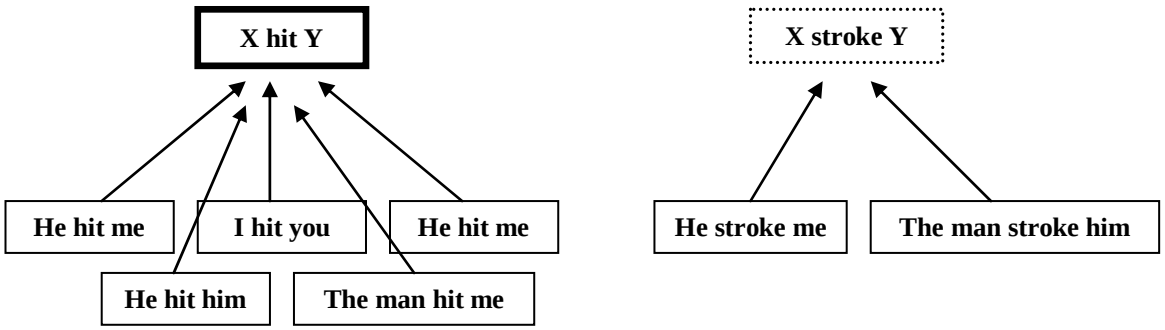


Figure 4: Schematization and generalization of symbolic units

Schemas can change to proper symbolic units if instances of the schema occur frequently. When these instances are different, that is, the ***type frequency*** of a schema is high, schemas are able to become more abstract and general (e.g., the *–ed* past tense). However, when these instances are just repetitions of the same form, that is, the ***token frequency*** is high, generalizations will become retarded and particular word forms become rigidified (e.g., irregular past tense forms). This phenomenon is called ***entrenchment***. Entrenched abstract or schematic syntactic constructions emerge (e.g., a transitive construction around the verb *hit*) if a verb occurs with different agents and patients (high type frequency leads to the abstract schema *X hits Y*) but additionally this verb occurs very often and exclusively in this particular syntactic structure (see Figure 5).



High token frequency
→ entrenched „X hit Y-schema"

Low token frequency
→ not entrenched „X stroke Y-schema"

Figure 5: Entrenchment of syntactic constructions

Thus, in the usage-based model, word forms and syntax are not the output of rules as in generative grammar but instances of schemas. Schemas represent generalizations at different levels of abstraction and are based on the process of language use and entrenchment. This predicts that in language acquisition, syntax and morphology are acquired in a ***gradual piecemeal and inductive*** fashion. In the following chapters I will extend the ideas of the usage-based model in grammar to recent research in child language acquisition.

1.2.2 Language acquisition in the usage-based approach

For those who see grammar as an emergent property of the child's development, abstract representations arise from an interaction between the learning of specific frames, their increasing connectedness to other frames and socio-cognitive development (Tomasello, 2000). As mentioned above, usage based theories invoke schematization as one of the major mechanisms for learning and abstracting language. Furthermore, for usage-based theorists a particular utterance will be multiply represented at different levels in the speaker's system ranging from the lexical specificity of the actual utterance through to its place in an abstract network of related constructions and paradigms. Thus, the process of

language learning and abstraction is based on ***exemplars***, i.e., the child recognizes the commonalities among the various exemplars that fill ***slots*** around particular ***frames***, e.g., noun phrases around particular verbs. Children's utterances are constructed in a variety of ways of which rote-learning forms one end of the continuum and the generation of utterances from abstract categories and rules forms the other, with a variety of semi-formulaic pattern lying somewhere in between (***constructivist account***). ***Frequency*** will partially determine whether a string is learned as an unanalysed whole or as a ***slot-and-frame formula***.

More explicitly, this means that most children begin language acquisition by learning some unparsed adult expressions as ***holophrases*** or ***frozen phrases***, such as *I-wanna-do-it* or *Lemme-see* (Pine & Lieven, 1993). As found in the observation of early spontaneous speech, children's first ***multiple word utterances*** are productive, lexically-based, positional patterns in which a constant item occupies a constant position in relation to variable items with which it is combined, e.g., *more X*, *there's-a X*, *I-want X*. These patterns are called ***pivot schemas*** by Braine (1976; 1963) and slot-and-frame patterns by Lieven and colleagues (Lieven et al., 1997; Pine & Lieven, 1997). However, people assume that these early combinatorial patterns do not have syntax, because of their consistent ordering which mirrors what children hear in the input. Thus, whether a child produces *juice gone* or *gone juice* does not mean something different and therefore word order does not contain any syntactic meaning (Tomasello, 2003).

Which frames are learned and which slots develop in them is accounted for by what is salient to the child. Thus, children may be able to generate some types of novel noun phrases at a relatively early point in their development of syntax. They can then place these noun phrases into schemas which are much more lexically specific, such as *Where's* ____? The complexity of these slots develops over time (Lieven, Behrens, Speares, & Tomasello, 2003).

Another strong constructivist account is Tomasello's ***Verb-Island Hypothesis*** which claims that children start producing multiword speech without any knowledge either of syntactic role categories such as subject and object or of semantic role categories such as agent and patient, but gradually build verb-specific categories on the basis of their experience with a particular verb (Tomasello, 1992, 2000). These verb island constructions have open nominal slots which are presumably built up as children hear type variation in the same constructional role (e.g., *I spilled it*, *You spilled it*, *He spilled milk*, *He spilled juice* etc. converge on the schema ___*spilled*___). Each verb island construction thus has its own semantic roles (e.g., preverbal position = spiller; post verbal position = thing spilled). Children then build up abstract constructions by accumulating some critical mass of transitive verb island constructions. The critical mass serving as the basis for generalization presumably comprises such schemas such as ___*hit*___, ___*chase*___, ___*kiss*___, ___*show*____ and so forth (see Figure 6). The process of abstraction is based on some kind of structure mapping in which the language learner discerns analogies among the relational structures of the different verb island schemas (Gentner & Markman, 1997).

However, the Verb-Island Hypothesis has been criticised for being centred only around verbs. Critics suggest that it depends on a correlation between the noun-verb distinction at the linguistic level and some kind of argument-predicate distinction at the cognitive semantic level which they point out to be far from perfect in children's early grammars (e.g., Fisher, 2002a; Maratsos, 1990). Therefore, it is argued that verb-island phenomena might be only one part of the story of early child grammar. For instance, Lieven et al. (1997) found that young children form their first item based constructions also around other high frequency items such as pronouns (see section 2.2.1). Item-based constructions, such as verb

or pronoun islands have, unlike slot-and-frame patterns, syntactic marking, e.g., word order marks that the agent comes before and the patient after the verb.

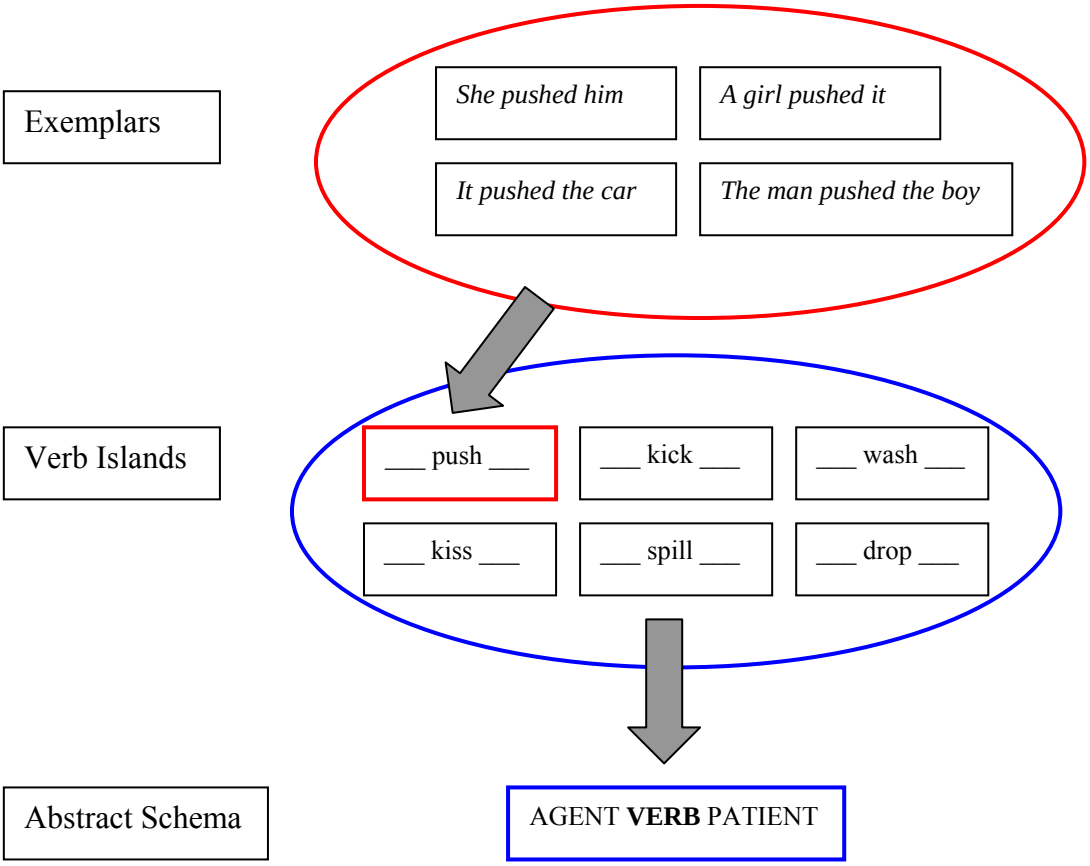


Figure 6: Verb island constructions

The importance of verbs in early syntax acquisition is also demonstrated by findings of Goldberg (1999). When analysing early speech of children she pointed to the importance of ***light verbs*** during language development. Light verbs are highly frequent verbs with a very general meaning which build the basis for the generalization to constructional meaning. For instance, the verb '*to give*' as well as the ditransitive construction Subject - Verb - $Object_1$ - $Object_2$ is associated with the meaning TRANSFER. In contrast, the verb '*to tell*' would not match prototypically the constructional meaning. An analysis of five English speaking children revealed that *give* was indeed the most frequently used verb in

the ditransitive frame. Thus, highly frequent verbs whose meanings match the constructional meaning are used earliest. Furthermore, the semantics that comes to be associated with a syntactic pattern emerges from early uses of the pattern with particular verbs. And finally, the meaning of the most frequent and early verbs occurring in a particular pattern form the prototype of the construction. Other light verbs are, for example, '*to go*' for the intransitive construction, '*to do*' for the transitive construction, and '*to put*' for the caused motion construction. Further empirical support for this view of argument structure acquisition comes from Ninio (1999). She also noted that children often begin using a single verb in a particular grammatical pattern long before other verbs are used in this pattern ('***pathbreaking verbs***').

When children arrive at the point in language development where they are able to generalize their syntactic knowledge, mechanisms are needed which prevent them from ***overgeneralization*** of their newly learned syntactic construction, e.g., from saying: *Don't giggle me*. Studies have shown that frequency effects such as ***entrenchment*** play an important role here. Entrenchment could be demonstrated by the fact that the more frequent and the earlier acquired a verb is, the less likely children will be to violate its argument structure by overgeneralization, that is, the children should be less likely to say *I disappeared the rabbit* than *I vanished the rabbit* because disappear is more frequent and is thus more entrenched in the intransitive construction (Brooks, Tomasello, Dodson, & Lewis, 1999; Theakston, 2004).

However, not only frequency determines when and whether a construction is fully acquired. One other phenomenon which influences children's generalizations of constructions is called ***pre-emption***. This means that if a child hears a verb used in one construction that serves the same communicative function as another construction s/he might infer that the not heard construction is

not the conventional one. Therefore, if a child hears *He made the rabbit disappear* when s/he expects *He disappeared the rabbit*, s/he might assume that the verb *disappear* does not occur in the simple transitive construction (Goldberg, 1995; Braine & Brooks, 1995). Brooks and Tomasello (1999a) showed experimentally that pre-emption was effective in constraining children's generalization tendencies but not before the age of 4;6 (see also Brooks & Zizak, 2002). The authors tested further Pinker's (1989) theory of ***semantic verb classes***, i.e., whether children learn classes of verbs via semantic constraints and found similar results, namely, that semantic verb classes begin to work late (also around age 4;6).

In addition, as the ***construction conspiracy hypothesis*** proposes, the development of a given grammatical construction (e.g., subject – transitive verb – object) may depend not only on experience of that particular construction but also on knowledge of other constructions to the extent that they share formal or semantic similarities with the construction being learned (Morris, Cottrell, & Elman, 2000; Abbot-Smith & Behrens, 2006). Thus, grammatical relations are family-resemblance categories which cannot be described by a single parameter as generative approaches suggest.

1.2.3 The Competition Model

One additional approach which investigates how children converge on the form-function mapping of their language comes from the ***Competition Model*** (Bates & MacWhinney, 1989; MacWhinney, 2004). This functionalist model which was originally developed to account for cross-linguistic adult language processing is based on only two levels of informational structure: The ***functional level*** which represents all the meanings and intentions to be expressed in an utterance, e.g., the actor role, and the ***formal level*** which represents all the surface forms and expressive devices available in a particular language, e.g., a noun

phrase marked with nominative. The mapping between these two is assumed to be as direct as possible. However, that does not mean that one form maps only on one function but usually several forms map onto several functions (see Figure 7).

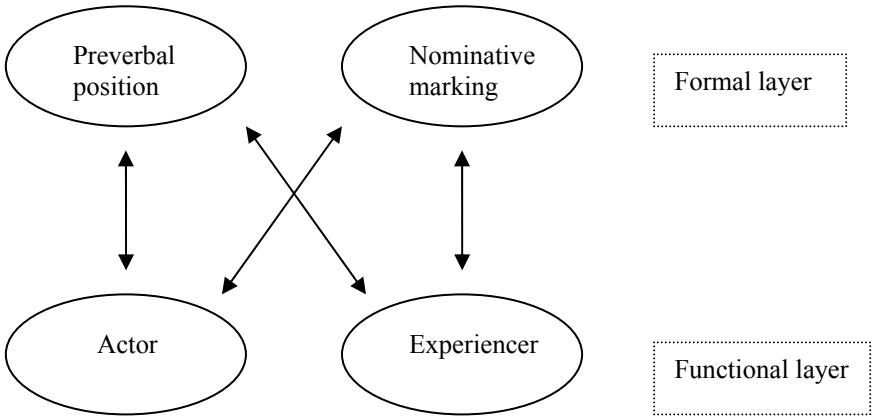


Figure 7: Form-function mapping based on Bates and MacWhinney (1989:48)

For instance, in a sentence such as *Der Löwe schubst den Hund* (the[+nominative] lion is pushing the[+accusative] dog) the actor role (the lion) is associated not only with its preverbal position but also with the nominative marking on the definite determiner. On the other hand exactly these two grammatical forms – preverbal position and nominative marking – can express a different function, e.g., experiencer role as in *Der Löwe fürchtet Hunde* (the[+nominative] lion fears dogs). And of course, there are even more forms which can map onto the actor or experiencer role, such as subject-verb agreement, stress or animacy. Therefore, it is a complex problem to finally investigate on which cues people rely on when processing a sentence.

Furthermore, the degree to which people rely on the different cues varies between languages. For example in English people rely heavily on word order to establish who the agent in a transitive sentence is whereas in German case marking and in Italian semantic plausibility (animacy) become more important. To predict which cues will be used by the listener of a particular language the

Competition Model uses the concept of ***cue validity***. Cue validity is the information value of the different linguistic and non linguistic cues which are used to interpret a sentence. It is determined by two factors which can be calculated from speech or text corpora of a particular language:

1. ***Cue availability***: Cue availability describes how often a cue is there when you need it. That means that it is defined as the proportion of sentences in which a cue is present in a particular task domain, e.g., when expressing or interpreting actor roles. For instance, in English nominative case marking to mark the actor role of a transitive sentence is only available in sentences in which agents are expressed by pronouns (*He pushed me*.) but this cue is not available in sentences in which a full noun phrase labels the agent *(The lion pushed the dog*.).
2. ***Cue reliability***: Cue reliability describes how often the cue leads to the function. That means that it refers to the proportion of sentences in which a cue correctly indicates the agent or patient when it is present. For instance, in a German sentence, such as, *Den Hund schubst der Löwe* ('the[+accusative] dog is pushing the[+nominative] lion') with the meaning 'It's the dog that the lion is pushing' the word order cue would be available because the listener can identify first and second noun phrase, but it would not be reliable because in fact the second – and not the first – noun phrase refers to the agent (as determined by the case marking cue).

Cue validity is thus defined as the product of cue availability times cue reliability. This kind of cue validity is also called ***overall validity*** (McDonald, 1986, in contrast to conflict validity, see below).

As mentioned, another concept which has been developed to predict which cue in a sentence people will rely on is the concept of ***conflict validity*** developed

by McDonald (1986). Conflict validity signifies the percentage of time that a cue is both available and indicates the correct categorization for all sentences in which at least two cues conflict with each other. From these kinds of sentences it is possible to identify which grammatical cue is stronger in competition with other cues and to learn about which cue is more reliable. McDonald found that children initially mapped cues in an order close to that of overall validity whereas the strength of adult cue usage corresponded to conflict sentence validity (see section 2.2.3).

This finding indicates that cues appear to be weighed differently during development. Therefore, in contrast to the very static concept of cue validity which is calculated from text samples and reflects the average values of a particular cue in a particular language, Bates and MacWhinney (1989) added a subjective property to their model which is called ***cue strength***. It defines the weight of a connection between a given surface form and an underlying function at a particular time (in language history and language learning) and captures also statistical differences between adult speakers. Only under ideal conditions (mature native speaker, perfect perception etc.) the value of cue strength converges on the value of cue validity. Cue strength can be estimated using experiments of sentence comprehension in which the different cues vary. For instance, to estimate the strength of the different grammatical cues in the transitive domain listeners can be presented with simple transitive sentences such as *The boy are following the girls* and then be asked who the agent/subject of the action is. English mature native speakers would usually choose *the boy* and therefore weighing word order more strongly than subject-verb agreement whereas Germans and Italians would show opposite pattern (MacWhinney, Bates, & Kliegl, 1984). However, when testing children or second language learners the importance of these cues to agent

assignment can be completely different (see table 1.1., p. 44 in Bates & MacWhinney, 1989).

But a cue which is often available and reliable can be hard to process or even hard to hear, so that the fact of ***cue cost*** has to be taken into account. Bates and MacWhinney (1989) divide cue cost into two factors: ***perceivability*** and ***assignability***. Perceivability refers to the ease with which a form can be detected in the speech stream. Some forms, such as auxiliaries are often unstressed, reduced, sentence medial and therefore much more difficult to detect than e.g., full noun phrases. One extreme example of imperceptibility of cues in oral language is subject-verb agreement in French, such as in *Elle mange* / *Elles mangent* (She eats / They eat). Although the agreement marker is there in written language it cannot be heard. Assignability refers to the amount of material that must be held in memory before a meaning assignment can be made. The amount of memory required for integration is relatively low when attachments between units can be made locally. For instance, case suffixes can lead to the assignment of a semantic role as soon as it has been recognized and integrated with its noun stem. Slobin (1982) refers to these as ***local cues***. Memory load increases when integration must be delayed until all information is received, such as in the processing of subject-verb agreement (the verb and all its associated nouns have to be heard before the cue can be used). Slobin (1982) refers to this kind of cue as ***distributed*** (also called global cues or topological cues in Bates & MacWhinney, 1987, 1989). If the processing system is under stress or the processor has limited auditory storage distributed cues might become too costly to handle so that the listener relies finally on the more local cues. The same argument holds for language acquisition because small children are less developed in perception and memory. Slobin's ***Local Cue Hypothesis*** proposes that the relative cue cost also influences the order of acquisition of grammatical cues and the local cues should

therefore be acquired earlier than distributed cues (Slobin, 1982, see also section 2.2.3 for a review of studies in this framework).

For language acquisition it is also important that because – as mentioned above – sometimes several forms map redundantly onto a single function, in some constructions cues form ***coalitions*** to yield a prototype (coalitions-as-prototypes approach, Bates & MacWhinney, 1987, 1989), for example, when agents are marked with both word order and case. Such prototypes might play a special role in language acquisition due to the extra information available, and especially if, as is often the case, this prototype occurs especially frequently. This means that an agent of a transitive action, for instance, should be comprehended most easily by a German child if it is not only marked by its preverbal position but also by nominative case.

On the other hand, it appears to be in particular difficult for young language learners if cues are put into ***competition***, i.e., for instance, if two cues in a transitive sentence assign agency to different noun phrases (preverbal position refers to the first noun to be agent but case marking to the second noun, such as in *Den Hund schubst der Löwe* ('the[+accusative] dog is pushing the[+nominative] lion')). This kind of sentence evokes the problem that a decision has to be made between the two competing possible agents. But to make this decision the child first has to build up analogies between each possible agent in the sentence (the dog or the lion) and the number of agents s/he has already in mind which overlap partially with them (either marked with preverbal position, with nominative case or both). Which candidate finally wins will depend on frequency (how many other agents have been marked with preverbal position before, how many with nominative case) but of course also on reliability (previously nominative marking always indicated agents in transitive sentences).

The Competition Model explains the transition of cue use from overall validity (depending mainly on cue availability) to conflict validity (depending on cue reliability) with a ***learning-on-error mechanism*** (McDonald, 1986): A strength counter is maintained for each cue, and in deciding a role, the noun with the largest total cue strength is assigned to that role. When a role is assigned incorrectly, cues that could have predicted the correct answer have their strength increased. There is no increase of strengths in the case of correct assignment. Initially (e.g., when the child starts to learn about cue values), all cue strengths are small random values so that errors will be made over all sentences (overall validity). At some point, sentences that do not have cues conflicting do not produce errors anymore. Then, cue strengths are incremented only for sentences with conflicting cues (conflict validity).

The interesting question is how children use all these different factors of the Competition Model presented above to develop a correct, respectively, adult-like cue use of their language. A number of studies in this framework have been carried out which I am going to present in section 2.2.3.

Chapter 2: Acquiring the transitive construction

2.1 The transitive construction in English and German

Transitive constructions prototypically describe a causative event where one participant, the ***agent***, carries out an action which directly affects another participant, the ***patient***. A prototypical transitive sentence therefore involves a verb with a causative meaning and two nouns which describe the participants of the action, as in the sentence "*the cow is kicking the horse"*. Transitive constructions include different kinds of action events, such as the caused motion transitive which describes a change of location of the patient (1) or the change of state transitive (2). However, transitive constructions can also describe non-action events (3).

(1) Change of location: *The dog chased the lion*.

(2) Change of state: *The cat bit the man*.

(3) Non action event: *The boy saw the girl*.

The central sense of the transitive construction is defined as a volitional actor affecting an inanimate patient (Goldberg, 1995; Hopper & Thompson, 1980). This prototypical meaning of transitivity further involves contact between agent and patient. Therefore, non action events are farther away from the prototypical sense of the transitive construction than action events.

To correctly understand transitive sentences people have to distinguish semantic roles (agent and patient) grammatically. Cross-linguistically the most common ways to do this is through ***word order***, ***case marking***, ***subject-verb agreement***, and ***animacy*** contrasts. For example, in the English sentence "*He throws pencils*", we identify the agent of the action as *he* based on the facts that: (i) it is said before rather than after the action word or verb [word order]; (ii) it is the subject pronoun *he* (and not the object pronoun *him*) [case marking]; (iii) it agrees in number with the verb (we say "*He throws*" but "*Pencils throw*", without

an -s) [subject-verb agreement]; and (iv) it is a statistical fact that animate beings, such as male persons, are more likely to act on inanimate things, such as pencils, than the other way around [animacy]. German transitive sentences are very similar to English ones. Semantic roles are also marked through the four grammatical cues alluded above. However, in German nouns can be case marked for their role in the sentence (not just pronouns, as in English) and German has a much more flexible word order. And if a word is locally marked with a case marker indicating its role in the sentence, then word order may be used for pragmatic functions such as emphasis and perspective. Thus, in German a sentence, such as, *Den Hund schubst der Löwe* ('the[+accusative] dog is pushing the[+nominative] lion') with the meaning 'It's the dog that the lion is pushing' is possible (see chapter 4 for more details of the German grammar).

2.2 Early transitive constructions

Recent discussions in the literature on the acquisition of syntax have centred on a debate regarding the nature of children's early syntactic representations (Tomasello, 2000; Fisher, 2002a; Tomasello & Abbot-Smith, 2002; Naigles, 2003; Tomasello & Akhtar, 2003). On one side of this debate are those who believe that early syntactic representations are abstract. This idea, the ***Generalization Hypothesis***, rests on the claim that even very young children have formed generalizations about the syntax of their native languages that are not simply rote-learned formulae tied to specific lexical items (Fisher, 2002a; Naigles, 2003). On the other side of the debate are those who suggest that young children's syntax develops in a piecemeal way. This ***Item-based Hypothesis*** postulates that early syntax is based on knowledge of the argument structures of individual lexical items and that these item-specific representations persist into the fourth year of life (Tomasello, 2000; Goldberg, 1999; Lieven et al., 1997). Arguments of

either side of this debate are mostly based on the acquisition of the transitive construction. Therefore, a central question in the study of language acquisition is how young children understand "who is doing what to whom" when they hear or utter a sentence such as *The cat is chasing the dog*. To produce and comprehend such sentences the child has to determine which of the two noun phrases is the agent and which is the patient of the described action. I now review a number of studies which have been carried out on the acquisition of the transitive construction to draw a developmental account of what we know so far about children's early syntactic representations.

2.2.1 Early lexical-specificity

When observing ***spontaneous speech*** production it has been found that from the beginning of multiword speech young English-speaking children produce active transitive utterances correctly with known verbs. However, Tomasello (1992) presented evidence for the concreteness of children's early transitive constructions. In an extensive diary study, he found that almost all of his English-speaking daughter's early multiword utterances during the second year of life revolved around the specific verbs involved (verb island constructions, see section 1.2.2). The lexical specific nature of this phase of language development was evident both in the patterns of participant roles (agents and patients) as well as in the way similar participant roles were syntactically marked or not marked across verbs. For instance, his daughter did not generalise argument structures across even very similar transitive verbs like *cut* and *draw* even though she started to use both verbs around the same time (at 1;7). Whereas she only used *cut* with the construction *cut*___ she used *draw* with several different structures, e.g., *draw*___, *draw with*___, *draw for*___, and ___*draw*___.

Whereas at that time Tomasello's theory was based on the observation of one child solely, Pine, Lieven and Rowland (1998) investigated subject-verb-object patterns of twelve English-speaking children who have just started with multiword speech (age range 1;4 – 2;7). Their results provide evidence that children in this early stage indeed produce main verbs together with a subject, a direct object or both. However, especially the subject use of these children was based on ***lexically specific formulae*** such as *X + go*, *Mummy + X*, *X + is* or *I + X* (Pine et al., 1998, table 9: 823). As can be further seen from these data, it is not always the verb which provides the basis for item-based constructions but much of children's early knowledge can be also organized around other high frequency items such as pronouns or nouns, e.g., the child's name or *Mummy*. Similar results come from an analysis of the direct object position by Lieven et al. (1997, Appendix C: 215) who demonstrated that the first constructed utterances containing verb and direct object have pattern such as *want + X*, *see + X* or *X + it*. Pine et al. (1998) further questioned whether the children showed contrastive use of SVO word order and therefore examined the number of different nouns and pronouns that occurred as subjects and objects of transitive verbs and how many of these items appeared in both subject and object position. Because they found nearly no overlap of items occurring in both positions they concluded that the items (nouns and pronouns) initially used by children as subject and object arguments come from different populations (items that occur always before the verb and items that occur always after the verb) and that therefore children in this developmental stage do not seem to use SVO word order contrastively.

2.2.2 Early abstract knowledge

Item specific formulae such as those outlined above would lead to appropriate performance on tests of production and comprehension of word order

with familiar verbs. Consequently, error free use and comprehension of word order with familiar verbs cannot distinguish between truly general knowledge of basic word order (SVO) and lexical-specific knowledge of word order (e.g., verb specific: PUSHER *push* PUSHEE). But what is needed is a test of how general young children's knowledge of the transitive construction is. The appropriate way to test for generality of children's knowledge of word order is to use completely ***novel verbs*** which the child has never heard before modelled together with noun phrase arguments. If the child has an abstract general knowledge of the argument positions around the verb s/he understands that the noun phrase before the verb assigns the agent or experiencer of the event and the noun phrase after the verb the patient or theme. If the child's knowledge of argument positions is restricted to particular familiar verbs s/he might know that the 'pusher' comes before the verb *push* and the 'thing pushed' comes after the verb *push* but s/he does not know yet that in a sentence, such as *X is gorping Y*, X must be the 'gorper' and Y the 'thing gorped'. Therefore, only experiments which control the conditions under which children hear particular words and constructions can answer the question of the level of abstraction at which the child's linguistic knowledge is represented at a particular developmental point.

One way to test this is to get children to produce sentences containing novel verbs. Because scientists normally want the children to produce a novel verb in a particular construction, e.g., in a transitive sentence they often use a method which is called ***elicitation*** or ***elicitated production***. That means that they create a situation in which the speaker is more likely to produce the novel verb in a particular sentence structure than in another. If they, for instance, want children to form a transitive sentence with the novel verb *gorping* they might show a scene to them in which one participant of the novel action *gorping* is acting on a second participant.

Olguin & Tomasello (1993) trained children aged 25 month on four transitive verbs for novel actions. Each verb was taught in a different combinatorial configuration: with only the agent expressed (in sentence initial position: *Ernie's chamming*), with only the patient expressed (in sentence final position: *Mibbing Cookie Monster*), with both agent and patient expressed (in their canonical positions: *Ernie's koobing Cookie Monster*), or with no arguments expressed (*Oh, look! Gaffing*). When given the opportunity to use their newly learned verbs in new ways, children most often reproduced the same combinatorial pattern they had heard for each specific verb (almost 90% of the time). When children did use a known object label in combination with the new verbs they did not use a canonical word order pattern to distinguish the different semantic roles involved (i.e. when they wanted to talk about the agent they were equally likely to place it before or after the verb). This demonstrates that 25-month-old English-speaking children use novel verbs very conservatively (only in a construction they heard it modelled in), even though further work by these authors finds syntactic generalization with novel nouns (Tomasello & Olguin, 1993). Thus, children of this age will use a novel noun in a syntactic position in which they have not heard it attested. They can create linguistic categories corresponding to the types of linguistic items that play particular roles in pivot schemas (nouns, pronouns etc.) but they will not show the same behaviour with novel verbs, i.e., they do not make generalizations across the various pivot schemas (see also Tomasello, Akhtar, Dodson, & Rekau, 1997 for 22-month-old's productive behaviour with novel nouns but not with novel verbs). Olguin and Tomasello (1993) take this as evidence that early syntactic representations are based on individual verbs, rather than more general syntactic frames, because they expect that an individual with generalized syntactic representations would use that knowledge to extend novel verbs to various syntactic frames. Further work by

Akhtar & Tomasello (1997, study 2) using a similar procedure as Olguin and Tomasello (1993) but with older children demonstrated that it is not until children are well into their fourth year of life that they begin showing this kind of productive knowledge of the transitive construction.

However, several people have argued that it might be problematic for young children to be presented with novel verbs in an intransitive sentence structure and then expect the children to use the verb in the active transitive sentence structure. This is because some verbs of action on an object can be used both transitively and intransitively, but with an associated change in meaning (e.g., Fisher, 2002a). Thus, in English the verb *spinning* can be used both to describe an agent's action on an object (*Bert is spinning Ernie*) and to describe the resulting motion (*Ernie is spinning*). To avoid difficulties which might originate from the intransitive-transitive alternation Dodson and Tomasello (1998) developed a study in which they presented children novel verbs either in a Two-Participant transitive sentence in which the experimenter said: *Look. Big Bird is dopping the boa*t, or in a No-Participant sentence in which the experimenter named the two participants but did not use them as arguments of the novel verb: *Look what Big Bird is doing to the boat. It's called keefing*. They tested an age range from 2;5 to 3;1 and found that children start to use the novel verbs productively in transitive sentences by age 2;10. Thus, these children demonstrated productivity with novel verbs at a younger age than those in Akhtar and Tomasello (1997). The reason for this might be that the authors designed their study in a way which allowed the children to use the novel verbs with pronouns in argument positions (*I am dopping it*). A study which focussed on this aspect was carried out by Childers and Tomasello (2001) who demonstrated that the majority (85%) of even younger English-speaking children (mean age 2;6) were able to demonstrate productivity with transitive sentences containing novel verbs when

they were previously trained with pronouns as the subjects and objects of transitive utterances, such as *He's ___-ing it*. This finding that pronouns facilitate the acquisition of the transitive construction supports the hypothesis that the transitive schema might be also structured around two pronouns (e.g., *I ___ it*) rather than always around the verb.

Another possible way to test children's ability to produce the transitive construction is to present them with an active-passive alternation. This kind of alternation avoids a possible change of the verb meaning as it might appear in the intransitive-transitive alternation. Two studies investigated German and English children's ability to form passives to actives (Brooks & Tomasello, 1999b for English; Wittek & Tomasello, 2005 for German children). Both the English and German-speaking children had a mean age of 2;10. The children heard the novel verbs used in the passive construction and were then asked questions to elicit the active transitive, e.g., *What happened? What did the frog do?*. Almost exactly a third of the children in both languages demonstrated productivity in this manner. This might be taken again as indicating that verb-general productivity with the transitive construction develops fairly late in both languages.

Finally, Akhtar (1999) has developed a method which completely avoids children having to deal with real sentence structure alternations during the experiment. She modelled novel verbs for novel causative events with 2;8-, 3;6-, and 4;4-year-olds in ungrammatical word orders (SOV: *Elmo the cow tammed* and VSO: *Gopped Elmo the cow*) and investigated whether the children corrected those word orders to the canonical English SVO-order when they produced the novel verbs themselves (***weird word order paradigm***). Two more conditions served as controls: novel verbs modelled in canonical SVO (*Elmo dacked the car*) and familiar verbs modelled in ungrammatical orders (e.g., *Elmo the car pushed*). In the control conditions all age groups almost exclusively produced sentences in

canonical English SVO-word order. In the two test conditions, however, they behaved quite differently. Whereas at 4;4 the children corrected the non canonical word patterns to a canonical English SVO-pattern 96% of the time the two younger groups only did this around 50% of the time. These findings are particularly important because they show that two- to three-year-olds are not just conservative that they produce novel verbs how they have heard them, they are so conservative that they can be induced to produce a novel verb in bizarre word orders unlike anything they would normally hear. To test this phenomenon with even younger English-speaking children, Abbot-Smith, Lieven and Tomasello (2001) adapted Akhtar's (1999) basic experimental paradigm for children aged 2;4. Since children of this age are more likely to produce two-word utterances they used intransitive constructions. The test sentence structure with a novel verb in an ungrammatical word order was VS (e.g., *Meeked the cat*), the control conditions were novel verbs in canonical word order (SV: *The horse baffed*) and familiar verbs in ungrammatical word orders (VS: *Jumped the dog*). The 2;4-year-olds in this study corrected the novel VS verb to SV-order only 21% of the time whereas the majority of control sentences were produced in canonical SV-order. In addition, both studies (Akhtar, 1999; and Abbot-Smith et al., 2001) found when the two-year-olds corrected the ungrammatical VS(O) structures to canonical SV(O) they used pronouns much more often than nouns for subject realization. Thus, the results of the two studies show very nicely a very consistent picture of gradual development in the acquisition of English word order beginning with conservative use of novel verbs only in frames they have been heard modelled before (verb-specificity) or the use of novel verbs between well known pronouns (pronoun specificity) and ending with a strong abstract representation of SVO-word order in English in which different verbs creatively occur with different noun phrases. The willingness of two-year-olds to use verbs in non canonical

word orders is additionally influenced by the frequency of which verbs appear in the input. When testing 2;9-year-olds in such an experimental paradigm using real verbs with different frequency values (e.g., *push* versus *shove* versus *ram*) Matthews, Lieven, Theakston and Tomasello (2005) were able to show that these children at the end of their third year corrected weird word order sentences such as *Bear elephant pushing* always to *Bear is pushing elephant* whereas they corrected sentences such as *Bear elephant ramming* only around 45% of the time (see also Matthews, Theakston, Lieven, & Tomasello, 2007 for French children). The frequency effect demonstrated in these studies provides strong support for entrenchment phenomena (see section 1.2.2) and therefore also for the usage based approach.

Thus, children younger than 3;0 are willing to accept word-order configurations that are inconsistent with the target language. However, scientists such as Fisher (2002a) who propose a more abstract general knowledge of word order even in children younger than three suggest that the results of the weird word order studies (as well as the results of the other production studies in which the children were more likely to use novel verbs conservatively) could be interpreted in a different way, namely, that the children might have been syntactically primed by the experimenter's linguistic models. ***Syntactic priming*** is the phenomenon in which individuals are more likely to use a syntactic form that they have heard or used recently than to use a different syntactic form, even if it is equally appropriate (Bock, 1986; Bock & Loebell, 1990). Therefore, if the two-year-olds' behaviour in the weird word order and other elicitation studies is due to syntactic priming rather than conservative use of verbs we must assume that children of this age know more about word order than previously thought. The theoretical debate in the literature is, however, whether the observed effect is due to purely ***structural priming*** (based on abstract syntax) or whether some of the

effects are due to some kind of ***lexical priming*** (primes and target share the same verbs or nouns) as well. Only if a child is able to get primed by a previously heard sentence structure it means, that this child must have some underlying abstract syntax. So far there is no evidence for syntactic priming in children younger than three. The youngest children who took part in a priming experiment were 3;2-year-olds (Savage, Lieven, Theakston, & Tomasello, 2003) and these children showed a priming effect only if a high lexical overlap occurred between the prime and the elicited target utterance (i.e., the prime was, for instance, *It got pushed by it* and the children were asked to describe a transitive action with a different verb but were allowed to use also the pronoun *it* for agent and patient, e.g., *It got cut by it*). Pure structural priming in children without the need of lexical overlap was found in a study by Huttenlocher, Vasilyeva and Shimpi (2004) but these children were already four and a half years old. Thus, it is very unlikely that the 2-year-olds' target utterances in the weird word order experiments have been syntactically (structurally) primed by the training sentences.

Since production is a demanding task it might be that children are able to show a general understanding of agents and patients earlier in comprehension than they can produce verb general transitive sentences (see Hirsh-Pasek & Golinkoff, 1996b; Shipley, Smith, & Gleitman, 1969, for the tendency for comprehension to precede production). Akhtar and Tomasello (1997) therefore tested also children's comprehension of word order using an ***act out*** procedure. After listening to a comprehension request either containing a novel or a familiar verb (*Can you make Ernie tam (push) Cookie Monster?*) children aged 2;10 were asked to make the characters perform the action. These children chose the correct agent of the action at chance when the sentence contained a novel verb but performed above chance when the sentence contained a familiar verb (study 3). Hence, their knowledge of English word order might be still lexically specific. Older children (3;8, study 2),

instead, chose nearly always the correct agent even in novel verb sentences, i.e., these children could demonstrate an abstract knowledge of English word order.

Naigles, Gleitman & Gleitman (1993) carried out a similar act out experiment, though the aim was not to test young children's comprehension of word order but to find evidence of whether they use some kind of abstract sentence structure to interpret verb meanings (syntactic bootstrapping). Participants were asked to enact grammatical and ungrammatical sentences consisting of known transitive and intransitive verbs in transitive and intransitive syntactic frames. Of interest were frame-compliant responses to ungrammatical sentences e.g., acting out 'zebra push lion' (caused motion action) when hearing *the zebra goes the lion*. Two- three- and four-year-olds (the two-year-olds were about 2;9-years-old) overapplied causative meanings to intransitive verbs which were presented in a transitive sentence frame. The authors interpreted this behaviour as showing that young children apply meanings to verbs in relation to the number of noun phrases with which the verbs occur. However, using the same procedure but novel verbs so that children had really no previous knowledge of the verb meanings Sethuraman, Goldberg and Goodman (1997) demonstrated that two- and three year olds (the two-year-olds were about 2;8-years-old) when tested on the same novel verb in different syntactic frames the children performed different actions for the same verb depending on the syntax in which they occurred. This finding goes against the syntactic bootstrapping hypothesis because the children did not show any tendency to try to determine what the root meaning of the novel verb might be. In contrast, their results show a clear tendency that children pay attention to the semantics associated with the syntactic frame for the overall interpretation of the sentence which accords with a construction grammar approach. Because adults did show a tendency to preserve the same action for each novel verb (independently of the syntactic environment) the authors

concluded that the ability to use syntactic bootstrapping as a strategy for learning verb meanings seems to emerge with development.

All these findings suggest that two- to three-year-olds' knowledge of argument structure (in particular word order) is item-specific rather than abstract and verb-general (Tomasello, 2000), although some understanding of differences between syntactic frames appears to develop at the end of the third year of life (Sethuraman et al., 1997). Discrepant results have come, however, from the relatively new methodology (i.e., new to research on syntactic development) of ***preferential looking***. The method is based on the supposition that children will look preferentially to a video screen (or live materials) that match some linguistic material, word or sentence, that they hear coming from a speaker between two video displays of which one screen matches the auditory stimulus and one does not (Spelke, 1976, 1979). Using preferential looking to investigate syntactic development was pioneered by Golinkoff, Hirsh-Pasek, Cauley and Gordon (1987) who showed that 28-month-old English-learning children can use word order to identify that in a sentence such as *Cookie Monster is tickling Big Bird,* 'Cookie Monster' is the agent and 'Big Bird' is the patient. Hirsh-Pasek and Golinkoff (1996b, experiment 3) were able to replicate these results also with 17-month-olds. Thus, English children know correctly very early in development that in a transitive sentence containing a familiar verb the first noun is the agent and the second the patient. However, these studies have used familiar verbs, and therefore do not address the question of whether these children understand word order in a more abstract, verb-general way (Tomasello, 2003). Therefore, to assess whether and when English children have extracted more abstract representations of word order, preferential looking studies with novel verbs are needed.

There is a number of such studies using novel verbs which have been carried out to test children's ability to discriminate transitive and intransitive

constructions which are not distinguishable only by argument number because they used intransitive sentences with two participants such as *The monkey and the bear are blicking* (e.g., Naigles, 1990; Hirsh-Pasek & Golinkoff, 1996b, chapter 6; Bavin & Growcott, 2000; Kidd, Bavin, & Rhodes, 2001). These are interesting insofar as that they suggest that it is not only the number of arguments that English two-year-olds use to discriminate sentence structures but other features such as where in the sentences the arguments occur and how they are connected with each other.

However, a deeper look into these studies yields very contradicting findings: Hirsh-Pasek and Golinkoff (1996b, experiment 5 & 6), for instance, found that children of 29 months of age (but not 24-, and 19-month-olds) showed a significant preference for a causal scene against a non causal scene when hearing a transitive sentence such as *Find Big Bird squatting Cookie Monster* (Naigles, 1990 found this preference for the causal scene also in 25-month-olds; and Bavin & Growcott, 2000 in 27-month-olds). However, this did not work the other way around. When hearing the intransitive sentence *Find Big Bird and Cookie Monster squatting* children of the same age did not show preference for the non causal scene but looked equally often to both scenes. On the contrary, 25-month-olds who listened to an intransitive sentence such as *Find Big Bird and Cookie Monster are glorping* looked significantly longer to the matching non causal event (Naigles, 1990). 28-month-olds performed similarly when presented with intransitive sentences containing the preposition *with* such as in *Find Big Bird squatting with Cookie Monster* (Hirsh-Pasek & Golinkoff, 1996b, experiment 7)[1]. However, 23-month-old boys (not the girls) instead treated the intransitive *with*-sentences as though they were active transitive sentences

[1] Unfortunately, because they did not find verb effects Hirsh-Pasek and Golinkoff (1996) collapsed the presented data over all verb types (known and unknown) and did not present results only for the unknown verbs.

(preferred looking to the causal scene). Bavin & Growcott (2000) repeated all three conditions (transitives, intransitives+'and', such as *Mark and Jane are sebbing*, and intransitives+'with', such as *Jane is zorking with Mark*) in a within subject design using only novel verbs. The children aged 27 month looked significantly longer to the matching screen only in the transitive condition. In the intransitive+'and' condition they even looked longer to the non matching event. Kidd et al. (2001) replicated the study with 30-month-old children and found preferred looking to the matching event only for the transitive and the intransitive+'and' condition. However, it has to be noted that there were methodological differences between the latter and the former studies. Whereas Hirsh-Pasek and Golinkoff (1996b) and Naigles (1990) presented two completely different actions to the children (e.g., someone bending the other one back and forth on one screen and two persons making arm circles on the other screen) Bavin and Growcott (2000) and Kidd et al. (2001) presented the same actions on both screens but one was carried out as a causative event (one person bending the other one up and down) and one as a non causative event (two persons standing side by side bending up and down). Showing two different actions might have facilitated the task for the children.

All these results suggest that children in the first half of their third year are able to recognize transitive sentences and map those with causative scenes but to recognize intransitive sentences with two participants as clearly non causal events they need extra lexical information such as the inflected verb form *are* or the preposition *with*. The authors claim that these studies support the syntactic bootstrapping hypothesis insofar that children around two appear to overapply all sentences with two noun phrases to causal events and this behaviour might only be overwritten when additional lexical information occurs. In my opinion, however, this conclusion has to be taken carefully because of the contradictory

results from the different studies and because there is no clear evidence that children prefer the causative scene when listening to an intransitive sentence with two participants. Chang, Dell and Bock (2006) further present an alternative explanation why performance in preferential looking with conjoined noun phrase intransitives and *with*-intransitives by children around two years of age is much more variable than their performance with transitives. They suggest that causative agents might be represented differently from non causative agents and that it might also play a role that constructions with causative meanings are more frequent relative to those with non causative agents (see also Cameron-Faulkner, Lieven, & Tomasello, 2003). However, being able to differentiate transitive and intransitive sentences does not mean that children from the very beginning on have also knowledge about the subject and object position in a transitive sentence which they automatically apply to agent and patient of a causal event.

Recently, a revised version of this transitive-versus-intransitive method has been used to focus directly on the question of children's understanding of verb-general syntactic marking. Gertner, Fisher and Eisengart (2006) exposed children 21 and 25 months of age to two video screens depicting caused-motion transitive actions. On one screen, a duck was performing some action on a bunny, and on the other screen the roles were reversed and the same bunny was performing an action - a different action - on the same duck. The linguistic stimulus was sentences like *The duck is gorping the bunny! Find gorping!* Because children did not know the specific action associated with the word *gorping*, the only way to find gorping would be to know that the agent of the action is the one mentioned first, and the patient second. The finding was that across a series of four studies, children of both ages looked longer to the matching screen, suggesting that they did indeed recognize the syntactic roles of the two characters on the different screens based on how those are marked in English.

Crucially, Gertner et al. (2006) also employed an initial practice phase in which crucial elements of the child's task could potentially have been learned before the test. Specifically, in the practice phase several transitive sentences using familiar transitive verbs were presented along with their respective events, for example, when hearing *The bunny's hugging the duck* the child saw on both screens the bunny acting on the duck as the agent of a causative action (one screen matched the action *hugging*, the other screen showed a different familiar action, e.g. *feeding*). In a second practice trial the child saw the duck as the agent acting in two familiar causative actions on the bunny as the patient while hearing a transitive sentence with the duck in pre-verbal position. The characters used in these practice trials (duck and bunny) were the exact same characters used in the subsequent test trials, so that, without necessarily knowing the familiar verbs in these trials, the children had the opportunity in the practice before the test to learn that the word *duck* used in sentence-initial position indicated the duck causing the action and when that same word *duck* was used in sentence-final position it indicated the duck as patient of the action (and the same for the word *bunny*).[2] It is important to note that the use of some kind of familiarization phase is used in all kinds of looking time studies – in order to familiarize children with the materials and procedure – but this phase should not enable children to learn crucial elements of the task.

Furthermore, the preferential looking paradigm seems to be problematic with older children. In Kidd et al. (2001) the 2;6-year-old children did not look significantly longer to the matching scene in the familiar verb condition whereas they did so in the novel verb condition. Similarly, in Gertner et al. (2006) the younger children looked longer to the target in the novel verb scene (study 3) than did the older children (study 1). This can be accounted for be arguing that once

[2] The same basic argument applies even in Gertner et al.'s second and fourth study in which only one full noun phrase was used.

the task becomes 'easy' – in that the child would have no difficulty accessing the relevant representation and using it to coordinate a complex executive functions task (e.g., production) – children may be so quick to look at the correct scene that they become quickly bored and therefore look equally long at both scenes for total looking time over the entire trial. But this makes the age and developmental stage of children critical to interpreting preferential looking results.

So far, the studies reviewed above suggest a paradox in the data. Production and act out studies have demonstrated that it is not until their third birthday that children begin showing a kind of productive knowledge of the transitive construction. On the other hand, there are the preferential looking studies which suggest that already early two-year-olds (or even younger children) can demonstrate abstract syntactic knowledge. Certainly, active behavioural tasks such as production or act out and passive looking tasks such as preferential looking are two completely different measures of children's syntactic knowledge. Whereas the active behavioural tasks involve many executive functions other than just detecting sentence structure (e.g., motoric skills and prospective memory), in preferential looking the participant need only attend to and understand the stimulus which might be sufficiently easy that even children with only the weakest syntactic knowledge could succeed (see also Munakata, McClelland, Johnsons, & Siegler, 1997 for the disparity between looking and reaching behaviour in non-linguistic cognitive development). Therefore, in the study of children's acquisition of the transitive construction during the third year of life a method is needed which a more direct measure of knowledge than preferential looking is but not a tricky memory-burdensome complex task such as act out.

One method which might work well with children between 2;0 and 3;0 is ***pointing*** to video scenes. The advantages are that when asked to identify e.g., the agent the children have to make a real decision for one of the two participants (or

for one of two video screens if two scenes are presented to the child). This behaviour is much easier to interpret than looking time proportions (see also Clements & Perner, 1994 for implicit knowledge represented by looking and explicit knowledge represented by pointing in a false belief task). In addition, pointing is a very practiced behaviour by two years of age and might be therefore not as complicated for a two-year-old as acting out a complex novel action.

A study which has used this method to investigate children's acquisition of the transitive construction has been carried out by Fisher (2002b). She presented one video scene showing a caused motion event to 2;6-year-old English-speaking children. While watching the video in which an agent performed an action on a patient the children heard either novel verb sentences such as *She is pilking her over there* (transitive condition) or S*he is pilking over there* (intransitive condition). They were then asked to point to the agent of the action (*Which one pilked the other one*? *Which one pilked*?). Fisher (2002b) found significant differences between the two groups, i.e., children who heard the transitive sentences chose the agent more often than children in the intransitive condition (who chose more frequently the patient than children in the transitive condition). Thus, children of this age appear to interpret a sentence with two noun phrases as the description of a causative event and a sentence containing one noun phrase as the description of an intransitive event (here the partial motion event of the patient). Fisher (2002b) claims that this finding supports syntactic bootstrapping which proposes number of noun-phrase arguments as an early constraint on sentence interpretation and verb learning. However, this study was not designed to investigate whether children know that subjects are agents and objects are patients in a transitive sentence.

In addition, a recent pointing study by Fernandes, Marcus, DiNubila & Vouloumanos (2006) found that English speaking children with a mean age of 2;6

were able to assign the subject and/or object of a transitive sentence to the agent and/or patient of a causative event and the subject of an intransitive sentence to the patient of a causative event. But again, methodological problems and the fact that data was collapsed over age groups prevents us from seeing what 2;6-year-old English-speaking children do know and what they do not know about word order. First of all the children had to succeed a training phase during which they had to learn that the aim of the task was to point to one out of two screens. For that the authors presented two scenes to the children: One scene showed a character called 'Bunny' sitting and a character called 'Greenbean' standing and the other showed the reverse. Then the children had to choose which scene matches a familiar sentence, for instance, *Greenbean is standing*. If children did not pass through this task they were excluded from the test (n = 14). However, this is quite a difficult task because the children had to decide which character is in which state. Hence, only data of already advanced children were included into the final analyses. A second critical point is that the children were tested in between subjects conditions but the age range is very wide (27 – 35 months) and it is not clear which mean ages the different groups have. The four between subject conditions were: Training on intransitives (*Bunny is dacking*) and test on transitives (*Bunny is dacking Greenbean*), training on intransitives and test on intransitives (only control condition), training on no arguments (*Look, dacking*) and test on transitives, and training on no arguments and test on intransitives. But not every condition is of the same interest in answering the question of whether children do generalize word order to novel verbs. The third critique is that during training the children had already watched one scene (always Greenbean acting on Bunny) which was either identical to the matching or non-matching scene in the subsequent test. However, they did not have prior exposure to the other scene (Bunny acting on Greenbean). That is, they were much more familiar with one

scene than with the other one during the test. Because counterbalancing was not complete it is not clear whether children's pointing behaviour was influenced by novelty or familiarity of one scene (In four out of the six test trials the matching scene could have been identical to the scene watched during training and if the pointing behaviour was influenced by this children reached already 66% correct pointing without knowing anything about word order). Nevertheless, there is some evidence that children are able to identify agents (and/or patients) of transitive sentences before they reach their third birthday. How robust this knowledge is needs further investigation.

However, once children have acquired a more or less abstract schema of the transitive construction it is not the case that they will be able to understand all transitive sentences correctly which are possible in their language. Unfortunately, most of the studies on children's early syntactic competence focused on the correct understanding of one cue in isolation, the word order cue in English. But in languages such as German in which word order is more flexible several cues are prominent and important. To fully achieve adult-like knowledge about the transitive construction children additionally need to know that the different cues to agent identification have to be weighed differently.

2.2.3 Learning of correct cue use

Evidence that children's acquisition of the transitive construction is influenced by the particular validities of various cues in their language comes from a study with English and Italian speaking children by Bates et al. (1984) which compared the use of word order and also animacy as a cue for agents (agents tend to be animate, patients inanimate). It was found that the high cue validity for word order in adult English leads English two-year-olds to rely on word order from early on and to be able to ignore animacy cues when interpreting

which noun phrases are agents and patients whereas in Italian, in which word order has lower cue validity, two-year-olds rely on animacy cues when these conflict with word order.

However, the particular aspects of cue validity which children follow appear to change over development. Sokolov (1988) found in a study with Hebrew-speaking children and adults that cue availability – that is how often a particular grammatical cue occurs – played a stronger role in sentence interpretation for younger children whereas older children and adults relied more on cue reliability – that is the proportion of sentences for which a particular grammatical cue correctly indicates the agent or patient. To learn which cue is most reliable children primarily have to find out which cue adults follow when two cues conflict. A study by McDonald (1986) indicates that this appears to be quite a drawn-out process in language development. This study compared how English and Dutch children and adults used cues with the two kinds of cue validity: overall validity and conflict validity. McDonald found that children initially mapped cues in an order close to that of overall validity whereas the strength of adult cue usage corresponded to conflict sentence validity. This is quite an important finding because it shows that correct weighing of a particular cue will finally only evolve if this cue has been experienced before in sentences in which it competes with other cues.

Similar results have been found when investigating German children's comprehension of transitive sentences. Studies which have made a direct comparison between conditions in which the cues support each other in indicating the same noun phrase as agent on the one hand and conditions in which two cues conflict on the other have found that older German pre-school children comprehend sentences in which case and word order conflict significantly worse than sentences in which case and word order collaborate (e.g., Mills, 1977; Primus

& Lindner, 1994; Schaner-Wolles, 1989). However, there is some variation between these studies as to when German children start to show above chance comprehension of sentences in which case and word order conflict; that is, the age at which they start to show the adult strategy of following the reliable cue of case. Primus and Lindner (1994) tested four-, five- and six-year old children with an act out comprehension task and showed that all children of all age groups were able to correctly comprehend sentences in which the agent was the first noun phrase and the patient the second noun phrase (coalition of the word order and case marking cue). The children responded correctly in this condition regardless of the position of the verb within the sentence (NVN, NNV or VNN). However, when the children were presented with sentences in which the patient was the first noun phrase in the sentence (and marked with accusative) they performed at chance with the NVN-pattern until age 5 and had still problems with NNV- and VNN-patterns until age 6. Schaner-Wolles' (1989) picture pointing task yields similar results for patient-first sentences. By age 4 two-thirds of the tested children correctly chose the second noun in the sentence as agent when both noun phrases were marked with case (O_{ACC} V S_{NOM}). If only the object in the sentence was marked with accusative (O_{ACC} V $S_{unmarked}$) four-year-olds performed still at chance but the majority of five-year-olds were able to choose the correct picture. However, if finally only the subject was case marked ($O_{unmarked}$ V S_{NOM}) even German five-year-olds showed chance performance. Such sentences in which only one noun phrase is case marked appear to be in particular difficult for children to interpret. A group of six- to nine-year-old German children tested by Mills (1977) on OVS-sentences showed hardly above chance performance with sentences with accusative marking at the initial noun phrase (O_{ACC} V $S_{unmarked}$) but interpreted sentences incorrectly (overgeneralization of SVO order) if case marking occurred on the final noun phrase ($O_{unmarked}$ V S_{NOM}).

All these studies suggest that sentences with cues in coalitions are earlier acquired than sentences in which cues compete. But are coalitions of cues also easier to interpret due to the provided redundant information than cues in isolation such as the coalitions-as-prototypes approach by Bates and MacWhinney (1987; 1989) predicts? To date, I am only aware of a small amount of data from Italian children presented by Slobin and Bever (1982, table A3, p.260) which shows that 2-year-olds can use the word order cue to identify the agent only if the first noun in the sentence is also marked by stress but they cannot use stress or word order by itself. However, this result consists only of data from six children.

Furthermore, the order of acquisition can be easily influenced by cue costs as a study by Devescovi, D'Amico & Gentile (1999) shows. Whereas Italian adults relied heavily on subject-verb-agreement, Italian children relied until age nine more on animacy cues in a transitive sentence although animacy is a less valid cue than subject-verb agreement in Italian. The authors claimed that younger children might postpone the use of highly valid agreement information, due to the memory costs that such cues exact ('distributed' agreement cue versus 'local' animacy cue).

In addition, cue cost does not only influence cue use during development but it is also responsible for cross linguistic differences at which age children acquire a correct understanding of semantic roles. Slobin and Bever (1982) compared Turkish, Serbo-Croatian, Italian and English children's ability to act out transitive sentences and found that Turkish children were more successful at a younger age (by two years) than the other three groups. They provided the explanation that against the other three groups Turkish children need to rely only on the inflectional case system of their language but not at all on word order. Case marking in Turkish is marked by a unique suffix which can be processed on the spot (when hearing the noun phrase). Slobin (1982) concluded from these data

that this kind of local cues are earlier acquired than distributed cues (e.g., word order) and formulated his Local Cue Hypothesis (see also section 1.2.3). Nevertheless, the advantage of local cues can be destroyed if the local marker is difficult to detect (cue perceivability). A similar study as for the Turkish children has been carried out for Hungarian children by MacWhinney, Pléh and Bates (1985). Although Hungarian also marks case locally on the noun its acquisition appeared to be delayed by several month compared to the Turkish children which the authors explained by problems to detect the accusative t-ending in Hungarian.

Some support for the Local Cue Hypothesis in German was found in a study by Lindner (2003) on the comprehension of transitive sentences containing competing cues to the agent, namely animacy, case, word order and subject-verb agreement. In this study the younger children were indeed found to orient to 'local cues' such as animacy (two-and three-year-olds) and case marking (four-year-olds). Only around the age of nine did they orient to 'distributed cues' such as subject-verb agreement.

However, there have been other studies which suggest that the Local Cue Hypothesis may be wrong, at least for German case marking (but note that nominative and accusative marking is normally placed on the determiner which precedes a noun but not on the noun itself). In two studies comparing young English and German children's productive ability with the passive construction, German children performed as poorly as English children (Brooks & Tomasello, 1999b) although they had the additional case marking cue and could already demonstrate productivity with case marked noun phrases (Wittek & Tomasello, 2005). This finding also suggest that coalitions of case marking and word order (presented to German children) might not provide an advantage over sentences in which semantic roles are only marked by word order (presented to English children).

Thus, cue validity does seem to determine the order in which cues in a particular language will be acquired. However, one has to consider that cue validity depends on two factors – availability and reliability – that play different roles at different stages in language development: Younger children rely more on cues which are very often available whereas older children rely on cues which are highly reliable. Knowledge about conflict validity is also acquired late in development. Therefore, only older children are able to correctly understand conflicting cues. On the other hand, redundant cues (coalitions) are said to be easier to interpret correctly than single cues. Nevertheless, when cues are too costly they might not be used by young children despite high validity, availability or reliability values.

An additional important finding which could help to understand acquisition of cues to sentence interpretation comes from tasks on adults' artificial grammar learning. McDonald & MacWhinney (1991) carried out a concept formation task in which adults had to decide via orienting on cues such as form and shading which one of two geometrical figures is the dominant one. Subjects were found to use the cue with the highest overall validity early in training and later the cue with the highest conflict validity was used the most. This finding confirms what McDonald (1986) found for children's cue learning. Matessa and Anderson (2000) taught adults a miniature artificial language and asked them afterwards to identify the agent in a sentence. Their results were similar: overall validity predicted which cues are used in early learning and conflict validity predicted which cues are used in late learning. In addition, the cues used in early learning (high overall validity, i.e., higher availability) blocked learning of the reliability of a cue with low overall validity (***cue blocking***) and the learning was therefore focussed on one cue at a time (***cue focussing***). Thus, cue availability also plays an important role for adults although they had already experienced in

their own natural language learning the fact that reliance on highly reliable cues (but maybe infrequent ones) leads better to the correct sentence interpretation than reliance on often available cues (see also the role of cue availability in reaction time studies: Kempe & MacWhinney, 1999).

2.3 A thesis overview

This thesis deals with the acquisition of the transitive construction and it seeks to test in particular how German children acquire this construction who in contrast to English learning children are stronger exposed to case marking cues. Within this topic I am going to address five main questions:

1. Verb Specificity: Is it possible to find verb specific behaviour in another language than English and is it observable also in language comprehension and not only in production?
2. Local Cues: Do local grammatical cues, such as case marking, help during language development? Do children who acquire a language in which local cues are more common have an advantage over children who acquire pure word order languages?
3. Prototypes: How do prototypical sentence structures and the redundancy of cues influence language acquisition?
4. Competition Model: How do the statistical features of the input language, such as cue availability and cue reliability, influence what kind of utterances children learn first?
5. Robustness: Is it possible to find different stages of knowledge robustness when using different test methods for language comprehension (e.g., pointing versus preferential looking)?

With the first study I examine the issue of verb specificity, namely, how general young German and English children's understanding of transitive SVO-

word order sentences is and how this changes over development. Therefore, I tested children of both languages and two different age groups (2;1- and 2;6 year olds) with transitive sentences containing familiar and novel verbs. In addition, this study is designed to tap into the field of robustness of knowledge for what I tested the same children using both a pointing and a preferential looking task. Since the test sentences presented to the English and German children varied insofar that the German ones included case marked agents and patients, this study also addresses the question whether local cues help during language acquisition.

In the second study I investigate children's general understanding of particular grammatical cues (word order and case marking) within one language (German). Therefore, I tested German children of different age groups (2;7-, 4;10-, and 7;3 year olds) with varying sentence structures of novel verb transitives (sentences in which case marking and word order support each other, sentences in which the two cues conflict with each other and sentences which provide only the word order cue). A comparison of the outcome of the investigations with input speech addresses the question about the influence of cue reliability and cue availability. Furthermore, this study deals with the topic of redundant cues and prototypical sentence structures since the three test sentence structures differ in how many cues they provide and in whether they are more common or not. Finally, this study also examines the role of local cues in the development within one language. For instance, do German children understand earlier transitive sentences with case markers (local cues) than sentences which contain only the distributed word order cue?

Finally, with the third study, I look into very young German children's general knowledge about the transitive construction using a preferential looking task combined with a training on familiar verb transitives. The question here is whether 21-month-olds already have some kind of (weak) abstract knowledge

about sentence structure which can be shown through reducing the task demands (preferential looking instead of pointing task) and through training / priming effects.

Chapter 3: Study 1 – Young children's comprehension of the transitive construction. A cross-linguistic study.

3.1 Introduction

For German children, there have been no studies which have examined very young two-year-olds' ability to demonstrate productivity with the transitive construction using novel verbs in an active behavioural comprehension task. Therefore, in the current study I tested comprehension of (case marked) transitive sentences by German 2;1- and 2;6-year-olds with familiar and with novel verbs. Because there have been no preferential looking studies with German children either, and because of the apparently conflicting findings from preferential looking versus active behavioural comprehension tasks in the English literature, I carried out both with the same children during the same test trial to investigate whether the two measures reveal the same or conflicting results. To additionally find out whether case marking leads to earlier acquisition of an abstract knowledge of the transitive construction and to clarify when and whether English-speaking children show verb specific behaviour I compared my data to that of 2;1- and 2;6-year-old children from England. For the active behavioural task I used a pointing task to minimize working memory demands.

If German children behave like the English speaking children from former studies in showing largely verb-based behaviour until around 3;0 I would expect both age and language groups to perform very poorly in the pointing task with novel verbs but not with familiar verbs. Alternatively, if I hypothesize (following

Slobin, 1982) that the 'local cue' of case-marking helps German children to learn an abstract transitive schema earlier than English children, I would expect German 2;6-year-olds to point correctly even in the novel verb condition but not the English 2;6-year-olds. Lastly, one other possible outcome would be that 2;1-year-old German and English children perform worse than 2;6-year-olds in the novel verb but not in the familiar verb condition and therefore show evidence that children learning both languages pass through a verb-specific stage.

3.2 Method

3.2.1 Participants

All children were monolingual speakers of either German or English. They were brought by a caregiver to a child lab. The German children were tested at the Max Planck Institute of Evolutionary Anthropology in Leipzig, Germany; the English children were tested at the Max Planck Child Study Centre at the University of Manchester, UK. Of the German children there were twenty-four 2;1-year-olds (mean = 24.75 months, range = 24 – 26 months; 10 girls, 14 boys) and twenty-four 2;6-year-olds (mean = 30.0 months, range = 29 – 31 months; 12 girls, 12 boys) who participated in the study. A further 26 children were tested but excluded from the study due to either showing a side bias during the test trials (11 children), fussiness (10), failure to understand the task (2), bilingualism (1), experimenter error (1), or because the child could not see the films due to short-sightedness (1). Of the English children twenty-four 2;1-year-olds (mean = 25.25 months, range = 24 – 26 months; 14 girls, 10 boys) and twenty-three 2;6-year-olds (mean = 31.0 months, range = 30 – 32 months; 16 girls, 7 boys) participated in the study and a further 34 children had to be excluded due to either showing a side

bias (15 children), fussiness (10), failure to understand the task (1), experimenter error (5), hearing problems (1) or mother error (2).

3.2.2 Materials

Three novel verbs and three familiar verbs were used in the study. All verbs referred to prototypical causative-transitive actions, involving direct contact between a volitional agent and an affected patient (Hopper & Thompson, 1980). All actions were reversible and involved either a caused change-of-state or change-of-location. The three novel verbs (*wiefen*, *tammen* and *baffen* for the German children and *weefing*, *tamming* and *baffing* for the English children) were used to describe three novel transitive actions that were performed with three novel apparatuses. For all three, the causality of the new events was emphasised by either a change of state or a change of location of the patient at the end of the scene. *Wiefen/weefing* referred to one animal rocking another animal which stood on a rocking-chair-like apparatus by pulling it towards itself with its head three times. With the third motion the agent forced the patient into a handstand. *Tammen/tamming* referred to an animal pushing down another animal which stood on a platform on top of a spring by jumping on its back. With the third motion the agent forced the patient to fall sideways. The third novel verb *baffen/baffing* referred to an animal spinning another animal around which stood on a spinning disk. With the third motion the location of the patient was changed from being next to the agent to being further away (see pictures in Appendix D). I used three familiar transitive verbs *pushing* (*schubsen* in German), *washing* (*waschen*) and *brushing* (*kämmen*).

Agents and patients of the presented events were the following animals. Their names are all on the US-American MacArthur Communicative Development Inventory (Fenson et al., 1994): *Bear* (*Bär*), *bunny* (*Hase*), *dog*

(*Hund*), *elephant* (*Elefant*), *frog* (*Frosch*), *lion* (*Löwe*) and *monkey* (*Affe*). Four of the animals (*bunny*, *bear*, *dog* and *elephant*) appeared also on the ELFRA-1 (Grimm & Doil, 2001), a much shortened German version of the MacArthur CDI. All these animals have names with masculine grammatical gender in German, which take distinctive case-marking on the definite article (and for some nouns also as a noun suffix in the accusative). Therefore, in all German test sentences (see Appendix A) both NPs were case-marked; with the nominative (*der*) marked NP in initial position and the accusative (*den*) marked NP in second position.

3.2.3 Design

I tested each child with six different verbs (three familiar verbs and three novel verbs), in one trial each, in transitive sentence structures using a combination of the preferential looking method and a pointing task. During the session the children sat on their caregiver's lap in front of a 31 x 49 cm 'Apple Cinema Display' screen. The procedure of the pointing task was based on the Intermodal Preferential Looking (IPL) paradigm pioneered by Golinkoff, Hirsh-Pasek, Cauley, & Gordon (1987; see also Imai, Haryu, & Okada, 2005 for an adaptation of the IPL to a pointing task). For the salience and test trials the child saw two film scenes on the computer screen, each starting simultaneously and lasting 6 seconds. Both involved animals enacting the same causative event and differed only in that agent and patient roles were reversed.

3.2.4 Counterbalancing

Half the children within an age group started with a familiar verb and the other half with a novel verb. Following this familiar (F) and novel (N) verb trials were alternated (either FNFNFN or NFNFNF). The order of the particular verbs which came in each familiar or novel slot was counterbalanced according to Latin

squares. The target screen order for the test trials was counterbalanced so that each side (left or right) was correct 50% of the time for each child. The same side was never the correct choice more than twice in a row. No child experienced a condition in which the correct choice alternated regularly (e.g., LRLRLR). For half the children the first correct side in the first trial was left and vice versa. There were thus twelve possible orderings for correct side and these were distributed evenly over the children within each group (i.e., for each age group, two children participated in each ordering). For each test trial scene pair, I also counterbalanced which particular scene correctly matched the test sentence (e.g. for the pair "dog push lion" and "lion push dog" half the children heard "the dog is pushing the lion" and the other half heard the reverse). The direction of the action (from left to right or from right to left) was also counterbalanced.

3.2.5 Procedure

Two cameras filmed the children's performance: one from behind the children to record their pointing behaviour and one from on top of the computer screen (centrally) to record the children's eye movements. The parents were asked to close their eyes during the test trials and they listened to music played through headphones so as not to influence their children.

3.2.5.1 Pointing practice training

To teach the children that the aim of the task was to point to one of the two pictures on a computer screen I showed the child a series of object pairs, for example, 'dog' and 'duck' which appeared at the screen simultaneously. Then the children were asked to point to one of the two objects (e.g., *Show me: where is the dog*? (*Zeig mir: wo ist der Hund*?)). The pictures were from the vocabulary

comprehension sub-test of the SETK-2 (Grimm, 2000). I repeated this task ten times with different objects and all children performed very successfully.

3.2.5.2 "Live" Word-learning Training

Prior to each test sentence each child was taught the name of each verb in the following manner. Using animals which take feminine gender in German (e.g. *cow* (*Kuh*) and *duck* (*Ente*)), every verb (novel and familiar) was presented to each child in a live act out by the experimenter in a variety of argument structures: in the citation form with no arguments (e.g. *This is called weefing*. (*Das heißt wiefen*.)) as well as in transitive argument structure with two feminine pronouns in German and two neutral pronouns in English (which are both identical for subject and object position) in three different tenses (*It's going to weef it*. (*Sie wird sie wiefen*.); *It's weefing it*. (*Sie wieft sie*.); *It weefed it*. (*Sie hat sie gewieft*.)). The child was also asked to repeat the verb in the citation form (e.g., *Can you say this: weefing*? (*Kannst du das sagen: wiefen*?)).

3.2.5.3 Film Familiarization trials

Following the live enactment, for each verb the child then saw a familiarisation trial, in which s/he watched each of the two film scenes individually and heard the experimenter describing them in the citation form, e.g., *Look, this is called weefing*. (*Guck mal, das heißt wiefen*.) while the other half of the screen remained blank. The side where the children saw the first picture (left or right) was counterbalanced across and within subjects. At the end of each film scene the experimenter pointed to each animal and asked the child *Who's that*? (*Wer ist das?*). The majority of the children had no problem spontaneously naming the participating animals. If a child did not name one of the animals, the

experimenter told the child the name and asked him/her to repeat it, which almost all children then did.

3.2.5.4 Salience trial

For each verb, following the familiarisation trial, a red centre point focussed the child's attention on the centre of the computer screen. Then, in the salience trial, s/he watched the same two scenes as in the familiarisation trials. Here they appeared simultaneously and were accompanied by a pre-recorded voice describing them in the citation form, e.g., *Look, this is called weefing*. (x2) (*Guck mal, das heißt wiefen.*). I ran this salience trial to ensure compatibility with previous preferential looking studies (e.g., Kidd et al., 2001; Naigles, 1990), where they were used to obtain a baseline visual preference and to get the children used to watching two films simultaneously before the test trial. A further advantage is to equalize the degree of novelty of both films before the test trial.

3.2.5.5 Test trial

Following this another red centre point centred the child's attention to the centre of the computer screen. Then, the test trial began. This was identical to the salience except that the child heard a pre-recorded linguistic stimulus with the target verb in transitive argument structure, e.g., *Look, the lion is weefing the dog*. (x2) (*Guck mal, der*[+nominative] *Löwe wieft den*[+accusative] *Hund*.). After the videos had stopped the experimenter asked the child to point to the correct still picture by asking, e.g., *Show me: where did the lion weef the dog*! (*Zeig mir: wo hat der*[+nominative] *Löwe den*[+accusative] *Hund gewieft*!). If the child did not point the experimenter repeated the question a second time, but she never asked the child to point again once s/he had already done so (see Figure 8).

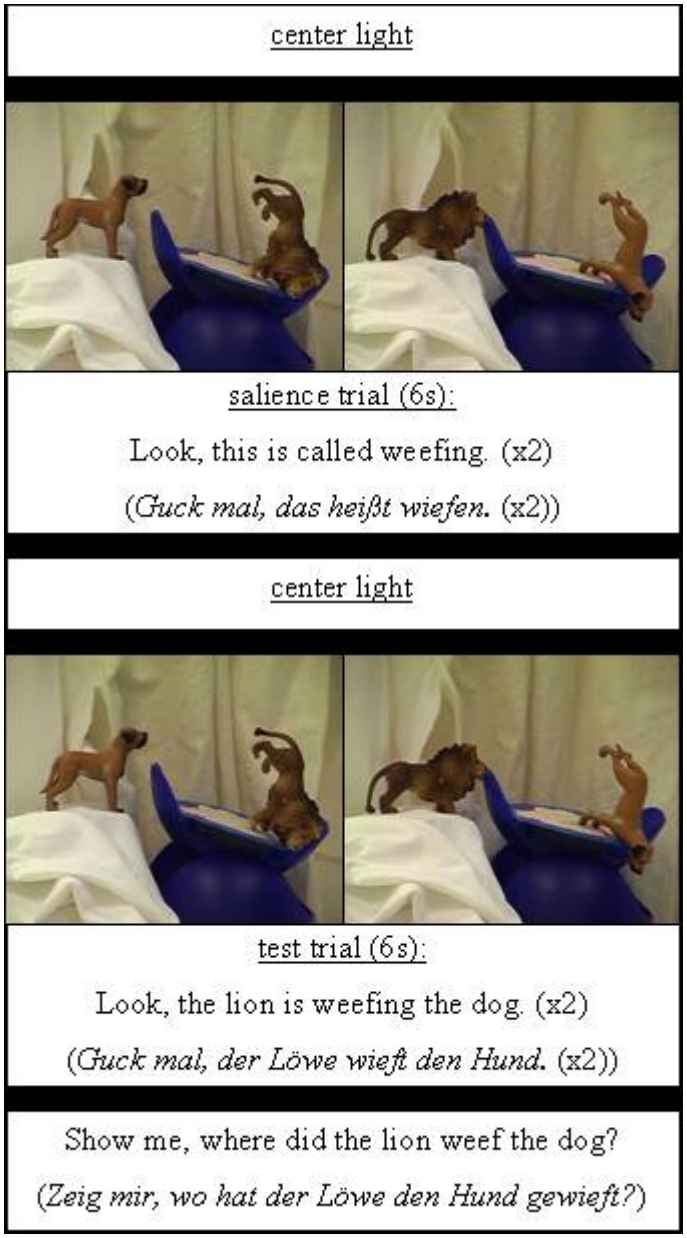


Figure 8: Procedure of Study 1

3.2.5.6 Vocabulary production post-test

After all test trials were over each child received the vocabulary production sub-test of the SETK-2 which has been standardized for German two- to three-year-olds (Grimm, 2000). The norm range for each age group is a score 40 – 60. In this test children are shown cards with pictures of objects which they have to name. The 2;1-year-old German children who participated in the test had a mean score of 49 (range 31 - 70), and the 2;6-year-olds had a mean score of 52

(range 37 - 65). I translated the test to English and tested the English children on this version. The 2;1-year-old English children reached a mean score of 57 (range 43 – 73), and the 2;6-year-olds had a mean score of 56 (range 44 – 71).

3.2.6 Coding

The six second preferential looking trials were coded frame by frame (each frame = 0.04 seconds), in terms of whether the child looked to the left or to the right screen. Coding started after the children had heard the first animal name after 1.312 seconds (33 frames) for the German children and after 0.68 seconds (17 frames) for the English children. For every pointing test trial, pointing to the target was assigned the value 1 and pointing to the distracter the value 0. If the child did not choose either scene, i.e., some children pointed to both scenes, I assigned the child 0.5 points. This occurred in 45 out of 576 trials. I coded all children, and two additional coders coded 17% of all trials for reliabilities with high agreement with the first coder (Cohen's Kappa Preferential Looking = .9547; Cohen's Kappa Pointing = .9238).

3.3 Results

3.3.1 Pointing results

I found that both age groups in both languages pointed to the target screen above chance (which is 1.5 correct answers out of 3 trials) in the familiar verb condition (GER (2;1): $t_{23} = 4.053$, $p = .000$; GER (2;6): $t_{23} = 4.252$, $p = .000$; ENG (2;1): $t_{22} = 3.598$, $p = .001$; ENG (2;6): $t_{22} = 2.802$, $p = .005$; one-tailed). However, a 2 (novel / familiar verb) x 2 (age group) x 2 (language) ANOVA revealed a significant interaction between age group and verb condition ($F(1,90) = 10.067$, $p = .002$) but no interaction or main effect for language. The older

children of both languages chose the correct scene in the novel verb condition above chance (GER: $t_{23} = 4.377$, $p = .000$; ENG: $t_{22} = 3.057$, $p = .003$; one-tailed) whereas the younger children pointed to target and distracter equally often (GER: $t_{23} = -.659$, $p = .259$; ENG: $t_{22} = 1.027$, $p = .158$; one-tailed). Consequently, the 2;1-year-old children were significantly better at pointing correctly in the familiar than in the novel verb condition although this effect was in particular due to the performance of the German children ($t_{23} = -3.822$, $p = .001$; two-tailed) whereas the English children showed only a tendency for better performance with familiar verbs than with novel verbs ($t_{22} = -1.903$, $p = .070$; two-tailed, see Figure 9). I did not find any correlation between the children's performance in this task and vocabulary scores and also no group differences when comparing high and low vocabulary children.

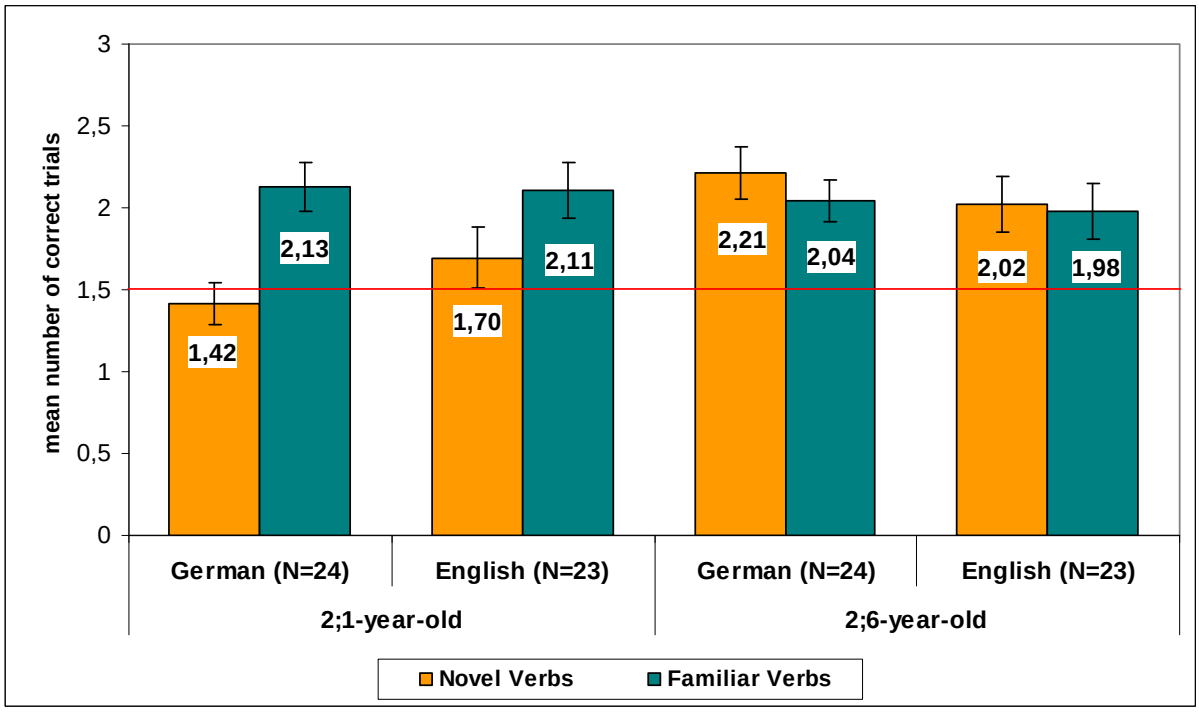


Figure 9: Mean number of correct points to the target screen (out of three trials)

Therefore I can assume that both 2;6-year-old as well as 2;1-year-old German and English speaking children understood prototypical transitive sentences with known verbs but that the ability to comprehend transitive sentences which contain familiar verbs is acquired before that for transitive sentences with novel verbs, where the children must rely on grammatical cues alone instead of a particular verb in its argument structure.

Interestingly I found a main effect for items within the novel verbs (ANOVA: $F(2;90) = 4.113$, $p = .020$) which shows that all children pointed more often correctly with the novel verb *weefing* (Mean = 70% correct pointing) than with *tamming* (Mean = 62%) and that the novel verb *baffing* was the most difficult one (Mean = 51%). No such a main effect was found for the familiar verbs.

Therefore I did an item-by-item analysis for the individual novel verbs. The performance differences were especially strong within the German 2;1-year-olds who had particular problems with the novel verb *baffing*, i.e., they pointed to the wrong scene above chance ($t_{23} = -3.680$, $p = .001$; one-tailed). With the other two novel verbs they performed at chance level (with a tendency for above chance performance with *weefing*, $t_{23} = 1.574$, $p = .065$; one-tailed). German 2;6-year-olds performed above chance with all three novel verbs (*baffing*: $t_{23} = 3.685$, $p = .001$; *weefing*: $t_{23} = 3.140$, $p = .002$; *tamming*: $t_{23} = 1.781$, $p = .044$; one tailed). English 2;1-year-olds pointed by chance with *baffing* and *tamming* but were better than chance with the novel verb *weefing* ($t_{22} = 1.785$, $p = .044$; one-tailed). English 2;6-year-olds pointed correctly with *weefing* ($t_{22} = 2.712$, $p = .006$, one-tailed) and *tamming* ($t_{22} = 2.554$, $p = .009$, one-tailed) but showed chance performance with *baffing* (see Figure 10).

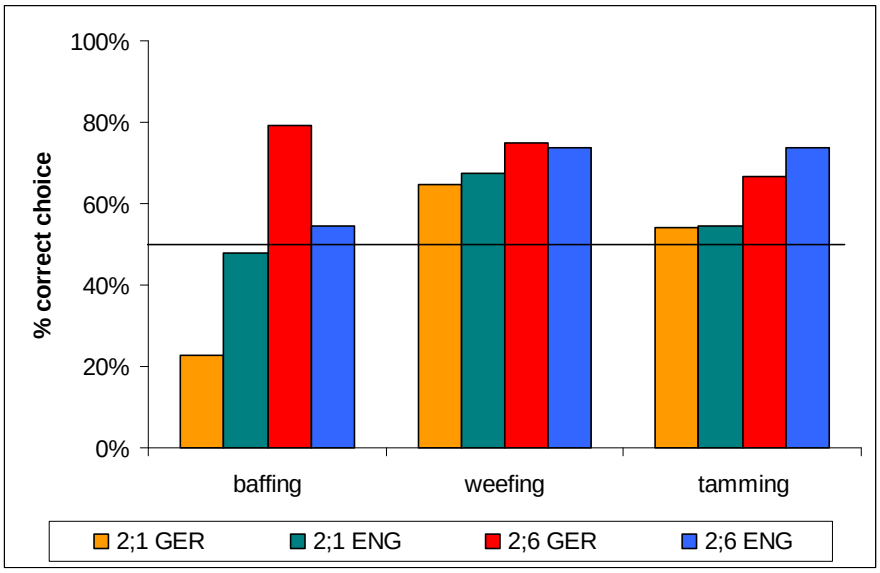


Figure 10: Mean proportion of correct points for each novel verb separately

An analysis of the children's naming of the animals found that this significantly poorer performance with the novel verb *baffing* was not due to wrong identification of the animals involved in the action. Therefore, these performance differences between items might appear because the meaning and thus the degree of causality of the three novel verbs differ. The novel verb *baffing* represented an action where the agent caused a change of location to the patient whereas the other two novel verbs represented actions where the agent caused a change of state to the patient. Most interestingly, I found a significant age group * language interaction for the novel verb *baffing* (ANOVA: $F(1;90) = 7.408$, $p = .008$) but not for the other two novel verbs which could mean that German children acquire productivity with a change of location transitive in a different way than English children.

However, all these results demonstrate that 2;6-year-old German and English children are already very productive with the prototypical transitive construction, whereas 2;1-year-olds in both languages show more difficulties in

generalizing over transitive constructions with different verbs when asked to assign agents and patients in such a pointing task.

3.3.2 Preferential looking results

Previous preferential looking studies have used either total looking time (e.g., Hirsh-Pasek & Golinkoff, 1996b; Kidd et al., 2001; Meints, Plunkett, Harris, & Dimmock, 2002; Naigles, 1990) or have analyzed each two seconds of the test trial separately (e.g., Fisher, 2000b; Gertner et al., 2006). I followed Meints et al.'s (2002) definition of total looking time, namely the proportion of looking time to the target (t) screen over looking time to the target and distracter (d) [t/(t+d)]. Thus, I analysed three different dependent variables for the preferential looking trials (see Table 2: the total looking time (out of 5 seconds, Total Look) of the test trials and salience trials (base line looking behaviour without a guiding linguistic stimulus); First Look (out of the first two seconds of the test trials); and Last Look (out of the last three seconds of the test trials)).

Table 2: Looking time proportions to the target screen

	Salience trial		**Total Look**		**First Look**		**Last Look**	
	Novel	Familiar	Novel	Familiar	Novel	Familiar	Novel	Familiar
2;1 GER	47%	49%	43%	55%	**39%***	55%	46%	53%
2;1 ENG	47%	56%	47%	51%	45%	54%	48%	**47%**[1]
2;6 GER	49%	51%	47%	47%	54%	48%	**42%***	46%
2;6 ENG	50%	50%	50%	52%	49%	57%	49%	49%

*significant below chance (50%), $p < 0.05$; [1]differs significantly from salience trial, $p < 0.05$

Unfortunately, the children did not show any preference at any time for the matching screen neither for the familiar verb nor for the novel verb trials. A 2 (novel / familiar verb) x 2 (age group) x 2 (language) ANOVA only revealed a

marginally effect for verb condition ($F(1,90) = 3.797$, $p = .054$) for Total Look. This effect was even stronger when analyzing only the first two seconds (First Look: $F(1,90) = 4.700$, $p = .033$). No interactions were found.

The group that in particular carried this effect was the younger German children who looked significantly longer to the matching screen in the familiar verb condition than in the novel verb condition ($t(23) = -2.854$, $p = .009$). This difference could not be found in the other three groups and might be due to the below chance looking of the German 2;1-year-olds in the novel verb condition.

3.3.3 Comparison of pointing and looking behaviour

For every trial (564 altogether) I compared the children's looking behaviour during salience and test with their subsequent pointing performance. Here I found a significant positive correlation between the proportion of looking to the target screen during the test and correct or incorrect pointing (Pearson Correlation: $r = .270$, $N = 564$, $p = .000$, Spearman's Rho: $r = .268$, $N = 564$, $p = .000$). Such a correlation did not appear when I examined looking behaviour during the salience trial and pointing (Pearson Correlation: $r = .055$, $N = 564$, $p = .195$, Spearman's Rho: $r = .057$, $N = 564$, $p = .173$, see Figure 11).

Thus, children who pointed correctly had previously looked longer to the target screen than children who pointed incorrectly. This indicates that looking to the target screen supports correct choice in the pointing task. This phenomenon appears in every age and language group but is stronger at younger ages (see Figure 12).

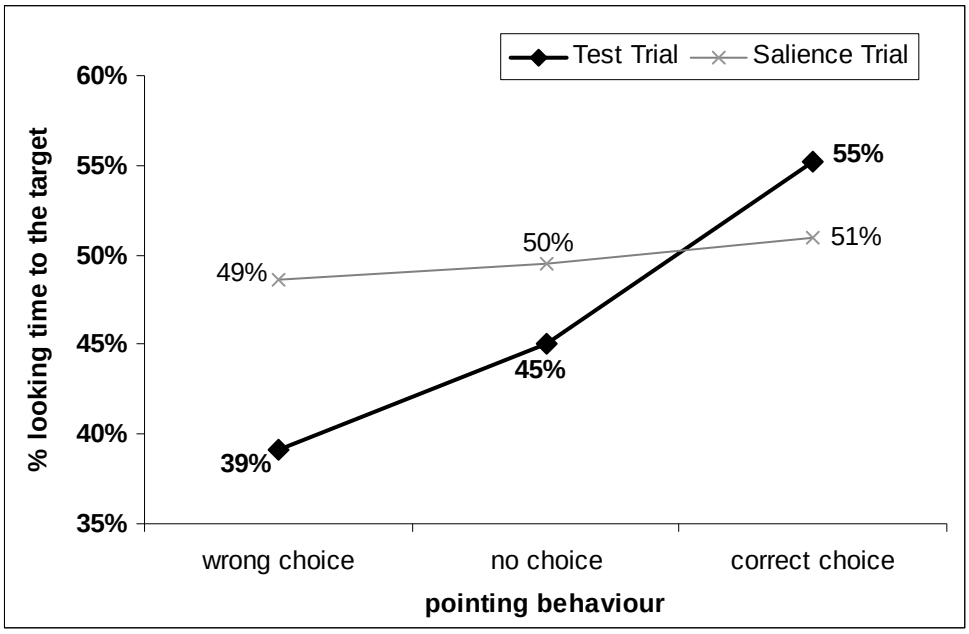


Figure 11: Correlation of looking to the target during salience and test trial and subsequent pointing performance

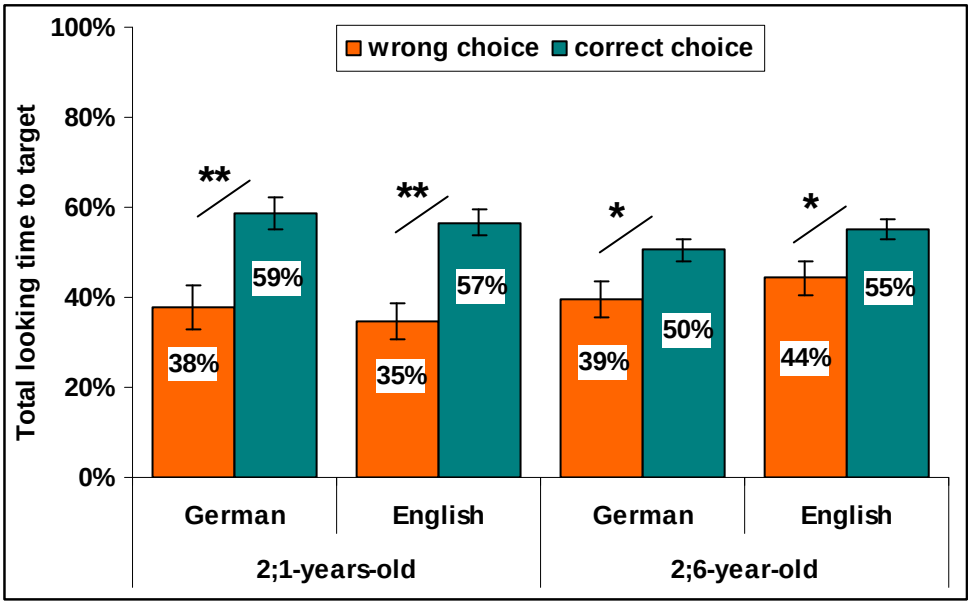


Figure 12: Mean total looking time (Total Look) to the target for correct and incorrect choice in the pointing task (significant difference, **p < .001, *p < .05)

Finally, I analyzed only those trials at which the children pointed correctly after their looking task because I can assume that during those trials the children had been supported by the looking task and the behaviour of the testing group in the pointing task should be mirrored better than during trials at which the children

pointed incorrectly for reasons such as inattention or boredom. Within these trials I indeed found looking behaviour above chance level (mean (test trial) = 55%, mean (salience trial) = 51%, $t(343) = 2.550$, $p = .011$).

3.4 Discussion

2;1-year-old German and English children point to the correct scene when asked an active transitive sentence with a familiar verb (e.g., '*where did the lion push the bear*?') whereas they point by chance if the transitive sentence contains a novel verb (e.g., '*where did the bear tam the elephant*?'). In contrast, 2;6-year-olds of both languages are significantly above chance at pointing in both conditions. Thus, in both languages children appear to pass through a verb-based comprehension phase before they are able to easily generalize this construction to novel verbs.

These findings do not fit predictions from Slobin's (1982) 'local cues' hypothesis, since the German 2;1-year-olds were not more likely to perform above chance in the novel verb condition than were their English age counterparts. My findings are, however, consistent with usage-based proposals that children may pass through a stage in which their grammatical comprehension and production is heavily based around the particular words which frequently occur in particular constructions (e.g., Tomasello, 2003; Goldberg, 1999). Interestingly, it appears that this holds for languages like German, which allows more word order variants than English and where case-marking is a major cue to semantic role interpretation.

Nonetheless, the current findings are clearly inconsistent with early claims from some usage-based theorists that most English-speaking children do not develop an abstract representations of active transitive word order until around the age of 3;0 (e.g., Tomasello, 2000). Rather, they fit with growing evidence that

most English-speaking children can demonstrate productivity with this construction by 2;6 at the latest (Tomasello & Brooks, 1999; Chan & Meints, 2005). This ties in well with Fernandes et al.'s (2006) findings for 2;6-year-olds from a study which also used a pointing method (but see critiques on their method in section 2.2.2).

However, that is not to say that I agree with Fernandes et al's (2006, p. B19) claim that their results are problematic for Abbot-Smith, Lieven & Tomasello's (2004) proposal that "toddler's knowledge of argument structure is limited to a weak verb-general transitive schema". 2;6-year-olds clearly demonstrate a robust productivity with the transitive construction, but my data reveal that this is not the case for younger two-year-olds.

Rather, the current results are quite compatible with Abbot-Smith and Tomasello's (2006) 'graded representations' proposal that English 24-month-olds have a weak verb-general representation of the active transitive, which is not yet robust enough to support an active choice (see also Chang et al., 2006). Preferential-looking findings such as those of Gertner et al. (2006) can also be accounted for within this framework because a 'weak' representation is adequate to support a highly automaticised behaviour such as looking. Abbot-Smith and Tomasello (2006) suggest that this 'abstract level' is in fact the summed potential of the semantic and distributional similarities between previously processed exemplars (see also Langacker, 2000). This proposal has very strong similarities with previous suggestions that knowledge may be represented at a more abstract level but nonetheless be further strengthened through continued experience of processing the input (Huttenlocher et al., 2004).

One indication that the 2;1-year-olds in the current study may have already represented the active transitive construction at a more abstract level comes from performance differences within the novel verbs. The detailed analysis of items

revealed that English children of this age performed better than chance (and Germans showed a tendency to do so) with the novel verb *weefing* (= *rocking*) but not with the other two. In fact, the German 2;1-year-olds performed below chance with the novel verb *baffing (= spinning)*. Therefore, the meaning of an unknown verb seems to play a role in how easy it is to assign semantic roles correctly (Huttenlocher, Smiley, & Charney, 1983; Marchman, Bates, Burkardt, & Good, 1991). It is possible that children have already acquired a concept of prototypical agency prior to 24 months (e.g., Budwig, 1989; Budwig, Stein, & O'Brien, 2001). It is also possible that children of this age are already starting to form semantic sub-classes based on semantic analogy (e.g., Goldberg, 1999; Ambridge, Pine, Rowland, & Young, 2008). How robust these sub-classes are and what semantic properties would, for example, differentiate a rocking motion from a spinning around motion is an important question for future research.

In my study the preferential looking results follow the same pattern as the pointing results but only for the German children. 2;1-year-olds looked longer to the matching screen in the familiar than in the novel verb condition whereas I did not find this difference for the 2;6-year-olds. Altogether, I did not find any evidence for better performance in preferential looking than in pointing and consequently no evidence for graded representations. But it could be that a stage in which knowledge is strong enough to pass a preferential looking task but not an active behavioural task such as pointing develops during some other age than the ones I tested in my study.

In addition, I also did not find either looking behaviour above chance for either total looking time or for the first two seconds of the test trial, but only for the last three seconds. However, preferential looking studies are not unproblematic. Children never look as long as the whole duration of the test to the target even if they seem to know the correct answer. Furthermore, previous

studies have shown that looking time to the matching screen actually decreases with age (Gertner et al., 2006) and increasing knowledge (Kidd et al., 2001). Thus, children's attention might be easily attracted by the distracter screen, maybe through saliency of the novel scene, even though they know that this is the wrong one. I found in my study that there is a positive correlation between the children's looking time to the target and the associated probability of pointing correctly to the target, which suggests that children between two and two-and-a-half need to look above chance to the target in order to point correctly. The preferential looking task before the pointing task helped them to make the right decision.

In conclusion, the current study found that German and English 2;1-year-olds' comprehension of the transitive appears to still be highly dependent on familiar verbs. By 2;6, however, children of both languages show productivity with a prototypical active transitive sentence. Further research is needed to find out how development progresses in the two languages between 2;1 and 2;6; that is, whether children of one language group tend to reach the productivity levels shown by 2;6-year-olds earlier than children of the other language group. In addition, further research on the status of active transitive representations prior to 25 months is sorely needed, especially for children learning languages other than English (see chapter 6: Study 4).

But before I come to the question whether German children have some kind of (partial) abstract knowledge of the transitive before their second birthday I want to evaluate how German children deal with transitive sentences that do not provide the two grammatical cues word order and case marking but carry less information (such as only word order for the English children in study 1) or provide conflicting cues. Therefore, I analysed first what German children hear in the input and compared the outcome to the results of two experiments in which I tested German children's understanding of different kinds of transitive sentences.

Chapter 4: What do children hear in the input?

Everyday speech which children hear when learning their language provides different linguistic and non linguistic cues to help children to interpret sentences correctly. But how do they detect those cues, find the relevant ones and finally use them appropriately in their own sentence interpretation? In this chapter I want to examine what transitive sentences which German children hear in the input look like and how the different cues to semantic role interpretation are distributed.

To correctly assign the semantic roles of an event when hearing a transitive sentence, German children need to learn the use of four different cues of which three are pure linguistic markings – subject-verb agreement, word order and case marking – and one is a semantic property – the animacy status of agents and patients. According to the Competition Model (Bates & MacWhinney, 1987, 1989) the acquisition of these cues is influenced by how frequently they appear in the language (cue availability). However, not only the different token frequencies play an important role in acquisition but also the certainty with which a cue, when present, marks one of the semantic roles and not the other one (cue reliability) and how often a cue appears in sentences in which it conflicts with other cues so that it is possible to learn about the weight of this cue (conflict validity, see McDonald, 1986).

Therefore, the following analysis first gives a description of the four cues to semantic roles in German child-directed-speech and examines their overall frequency. I then show how reliable the particular cues are in assigning the agents and patients of transitive sentences and finally I analyze how often cues conflict or converge.

4.1 Method

4.1.1 Material

For my analysis I used CHILDES data of spontaneous speech by six German mothers to their monolingual normally developing children (see Szagun, 2004). At the time of the first recording the children were 1;8 years old and 2;5 years at the second time of recording. Of this I analyzed a sample of 7032 utterances previously examined by Stoll, Abbot-Smith & Lieven (2009), which these authors had coded into syntactic construction types. I examined all categories in which a transitive construction might occur and extracted transitive sentences by hand. Sentences with transitive verbs were excluded when they involved idioms, such as *Hunger haben* (to be hungry) and passive constructions were also excluded.

4.1.2 Coding

First, following Hopper & Thompson (1980) and Bowerman (1990) I divided all transitive sentences into two groups. The first contained sentences with verbs which were highly causative and prototypical agent-patient verbs. These were utterances with a volitional agent acting on the patient in a physically obvious way, such as *schubsen* 'to push', waschen 'to wash', beißen 'to bite' and utterances which expressed the causation by the agent of a change of state or location, such as *öffnen* 'to open', *schließen* 'to close', *wegwerfen* 'to throw away' (action verbs). The second group of two-argument verbs was utterances with a theme-subject verb, e.g., *haben* 'to have', or with stative transitive verbs, e.g., *sehen* 'to see', *hören* 'to hear', *brauchen* 'to need' (non action verbs). Subsequently, for both groups, I analyzed whether the sentence was complete, i.e.,

with two noun phrases or whether it was a 'fragment', i.e., subject or object was dropped.

I coded all transitive sentences for subject-verb agreement, animacy, word order and case marking in terms of whether the cues were present and which form they had. ***Subject-verb agreement*** was coded for whether agreement was unambiguous (i.e., the verb agreed with the agent but not with the patient (i)) or ambiguous (i.e., the verb agreed with agent and patient (ii)). Furthermore, in some of the fragment sentences the subject was dropped and the object did not agree with the verb form (iii). These cases were coded as agreement not present, because the child is not able to learn from them what the correct form of the verb would be. However, if the subject was dropped but the object had a form that, on the surface, agreed with the verb (iv) then the agreement was coded as present but as not providing the correct interpretation. If the object was dropped and only the subject present (v), these sentences were coded as unambiguous agreement because the hearer of such sentences is able to assign the agent correctly to the only present noun phrase s/he finds in the sentence. In addition, learning the corresponding verb form to the agent is possible. Thus, the agreement cue was defined here as the discrepancy between the verb form agreeing with one of the two noun phrases but not with the other one (or the other one is not available) and therefore it is present only if the verb form fits with number and person of the agent and is unambiguously distinguishable from the number and person of the patient (or the patient is not present). Thus, when the agreement cue is present it is always correctly indicating the agent in all full transitive sentences and the fragment sentences with object ellipsis.

(i) Agreement is present and leads to the correct interpretation:

Die Bienen	verjagen	ihn.	(mother to rah, 20;07.05)
The bees	hunt	him.	
Plural, 3rd Pers.	Plural, 3rd Pers.	Singular, 3rd Pers.	

'The bees are hunting him.'

(ii) Agreement is ambiguous and therefore not present:

Das Pferdchen	zieht	die Kutsche.	(mother to rah, 2;07.05)
The horse	pulls	the carriage.	
Singular, 3rd Pers.	Singular, 3rd Pers.	Singular, 3rd Pers.	

'The horse is pulling the carriage.'

(iii) Subject is dropped and agreement is not present:

Malst	den Hasen	ja an.	(mother to rah, 1;08.00)
Paint	the bunny.		
Singular, 2nd Pers.	Singular, 3rd Pers.		

'(You) are painting the bunny.'

(iv) Subject is dropped but verb agrees with object = agreement is present but leads to the wrong interpretation:

Bringt	noch eine Tasse.	(mother to rah, 2;07.05)
Brings	another cup.	
Singular, 3rd Pers.	Singular, 3rd Pers.	

'(He/she) is bringing another cup.'

(v) Object is dropped, but agreement is present and leads to the correct interpretation:

Streichelst	du	ja.	(mother to fal, 2;04.00)
Pet	you		
Singular, 2nd Pers.	Singular, 2nd Pers.		

'You are petting (it).'

Animacy was coded in terms of whether the agent or patient was animate (A) or inanimate (I). The animacy cue was defined as the discrepancy between an animate noun phrase and an inanimate noun phrase in the sentence, so that the animacy cue is neutralised in sentences in which either both noun phrases are animate (AA) or inanimate (II). In fragment sentences the animacy cue is always present because it cannot be neutralised due to the missing second noun phrase. The animacy cue correctly indicates the semantic roles if the agent is animate and the patient inanimate (AI) or if the agent is animate (A0), respectively the patient inanimate (0I), in fragment sentences.

(i) Both noun phrases are animate (AA):

Diese Fische	kann	der Delphin	fressen.	(mother to ann, 1;08.00)
These fishes	can	the dolphin	eat.	

'The dolphin can eat these fishes.'

(ii) Both noun phrases are inanimate (II):

Die	hat	rote Räder.	(mother to soe, 2;05.07)
It	has	red wheels.	

'It has red wheels.'

(iii) Agent is animate and patient is inanimate (AI):

Die Katze	will	die Wassertropfen	fangen.	(mother to rah, 2;05.07)
The cat	wants	the water drops	catch.	

'The cat wants to catch the water drops.'

(iv) Agent is inanimate and patient animate (IA):

Die Kamera	irritiert	dich, ne?	(mother to rah, 1;08.00)
The camera	confuses	you, isn't it?	

'The camera is confusing you, isn't it?'

(v) Agent is animate and patient is dropped (A0):

Kann	der Delphin	fressen.	(mother to ann, 1;08.00)
Can	the dolphin	eat.	

'The dolphin can eat (that).'

(vi) Agent is dropped and patient is inanimate (0I):

Kannst	die Kasse	ja mal eben	aufmachen.	(mother to lis, 2;05.07)
Can	the cash box	just	open.	

'(You) can just open the cash box.'

(vii) Agent is inanimate and patient is dropped (I0):

(Does not occur in the corpus)

(viii) Agent is dropped and patient is animate (0A):

Malst	den Hasen	ja an.	(mother to rah, 1;08.00)
Paint	the bunny.		

'(You) are painting the bunny.'

Case marking was coded in terms of whether the forms of the noun phrases were unambiguously marking agent or patient (i.e., clearly distinguishable nominative or accusative forms (i.a/b/c)) or whether the noun phrases were ambiguously marked with a form which could either be nominative and accusative (ii). The case marking cue was assumed to be present if at least one of the two noun phrases was unambiguously marked with either nominative or accusative. If the case marking cue is present it is always correctly indicating agent, patient or both. In addition I coded which kind of case marker (e.g., personal pronoun, definite article) and which lexical form was used.

(i) Unambiguous case marking

(a) Agent and patient unambiguously case marked

Der Maulwurf	hat	einen grossen Erdhaufen	aufgeworfen	(mother to rah, 2;05.07)
The mole	has	a big heap of earth	accumulated.	
Nominative		Accusative		

'The mole has accumulated a big heap of earth.'

(b) Only agent unambiguously case marked.

Diese Fische	kann	der Delphin	fressen.	(mother to ann, 1;08.00)
These fishes	can	the dolphin	eat.	
Nominative/Accusative		Nominative		

'The dolphin can eat these fishes.'

(c) Only patient unambiguously case marked.

Die	kann	den Fuss	nicht	ausstrecken.	(mother to ann, 2;05.07)
She	can	the foot	not	stretch.	
Nominative/Accusative		Accusative			

'She cannot stretch the foot.'

(ii) Ambiguous case marking

Das Pferdchen	zieht	die Kutsche.	(mother to rah, 2;07.05)
The horse	pulls	the carriage.	
Nominative/Accusative		Nominative/Accusative	

'The horse is pulling the carriage.'

Word order was coded for whether the subject is the first noun phrase in the sentence (SO), whether the object is the first noun phrase in the sentence (OS) or whether one argument is dropped. The word order cue is defined as the first-second-noun-phrase-relation. Therefore, the word order cue is only present in full transitive sentences. Fragment sentences are not considered to provide a word order cue because due to the relatively flexible position of the verb in German sentences the relation between the single noun phrase and the verb does not tell the listener whether the single noun phrase is more likely to be an agent or patient. The word order cue correctly indicates the semantic roles if the agent is the first noun phrase in the sentence and the patient is the second noun phrase (but see section 4.3, about how to define the word order cue).

(i) Subject before object order (SO):

Der Maulwurf	hat	einen grossen Erdhaufen	aufgeworfen	(mother to rah, 2;05.07)
The mole	has	a big heap of earth	accumulated.	
Subject	Verb	Object	Verb (participle)	

'The mole has accumulated a big heap of earth.'

(ii) Object before subject order (OS):

Diese Fische	kann	der Delphin	fressen.	(mother to ann, 1;08.00)
These fishes	can	the dolphin	eat.	
Object	Verb	Subject	Verb (infinitive)	

'The dolphin can eat these fishes.'

(iii) Subject dropped (O):

Legen	da	Eier	rein.	(mother to fal, 2;04.00)
Lay	there	eggs	in.	
Verb		Object		

'(They) lay eggs in there.'

(iv) Object dropped (S):

Kann	der Delphin	fressen.	(mother to ann, 1;08.00)
Can	the dolphin	eat.	
Verb	Subject	Verb (infinitve)	

'The dolphin can eat (that).'

Finally I coded every transitive sentence in terms of whether the cues conflicted with each other or supported each other and which cues were involved in the particular conflict or coalition. All coding was carried out by the first author, and an additional coder coded 15% of all sentences for reliabilities with high agreement with the first author (Cohen's Kappa = .9238).

4.1.3 Analyses

I followed Kempe & MacWhinney's (1998) formula for calculating cue availability, cue reliability and cue validity for the cues that assign agent and patient. Availability of a cue was thus defined as the number of sentences in which a cue is present, divided by the total number of transitive sentences. Reliability of a cue was defined as the ratio of sentences in which a cue correctly indicated the agent, divided by the number of sentences in which the cue was present. Finally, cue validity is defined as the product of availability and reliability.

For the main analyses I divided the data into data from sentences with highly causative verbs, because only they contain agent and patient, and data for the non causative transitive sentences. However, it is not clear whether children distinguish these two categories via the building up two different semantic classes or handle them in the same way because they involve the same sentence structure.

4.2 Results

Out of our final sample of 745 transitive sentences 411 (55%) contained highly causative verbs (action verbs), and 334 (45%) were without causative meaning (non action verbs). 55 (13%) of the highly causative transitive sentences and 48 (14%) of the non causative ones were 'fragments', i.e., they involved either subject (26 (6%) of the action verbs and 13 (4.5%) of the non action verbs) or object ellipsis (29 (7%) of the action verbs and 35 (10%) of the non action verbs).

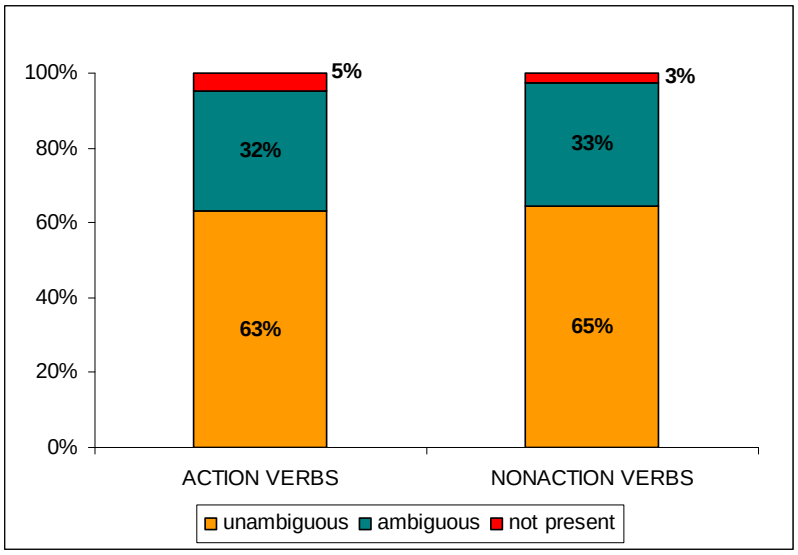


Figure 13: Subject-verb agreement in transitive sentences in child directed speech

4.2.1 Agreement cue

Out of the sample of 411 sentences with action verbs 260 (63%) contained unambiguous agreement marking and 131 (32%) ambiguous agreement marking. Only 20 of the fragment sentences did not provide any noun phrase-verb agreement at all (5%). In the sample of the 334 non action verbs the percentage of unambiguous agreement marking was with 216 (65%) slightly higher. Ambiguous agreement marking appeared in 109 (32%) of the sentences and in only 9 (3%) of

the fragment sentences noun phrase-verb agreement was not present (see Figure 13, above).

4.2.2 Animacy cue

Typical agents of transitive sentences are animate and typical patients are inanimate. The distribution is similar in high causatives (action verbs) and non causatives (non action verbs). Out of the 411 sentences with action verbs 382 (93%) contained an animate agent and only 3 (1%) contained an inanimate agent. 26 (6%) contained no agent at all (fragments with subject drop). In 316 (77%) sentences the patient was inanimate and in only 66 (16%) it was animate. The object was dropped in 29 (7%) sentences with action verbs. Out of the 334 sentences with non action verbs 309 (93%) contained an animate agent and slightly more than in highly causative sentences, namely 12 (4%), contained an inanimate agent. 13 (4%) contained no agent at all (fragments with subject drop). In 259 (78%) sentences the patient was inanimate and in only 40 (12%) it was animate.

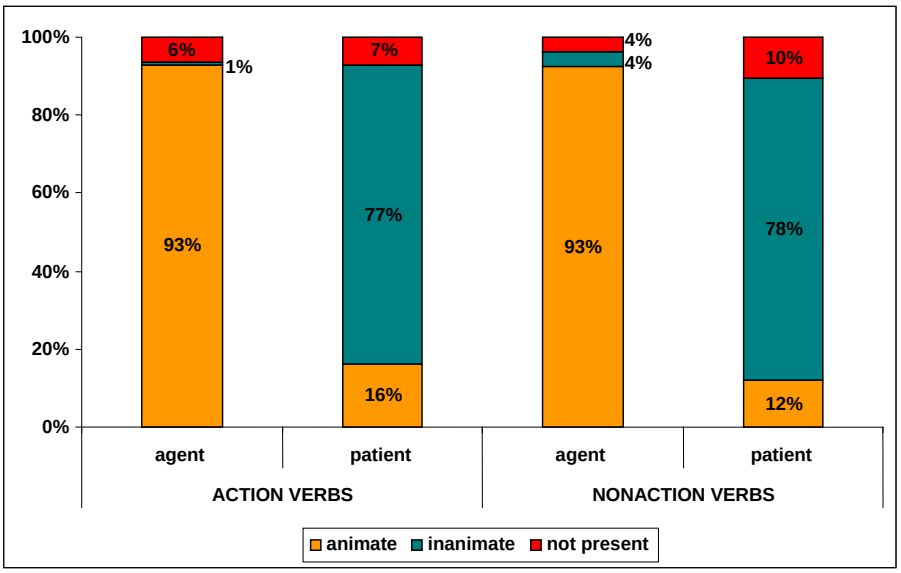


Figure 14: Distribution of animate and inanimate agents and patients in transitive sentences in child directed speech

The object was dropped in 35 (10%) sentences with non action verbs (see Figure 14, above).

The animacy cue as defined above was assumed to be only present if either a discrepancy between the animacy properties of the both noun phrases occurred or subject or object was dropped. Out of all highly causative and non causative sentences most frequently the agent was animate while the patient was inanimate (AI: action verbs = 290 (71%), non action verbs = 246 (74%)). In some of the sentences both noun phrases were animate (AA: action verbs = 63 (15%), non action verbs = 28 (8%)). Sentences with inanimate agents were very rare (IA: action verbs = 1 (0.2%), non action verbs = 9 (3%); II: action verbs = 2 (0.5%), non action verbs = 3 (1%)). Of all fragment sentences with object ellipsis the most common pattern was an animate agent (A0: action verbs = 29 (7%), non action verbs = 35 (10%)).

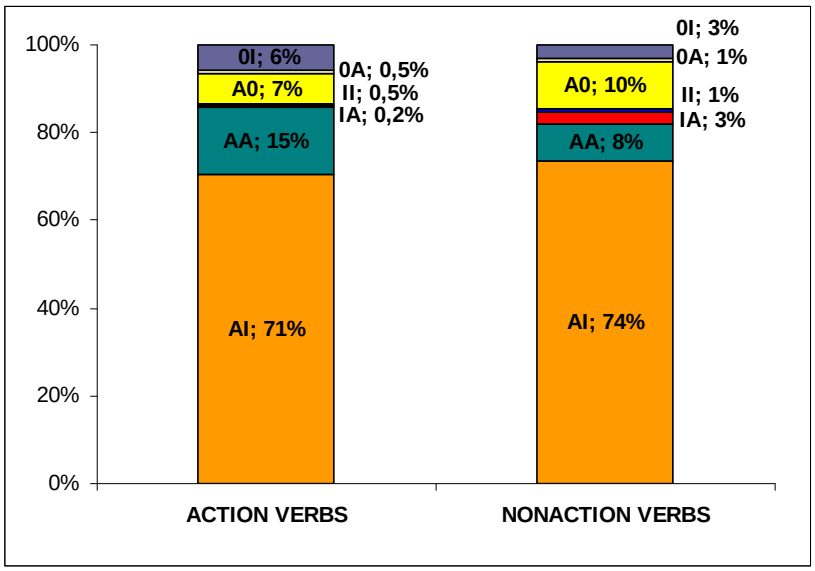


Figure 15: Animacy cues in transitive sentences in child directed speech

Inanimate agents in fragment sentences have never occurred. Of all fragment sentences with subject ellipsis the most common pattern was an inanimate patient

(0I: action verbs = 24 (6%), non action verbs = 10 (3%)). Animate patients occurred very rarely (0A: action verbs = 2 (0.5%), non action verbs = 3 (1%), see Figure 15, above).

4.2.3 Case marking cue

Typical agents are unambiguously case marked with nominative (action verbs: 334 (81%); non action verbs: 276 (83%)) whereas the majority of patients are marked with a form which is ambiguous for nominative and accusative (action verbs: 285 (69%); non action verbs: 252 (75%)). Ambiguously marked agents appear only in 51 (12%) of the sentences containing action verbs and in 45 (13%) of the sentences containing non action verbs; unambiguously marked patients appear only in 97 (24%) of the sentences containing action verbs and in 47 (14%) of the sentences containing non action verbs (see Figure 16).

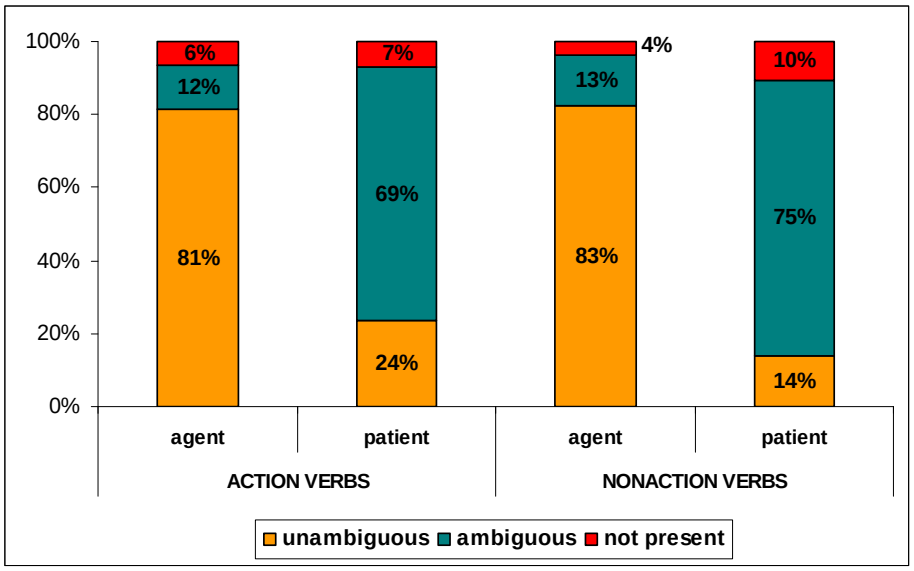


Figure 16: Distribution of unambiguously and ambiguously case marked agents and patients in transitive sentences in child directed speech

The high percentage of unambiguously case marked agents is due to the fact that agents of transitive sentences are mostly expressed by personal pronouns

(action verbs: 315 (82%); non action verbs: 244 (76%)) which are in the majority of cases *ich* ('I'; action verbs: 98 (26% of all agents); non action verbs: 103 (34%)), *du* ('you'; action verbs: 116 (30%); non action verbs: 83 (28%)) and *wir* ('we'; action verbs: 58 (15%); non action verbs: 38 (12%)). Patients, instead, are more often marked with demonstrative pronouns (action verbs: 155 (41%); non action verbs: 98 (33%)) which take the same form for accusative and nominative in German when they refer to nouns with feminine or neuter grammatical gender. This also holds for full noun phrases with a determiner (definite or indefinite) which occur more often as patients (action verbs: 100 (26%); non action verbs: 78 (26%)) than as agents (action verbs: 18 (5%); non action verbs: 18 (6%)). Rarely, noun phrases without determiner (action verbs / agents: 17 (4%); action verbs / patients: 29 (8%); non action verbs / agents: 9 (1%); non action verbs / patients: 31 (10%)) and noun phrases composed of an adjective and noun (action verbs / agents: 0 (0%); action verbs / patients: 21 (5%); non action verbs / agents: 1 (0.3%); non action verbs / patients: 25 (8%)) are found in child directed speech (see Figure 17).

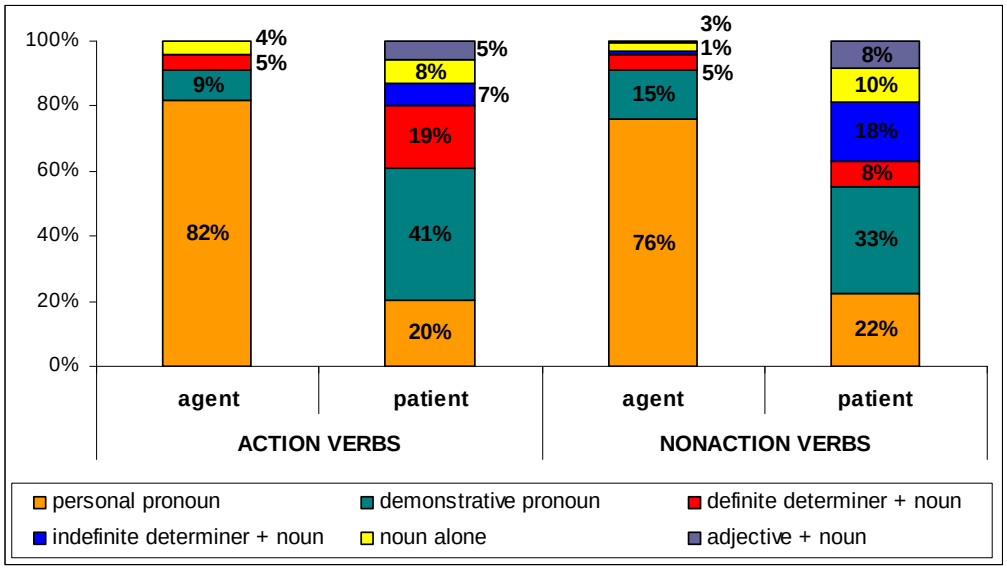


Figure 17: Distribution of case markers for agents and patients in transitive sentences in child directed speech

Especially interesting is the appearance of noun phrases with nouns plus definite articles in child directed speech because this kind of noun phrases is very often used in studies examining children's productivity with the transitive construction in German although they do not appear very frequently in the input (Lindner, 2003; Schaner-Wolles, 1989; Wittek & Tomasello, 2005). However, the lexical forms of the definite articles (*der*, *den* [+masculine], *die* [+feminine], *das* [+neuter]) which carry most of the case marking information in these noun phrases are the same lexical forms as of most demonstrative pronouns. Out of all agents in my sample of transitive sentences with action verbs 53 (14%) contained these lexical forms (either with a following noun or not) and 65 (20%) in the sentences with non action verbs. Out of all patients of the sample 227 (59%) were expressed by these lexical forms in sentences with action verbs and 115 (38%) in sentences with non action verbs (see Figure 17 above)[3].

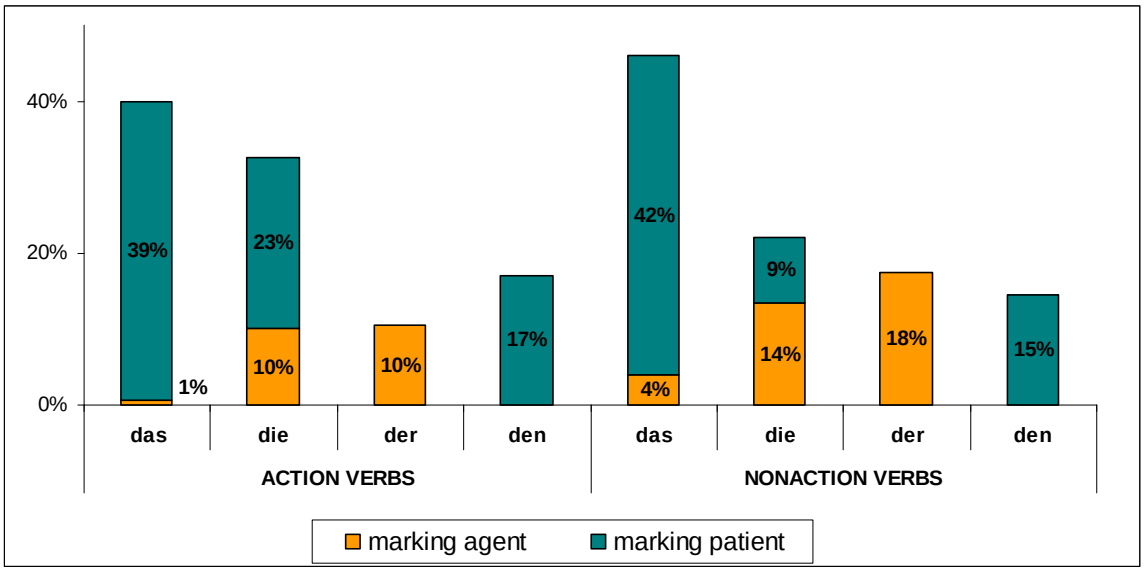


Figure 18: Distribution of the determiners der, den, die, and das in transitive sentences in child directed speech

[3] the slightly lower values are due to exclusion of *dieser*, *diese*, *dieses* (this)

When looking at how these determiners are distributed over agents and patients the most frequent determiner to mark the agent is *der* (action verbs: 30 (10%); non action verbs: 35 (18%)), followed by *die* (action verbs: 29 (10%); non action verbs: 27 (14%)) and least frequently agents are marked with *das* (action verbs: 2 (1%); non action verbs: 8 (4%)). Patients are mostly marked with *das* (action verbs: 113 (39%); non action verbs: 84 (42%)), followed by *den* (action verbs: 49 (17%); non action verbs: 29 (15%)) and *die* (action verbs: 65 (23%); non action verbs: 17 (15%)). Interestingly, *die* marks patients more often in highly causative sentences than in non causative transitive sentences (see Figure 18, above).

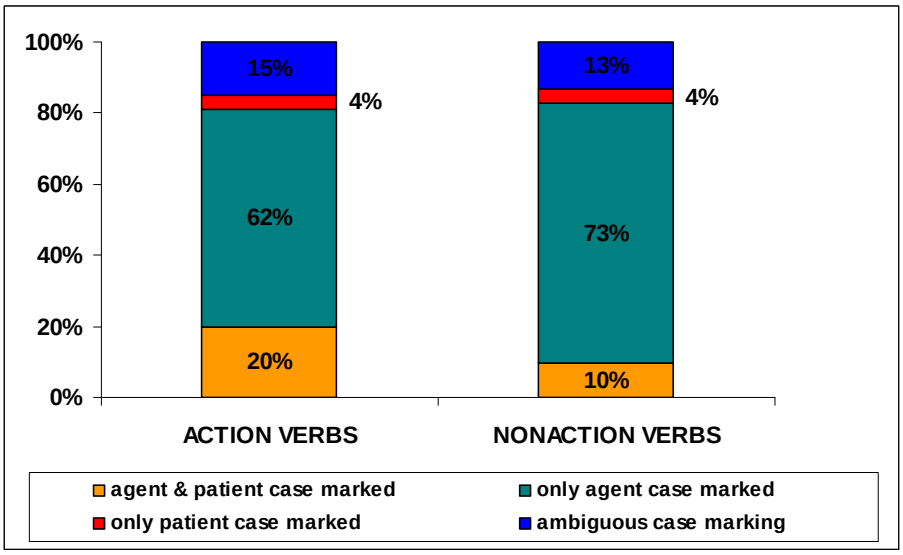


Figure 19: Case marking cues in transitive sentences in child directed speech

Because case can be already clearly assigned when forms are used which appear only in subjects or in objects the case marking cue is present as soon as one of the semantic roles in the sentence is unambiguously marked. This is the case in 350 (86%) of the high causatives and in 290 (87%) of the non causatives. Generally, only the agent is unambiguously case marked (action verbs: 253 (62%); non action verbs: 243 (73%)). Double case marking, i.e. the agent as well as the patient is marked with an unambiguous form, appears in 81 (20%) of the

transitives with action verbs and in 33 (10%) in the sentences with non action verbs. Patients are hardly ever the only unambiguously case marked noun phrase (action verbs: 16 (4%); non action verbs: 14 (4%)). 61 (15%) of highly causative sentences and 44 (13%) of non causative sentences have ambiguous case markers in both agents and patients so that the case marking cue is not present in these sentences (see Figure 19, above).

4.2.4 Word order cue

The canonical word order in German child directed speech is subject-before-object word order. This kind of sentences occurs in 279 (68%) of all transitive sentences with action verbs and in 189 (57%) of all transitives with non action verbs. On the other hand sentences with an object-first word order occur only in 77 (19%) of the highly causative sentences and in 97 (29%) of the non causative sentences. The remaining sentences are fragments in which the subject is dropped (action verbs: 26 (6%); non action verbs: 13 (4%)) or the object is dropped (action verbs: 29 (7%); non action verbs: 35 (11%), see Figure 20).

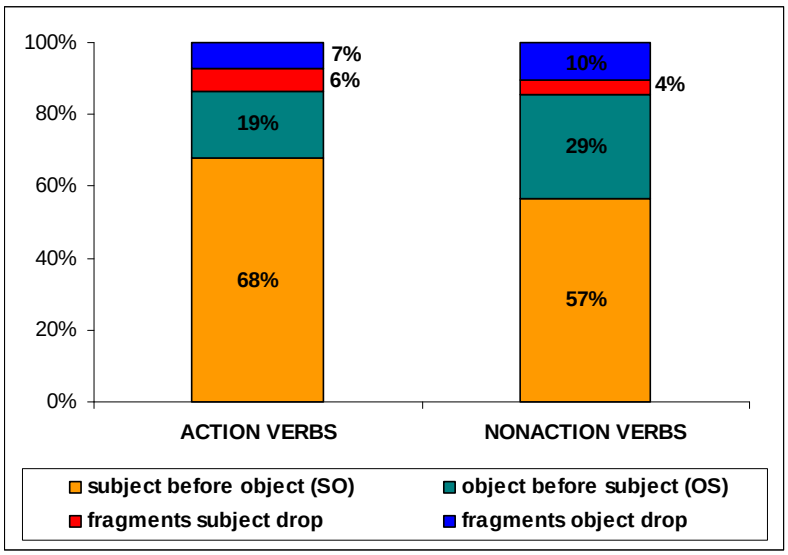


Figure 20: Word order cues in transitive sentences in child directed speech

4.2.5 Cue availability, reliability and validity

With regard to the experiments to be reported, I was especially interested in the relative strength of the two markers word order and case marking as cues to the interpretation of agents and patients. Therefore, I calculated cue availability, cue reliability and cue validity for both following Kempe & MacWhinney (1998). I found that the word order cue was available in 356 (87%) of the sentences with highly causative meaning and in 286 (86%) of the transitives with non action verbs. The case marking cue was available in 350 (85%) of the transitive sentences with action verbs and in 290 (87%) of the transitive sentences with non action verbs. In terms of reliability, however, case marking in German, when available, always reliably indicates the agent and/or patient of a transitive sentence 100% of the time whereas I found that word order does this reliably only in 279 (78%) of the highly causative sentences and even less, i.e., in 189 (66%) of the non causatives.

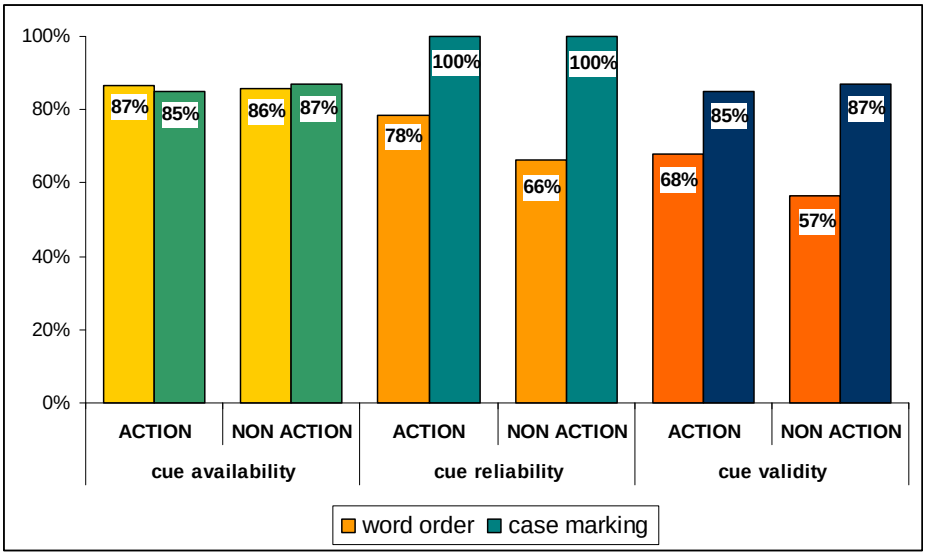


Figure 21: Cue availability, cue reliability and cue validity of the word order and case marking cue in transitive sentences in child directed speech

Therefore, the cue validity for case marking is higher with 85% compared to 68% cue validity for word order in German transitive sentences with real action verbs

in child directed speech. In transitive sentences without causative meaning this discrepancy is even stronger with 87% cue validity for case marking and only 57% cue validity for word order (see Figure 21, above).

Thus, even though the word order and case marking cue appear with very similar frequency in German child directed speech, their cue validities differ considerably due to a low cue reliability of the word order cue, i.e., a relative flexible order of subjects and objects in German. To complete the picture I also report the cue validities for animacy and subject-verb agreement. Cue validity is higher for animacy (action verbs: 83%; non action verbs: 87%) than for agreement (action verbs: 63%; non action verbs: 65%). This is because, although very reliable (action verbs / non action verbs: 98%), the agreement cue is not very often available in German input (action verbs: 64%; non action verbs: 66%) due to ambiguous forms for subjects and objects. The animacy cue, instead, is often available (action verbs: 84%; non action verbs: 91%) and also very reliable (action verbs: 99%; non action verbs: 96%).

4.2.6 Cue coalition and cue conflict

Previous studies have shown that not only the validity of cues to semantic roles is important for sentence comprehension or cue acquisition but that it also matters a lot whether these cues converge or compete in a sentence (see Bates & MacWhinney, 1987 for the coalitions-as-prototypes approach; Matessa & Anderson, 2000 for adult cue learning; McDonald, 1986 for children's cue acquisition). Therefore I analysed how often the four cues to agent and patient assignment appeared as conflicting cues or as cues in coalition.

Interestingly, all four cues do not differ in their distribution whether they appear in conflicting sentences or in sentences in which the cues support each other, i.e., in 75% to 80% of transitive sentences with action verbs all present cues

provide the same information (coalition) whereas in around 20% the cues conflict. In transitives with non causative meaning the cues conflict in slightly more sentences (ca. 35%) and fewer sentences show converging cues (ca. 65%, see Figure 22). Thus, the availability of conflict sentences is more or less the same for every cue to semantic roles in German transitive sentences.

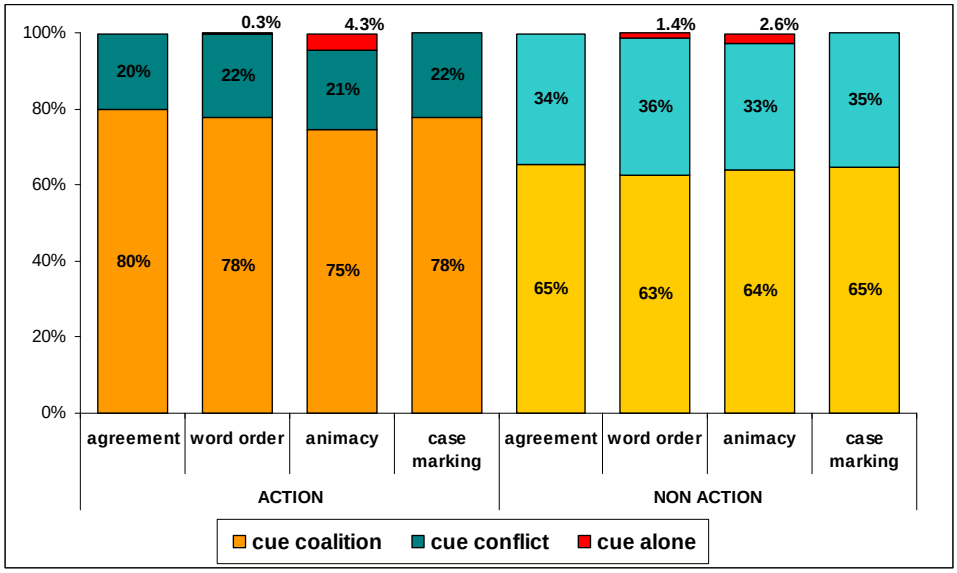


Figure 22: Distribution of cues in coalition or in conflict in transitive sentences in child directed speech

However, the way in which the four cues to semantic role interpretation really differ is in their conflict validity, i.e., how often the particular cue leads to the correct interpretation when it appears in a conflict with other cues. Here the word order cue is the weakest one, mostly leading to the wrong interpretation, which means that in sentences in which cues conflict the majority of sentences have a non canonical object-first order. Therefore, the conflict validity of word order is very low (action verbs: 1.2%; non action verbs: 6%). The other three cues reach quite high values for conflict validity. The strongest cue here is again case marking with 93% (action verbs), respectively 95% (non action verbs) conflict validity. The animacy cue is again stronger with 82% (action / non action verbs)

conflict validity than subject-verb agreement (action verbs: 57%; non action verbs: 67%; see Figure 23).

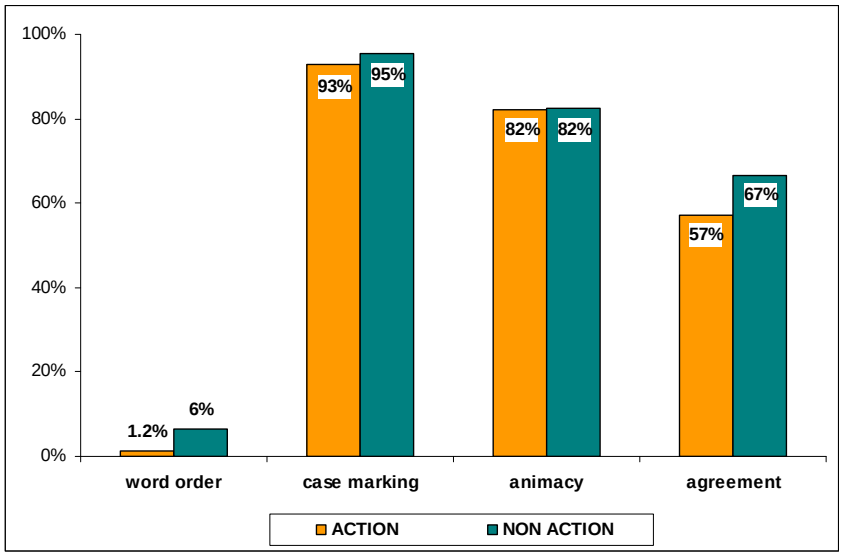


Figure 23: Conflict validities of the four cues to semantic role interpretation in transitive sentences in child directed speech

Finally, I will describe in particular how the two cues case marking and word order converge or conflict in German transitive sentences in child directed speech, because these are the cues that I use in the experiments when testing semantic role interpretation during language acquisition (see study 2 & 3). In most transitive sentences (action verbs: 67.7%, non action verbs: 55.9%) the case marking cue and the word order cue lead to the same semantic role interpretation. These are sentences with a subject-first order and unambiguously case marked noun phrases (SO + case). In contrast, a lot of sentences also put word order and case marking in competition (action verbs: 20.8%, non action verbs: 32.9%), i.e., unambiguous case marking assigns the agent role to the second noun phrase (OS + case). The remaining sentences (action verbs: 11.5%, non action verbs: 11.2%) provide no case marking cue at all, so that the listener has to rely only on word order (SO, see Figure 24).

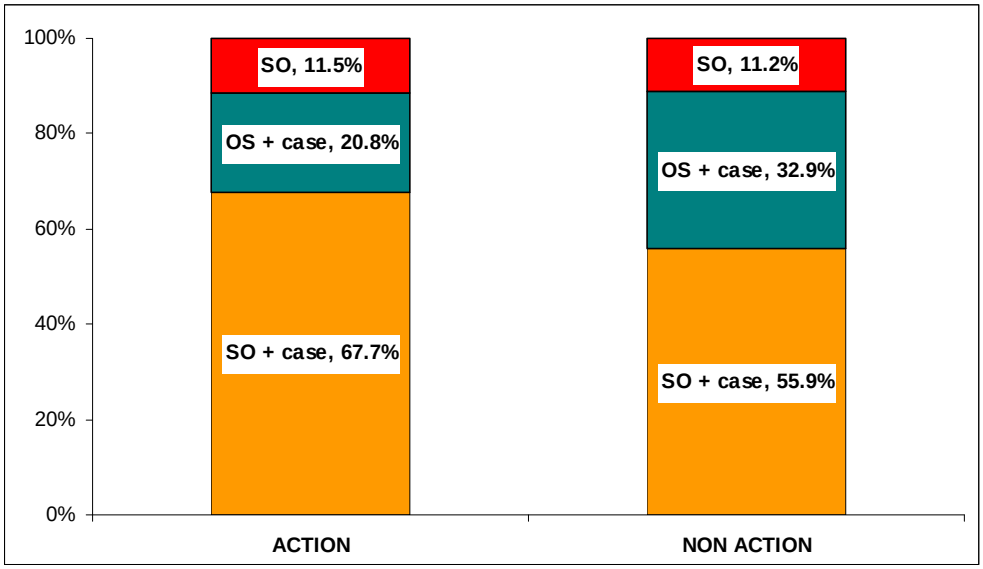


Figure 24: Distribution of SO- and OS-order with unambiguous and ambiguous case marking for German transitive sentences in child directed speech

Nevertheless, it must be noted that in the majority of these sentences not only case marking and word order appear as cues to sentence interpretation but also the other two – agreement and animacy, so that one cannot be sure on which cues children will finally rely when hearing the sentences. In 4% of the transitive sentences with high causative meaning and in 1.5% in sentences with non action verbs, word order and case marking appear together and are the only cues to semantic role interpretation. Word order cue as the exclusive cue and a pure conflict between case marking and word order with the other two cues neutralized also happens but very rarely (less than 1% in child directed speech). However, if one considers the number of utterances a child hears during his first years, learning should be possible even from these few cases.

4.3 Discussion

The input study found in terms of word order and case marking cues that German transitive sentences are most often built with case marked agents and

patients and the word order subject before object. The next most frequent pattern is of case marked transitive sentences but with the word order object before subject. Rarely, children hear sentences which contain word order as the only cue. Furthermore, word order and case marking are similar often available in child directed speech but case marking is much more reliable than the word order cue and therefore has higher cue validity.

But whereas it is relatively easy to determine whether the case marking cue is available or not (unambiguous nominative and accusative forms) it is difficult to know exactly how German children use the word order cue. In German the position of the verb in the sentence is relatively flexible. It can either be at the beginning of a sentence as in questions, in the middle as in main clauses, or at the end as in subordinate clauses. Therefore, in a sentence such as, *…, weil der Mann den Jungen schubst* […, because the+masculine+nominative man the+masculine+accusative boy pushes] the object (patient) comes directly before the verb although the word order still maintains the most common (canonical) subject before object order. Thus, in fragment sentences without case-marking, it is very difficult to say whether a noun phrase immediately before the verb is the agent or the patient (‘*hat die Frau geschubst*’ could either mean ‘he has pushed the woman’ or ‘the women pushed him’). Therefore I decided that the word order cue is not available in German fragment sentences, i.e., those with subject or object omission, because the child needs to hear the relation between two arguments in the sentence to use the word order cue and this way of calculating word order availability and reliability leads to the results reported in section 4.2.4 (above).

However, there is a second possible way to calculate the availability of word order. The position of one argument in relation to the verb might be sufficient to decide whether this noun phrase is agent or patient (SV versus VO). That is, *die Frau schubst* (the+feminine woman pushes) is likely to mean ‘the woman is

pushing', whereas *schubst die Frau* (pushes the+feminine woman) is likely to mean 'is pushing the woman'. Under this analysis the word order cue would also be available in fragment sentences (with either the subject or object omitted). Using this analysis, the word order cue is available 100% of the time and the case marking cue in 89% of the transitive sentences. In terms of reliability, however, case marking in German, when available, always reliably indicates the agent and patient of a transitive sentence 100% of the time, whereas we find that word order does this reliably only 74% of the time (since objects can come before, and subjects after, the verb). But even by using this new analysis, the cue validity for case marking is still higher with 89% compared to 74% cue validity for word order.

In the following two studies I investigated German children's understanding of word order and case marking cues in transitive sentences, and - unlike previous studies in the Competition Model framework - I did this using novel verbs. My specific question was when German children come to understand that in their language case marking is a 100% reliable cue (even if it is not always available), whereas word order is not (even though it is quite often available). I use the findings from the input analysis to make various predictions about which kinds of transitive sentences German children should comprehend most readily and at the earliest ages. If what is most important from the beginning is cue reliability – as suggested by MacWhinney et al. (1984) – or cue cost – as suggested by the Local Cues Hypothesis (Slobin, 1982) – then children should comprehend most readily sentences with unambiguous case marking regardless of the order in which the noun phrases occur (i.e., even in object-first sentences). On the other hand, if what is most important from the beginning is cue availability – based mainly on frequency in the input – then they should comprehend very early sentences in which the agent is the first noun phrase, regardless of case marking

(i.e., even in sentences with ambiguous case marking). Finally, if prototype sentences with redundant marking have a special role - as suggested by the coalitions-as-prototypes-approach of Bates & MacWhinney (Bates & MacWhinney, 1987) – then children should comprehend most readily prototype sentences, and might be expected to struggle when the cues conflict (i.e., in object-first sentences). Of course it is also possible as I pointed out in the introduction (section 2.2.3) and as suggested by Sokolov (1988), that cue availability, cue reliability, and prototypes play different roles at different periods of development.

Chapter 5: Competing cues are hard to interpret. How children learn to weigh grammatical cues appropriately.

5.1 Study 2 – Who is doing what to whom? An act out task.

In this study I test these predictions experimentally using an act out comprehension task, which is the task used most often in previous investigations of the Competition Model and Local Cues Hypothesis. I adapted this task to examine how young German children perform when they hear sentences containing **novel** verbs to determine when and in which developmental order they start to use these grammatical cues productively, independent of any particular known verbs and independently of animacy cues.

5.1.1 Method

5.1.1.1 Participants

Sixteen monolingual German 2;7-year-old children (range = 2;6 – 2;8; nine girls, seven boys) and sixteen monolingual German 4;10-year-old children (range = 4;6 – 5;3; nine girls, seven boys) were included in the study. A further nine children were tested but excluded from the study due to either fussiness (3), bilingualism (1), experimenter error (4), or because the child was too young (1). All children were tested in nursery schools in a medium-sized German city.

5.1.1.2 Materials

The children were tested on two novel verbs with German sound patterns and one familiar verb. Similar to study 1 all verbs referred to prototypical causative-transitive actions, involving direct contact between a volitional agent

and an affected patient. All actions were reversible (Hopper & Thompson, 1980). The two novel verbs and novel actions were *wiefen* and *tammen* which were described in study 1. The tested familiar verb was *schubsen* (*pushing*).

Agents and patients of a particular event were pairs of animals with the same grammatical gender, exactly which gender depended on the condition. All animals were well-known to two-year-olds. Here I again used the ELFRA-1 (Grimm & Doil, 2001), and the MacArthur CDI (Fenson et al., 1994) to identify which animals to use. *Der Hase* (the[+masculine] bunny), *der Bär* (the[+masculine] bear), *der Elefant* (the[+masculine] elephant), *der Hund* (the[+masculine] dog), *die Katze* (the[+feminine] cat), and *das Schwein* (the[+neuter] pig) were on the ELFRA-1, *der Löwe* (the[+masculine] lion), *der Frosch* (the[+masculine] frog) and *der Tiger* (the[+masculine] tiger) were on the US-American MacArthur. Just two animals, *das Zebra* (the[+neuter] zebra) and *die Ziege* (the[+feminine] goat), were on neither of them, but the children did not show any difficulties in identifying these animals (see procedure).

All children heard the same test sentences (see Appendix B) in three conditions: In the 'prototype' condition they heard the novel verbs with an argument structure in which the agent was the first NP and case marked with nominative and the patient was the second NP and case marked with accusative, e.g., *Der Hund wieft den Löwen*. (The[+nominative] dog is weefing the[+accusative] lion). In the 'word order only' condition, they heard an argument structure in which the agent was the first NP and the patient was the second NP but case marking was ambiguous because animals of masculine gender were not used, e.g., *Die Katze wieft die Ziege*. (The cat is weefing the goat). In the 'conflict' condition the patient was the first NP and case marked with accusative and the agent was the second NP and case marked with nominative, e.g., *Den Bären wieft der Tiger*. (The[+accusative] bear is weefing the[+nominative] tiger).

Such sentences have the meaning: it is the tiger that is weefing the bear. As a control condition I used one familiar verb *schubsen* (pushing) in the prototype argument structure, e.g., *Der Hund schubst den Tiger*. (The[+nominative] dog is pushing the[+accusative] tiger). Thus, each child heard seven test sentences, six with novel verbs and one with a familiar verb.

5.1.1.3 Design

The children were tested on the transitive sentences using an act out task. A camera in front of the children recorded their enactment. Counterbalancing was used for the agent (e.g., lion / dog) and for sides, e.g., sometimes the agent was to the left and sometimes to the right of the patient. The order of the verbs and the conditions was counterbalanced by Latin squares. There were thus 72 possible orderings of which 16 were chosen randomly and these were distributed evenly over the children within each age group.

5.1.1.4 Procedure

During the session the child sat at a small children's table on which the apparatuses for the act out task were placed. The experimenter sat next to the child. Animals and apparatuses for the act out task were hidden in a box. The two animals for each act out task were always placed by the experimenter in front of the child between the child and the apparatus which faced the child so that it was never the case that one animal was nearer to the apparatus. Which animal (agent or patient) was to the left of the child was counterbalanced both within and between subjects.

Warm up: The children first experienced a warm up in which they were required to imitate acting out an intransitive locative, namely: *Der Fisch springt ueber den Elefanten*. (The[+nominative] fish is jumping over the[+accusative] elephant.). If

they did not correctly act this out, they got a second trial with the sentence *Der Fisch klettert auf den Elefanten.* (The[+nominative] fish is climbing onto the[+accusative] elephant.) If the child passed one warm up trial correctly I proceeded with the experiment.

Verb-learning training: The verb-learning training was carried out prior to all three test conditions in the same manner as described in study 1. Using animals which take German feminine gender every verb was presented to each child in a live act out by the experimenter in a variety of argument structures. The child was also asked to repeat the verb in the citation form and to attempt the act out with the two feminine animals.

Test Trial: For the act out trials the experimenter placed two animals and the apparatus in front of the child and told the child the test sentence: *Jetzt bist du dran! Zeig mir: Der Löwe wieft den Hund*. (Now it's your turn! Show me: The[+nominative] lion is weefing the[+accusative] dog.) The experimenter repeated the test sentence until the child started enacting.

Vocabulary / Morphology Production Post Test: After all test trials were over all children took part in a language development test. The 2;7-year-olds received (similarly to the children in study 1) the vocabulary production sub-test of the SETK-2 (Grimm, 2000). The 4;10-year-olds received the morphological production sub-test of the SETK 3 - 5 which has been standardized for German three- to five-year-olds (Grimm, 2000). In this test children are shown pictures with familiar and novel objects and they had to build the correct plural form (of which there are eight possibilities in German). The 2;7-year-old children who participated in the test had a mean score of 44 (range 36 - 56) and the 4;10-year-olds had a mean score of 47 (range 36 - 63). Thus, their mean scores were a bit lower than the expected ones for their age range (expected mean = 50, standard deviation 40 - 60).

5.1.1.5 Coding

For every test trial, choosing the correct animal as agent was assigned the value 1 and choosing the wrong animal as agent the value 0. If the child did not act out a causative scene but instead put both animals next to each other onto the apparatus I excluded those trials. I had to exclude 26 trials out of 144 in the younger age group (prototypical condition (9), word order only condition (9) and conflict condition (8)), and none in the older age group. All children were coded by the first author, and an additional coder coded 15% of all trials for reliabilities with high agreement with the first author (Cohen's Kappa = .8774).

5.1.2 Results

The act out was analyzed using a 2 (Age) X 4 (Experimental Condition) mixed factorial analysis of variance (ANOVA). There were main effects for both Condition (F (3, 81) = 3.018, $p < .05$) and Age (F (1, 27) = 17.672, $p < .001$), but not a significant Condition * Age interaction. Post-hoc tests with a Bonferroni correction for the main effect of condition with six comparisons revealed only significant differences between the 4;10-year-old's performance with the familiar-verb control condition (M = 94%) and the conflict condition (M = 56%, t (15) = -4.392, $p < .05$).

Because the chance level for the dependent variable was always 50%, I also investigated in which conditions and at which ages the children were above chance. The results show that the 2;7-year-olds were only above chance with the familiar verb (t (15) = 2.236, $p < .05$), whereas the 4;10-year-olds were above chance in the familiar verb condition (t (15) = 7.000, $p < .001$), the prototypical (t (15) = 3.576, $p < .05$) and the word order only condition (t (15) = 3.478, $p < .05$, see Figure 25). Non-parametric tests (Wilcoxon) found the same result.

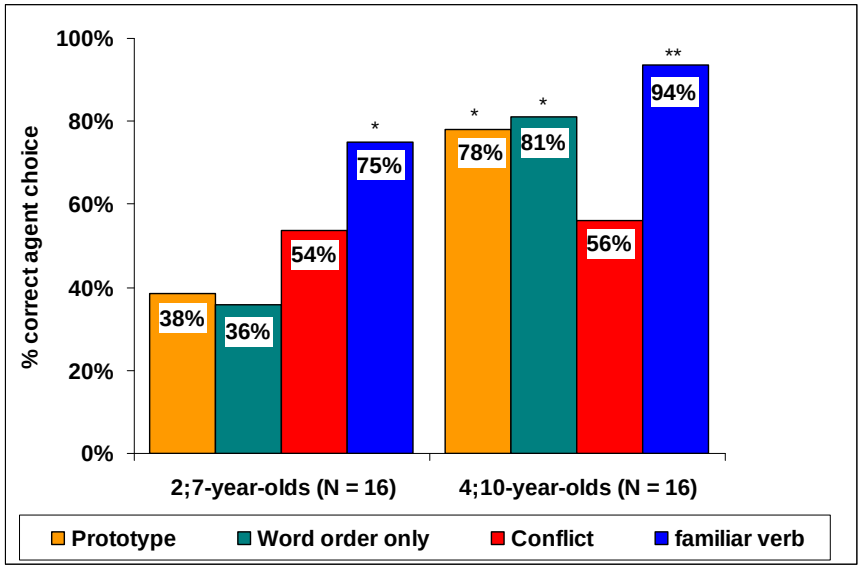


Figure 25: Mean proportion of correct agent and patient choice in an act out task

Thus, in the case of the 2;7-year-old German children these findings suggest that they are only able to correctly carry out this act out task with a known action. One possible reason for this is that children initially form grammatical schemas around familiar verbs and are therefore only able to comprehend transitive sentences correctly with familiar verbs (Tomasello, 2003). However a second explanation of the results is that the act out task is a particular difficult task for young children and it might be easier to carry out when asked to perform a known action than a novel action.

German 4;10-year-olds can correctly interpret transitive sentences with novel verbs in subject-first word order. That is, they have productive knowledge of the grammatical cue word order. But in the conflict condition they performed at chance level. Thus, I can assume that German 4;10-year-olds have not yet acquired the use of the case marking cue separately from subject-first word order and therefore do not interpret correctly object-first sentences with case marking on the noun phrases.

5.2 Study 3 – Different weighing of grammatical cues. A pointing task

It might be argued that the reason I found such late acquisition of case marking and verb-specific behaviour in study 2 is that the act out task I used has high working memory and executive function demands. Some support for such an argument might be drawn from my previous study (study 1) where - contrary to the findings of the current experiment – I found that German-speaking two-and-a-half-year-olds did show productivity with novel verbs in transitive sentences in a pointing comprehension task. Therefore, in the next experiment I adapted the pointing task to examine relative reliance on word order and case marking, using the same three novel verb conditions I used in study 2. Furthermore, I tested a third age group of older children to try to identify a later point in language development when German children are able to comprehend object-first transitive sentences.

5.2.1 Method

5.2.1.1 Participants

All children were monolingual speakers of German, who were brought by a caregiver to a child lab in a medium-sized German city. Of these were sixteen 2;7-year-old children (range = 2;6 – 2;8; eight girls, eight boys), sixteen 4;10-year-old children (range = 4;6 – 5;2; eight girls, eight boys) and sixteen 7;3-year-old children (range = 7;0 – 7;11; eight girls, eight boys) included in the study. A further 13 children were tested but excluded from the study due to either showing a side bias during the test trials (2), fussiness (7), bilingualism (2), or experimenter error (2).

5.2.1.2 Materials

All novel verbs referred to prototypical causative-transitive actions, involving direct contact between a volitional agent and an affected patient. All actions were reversible and involved either a caused change-of-state or change-of-location (Hopper & Thompson, 1980). The three novel verbs *wiefen*, *tammen* and *baffen* were used to describe three novel transitive actions that were performed with three novel apparatuses. *Wiefen, tammen* and *baffen* were identical with the actions used in study 1.

Agents and patients of a presented event were the same pairs of animals as in study 2 plus three more: *das Schaf* 'the(+neuter) sheep' and *das Pferd* 'the(+neuter) horse', which were on Elternfragebogen and *der Affe* 'the(+masculine) monkey' which was on the US-American MacArthur. The structural pattern of the test sentences (see Appendix C) were the same as described in study 2. Each of the three conditions was tested with each of the three novel verbs, so that the children got nine test sentences. Unlike study 2 I did not test familiar verbs.

5.2.1.3 Design

I tested each child with three different novel verbs in transitive sentence structures using a pointing task. During the session the youngest children sat on their caregiver's lap, the older ages alone, in front of a 30 x 49 cm 'Apple Cinema Display' screen. For the test trials the child saw two film scenes on the computer screen, each starting simultaneously and lasting six seconds. Both involved animals enacting the same causative event and differed only in that agent and patient roles were reversed. All children got alternating test sentences with the three different conditions and all three novel verbs were tested in one session.

For each test trial scene pair I counterbalanced which particular scene correctly matched the test sentence (e.g. for the pair "dog weef lion" and "lion weef dog" half the children heard German equivalent of "the dog is weefing the lion" and the other half heard the reverse). The order of the verbs and the conditions was counterbalanced by Latin squares. The target screen order was counterbalanced so that each side (left or right) was correct four or five times out of nine trials for each child (depended on counterbalancing order). The same side was never the correct choice more than twice in a row. No child experienced a condition in which the correct choice alternated regularly (e.g., LRLRLRLRL). For half the children the first correct side in the first trial was left and vice versa. There were thus 52 possible orderings for correct side of which 16 were chosen randomly and these were distributed evenly over the children within each age group. Furthermore the direction of the action (from left to right or from right to left) was also counterbalanced.

5.2.1.4 Procedure

One camera from behind the children recorded their pointing behaviour. Only children of the youngest age group sat on their parents lap. When testing the older children their mother or father sat behind the child on a separate chair. The parents who had their children sitting on their lap were asked to close their eyes during each test trial so as not to influence their child during pointing. I decided not to give head phones to the parents because I found this distracted the children when carrying out study 1. Therefore, the experimenter who sat next to the parent and child controlled whether the parent closed his/her eyes. The experimenter herself never looked to the screen during the test trials but always to the child.

Pointing practice training: To teach the children that the aim of the task was to point to one out of two pictures at a computer screen I used again the very easy

warm up task with two pictures of objects from study 1. But this time the children were asked to point to one of the two objects with a sentence in the following manner: e.g., *Zeig mir das Bild: Das ist der Hund*. 'Show me the picture: That's the dog.' I repeated this task again ten times with different objects and all children solved it perfectly.

Word-learning training: Similar to study 1 and study 2 every novel verb was presented to each child in a live act out by the experimenter in a variety of argument structures.

Film Familiarization trials: Following the live enactment, for each verb the child then saw a familiarization trial in which s/he watched each of the two film scenes individually and heard the experimenter describing them in the citation form, e.g., *Guck mal, das heißt wiefen*. 'Look, that's called weefing.' while the other half of the screen remained blank. The side where the children saw the first picture (left or right) was counterbalanced across and within subjects. At the end of each film scene the experimenter pointed to each animal and asked the child "*Wer ist das?*" (Who's that?).The majority of the children had no problem spontaneously naming the participating animals. If a child did not name one of the animals, the experimenter told the child the name and asked him/her to repeat it, which almost all children then did.

Test Trial: Following this a red centre point centred the child's attention to the centre of the computer screen. Then, the test trial began and as in study 1 the child watched the same two scenes as in the familiarization trials. They appeared simultaneously and were accompanied by a pre-recorded linguistic stimulus with the target verb in transitive argument structure, e.g., *Guck mal, der Löwe wieft den Hund*. (x2) 'Look, the(+nominative) lion is weefing the(+accusative) dog.' After the videos had stopped the experimenter asked the child to point to the correct still picture by asking, e.g., *Zeig mir das Bild: Der Löwe hat den Hund gewieft*! 'Show

me the picture: The(+nominative) lion weefed the(+accusative) dog!' If the child did not point the experimenter repeated the question a second time, but she never asked the child to point again once s/he had already done so.

Vocabulary / Morphology Production Post Test: After all test trials were over the children took part in a language development test. The 2;7-year-olds and the 4;10-year-olds received the same tests as in study 2. The 7;3-year-olds received the morphological production subtest of the Heidelberger Sprachentwicklungstest in which children are shown pictures with familiar and novel objects and they had to form the correct plural or singular. This test has been standardized for three- to nine-year-old Germans (Grimm & Schöler, 1998). The 2;7-year-old children achieved a mean score of 55 (range 42 - 71) in their test, the 4;10-year-olds achieved a mean score of 56 (range 38 - 69), and the 7;3-year-olds achieved a mean score of 49 (range 40 - 59). The expected mean score is again 50 with a standard deviation between 40 and 60.

5.2.1.5 Coding

For every pointing test trial, pointing to the target was assigned the value 1 and pointing to the distracter the value 0. If the child did not choose either scene or pointed to both I excluded those trials. I had to exclude ten trials out of 144 in the youngest age group (prototypical condition (4), word order only condition (5) and conflict condition (10)), one (conflict condition) in the 4;10-year-olds and none in the oldest age group. All children were coded by myself, and an additional coder coded 15% of all trials for reliabilities with high agreement with the first author (Cohen's Kappa = .968).

5.2.2 Results

The pointing behaviour was analyzed using a 3 (Age) X 3 (Experimental Condition) mixed factorial analysis of variance (ANOVA). There were main effects for both Condition (F (2, 90) = 34.875, $p < .001$) and Age (F (1, 45) = 19.258, $p < .001$). However, these must be interpreted in the context of a significant Condition * Age interaction (F (4, 90) = 5.855, $p < .001$).

Post-hoc tests with a Bonferroni correction for three comparisons revealed that the interaction was due to the 2;7-year-olds showing a difference trend between their correct pointing in the prototypical condition (M = 76%) and in the word order only condition (M = 50%, t (15) = 2.595, p = .06) and between correct pointing in the prototypical condition and in the conflict condition (M = 46%, t (15) = 3.143, $p < .05$). No difference was found between the word order only condition and the conflict condition. The 4;10-year-olds in contrast showed a significant difference for both, between correct pointing in the prototypical condition (M = 88%) and in the conflict condition (M = 35%, t (15) = 4.970, $p < .001$) and between the number of correct points in the word order only condition (M = 94%) and in the conflict condition (t (15) = 6.586, $p < .001$). No difference was found between the prototypical condition and the word order only condition. Similar to the 4;10-year-olds the only significant difference for the 7;3-year-olds was between the number of correct points in the prototypical condition (M = 98%) and in the conflict condition (M = 69%, t (15) = 3.416, $p < .05$) and between the number of correct points in the word order only condition (M = 100%) and in the conflict condition (t (15) = 3.758, $p < .05$). No difference was found between the prototypical condition and the word order only condition.

Post hoc tests for the main effect of condition with Bonferroni correction revealed significant differences between all children's performance in the prototype condition (M = 87% correct pointing) and the conflict condition (M = 50% correct pointing, t (47) = 6.601, $p < .001$) and between the word-order-only

condition (M = 81% correct pointing) and the conflict condition (t (47) = 5.447, p < .001) which shows that conflicting cues, here word order and case marking, are especially difficult to use for children of all ages. Non-parametric tests (Wilcoxon) found the same result.

Because the chance level for the dependent variable was always 50%, I also investigated in which conditions and at which ages the children were above chance. The results reflect the previous analyses, namely the 2;7-year-olds were only above chance in the prototypical condition (t (15) = 4.354, p = .001), whereas the 4;10-year-olds were above chance in both the prototypical (t (15) = 9.121, p < .001) and the word order only condition (t (15) = 13.174, p < .001) but not with the conflict condition. And finally the 7;3-year-olds reached ceiling in the prototypical and the word order only condition and were above chance in the conflict condition (t (15) = 2.249, p < .05, see Figure 26).

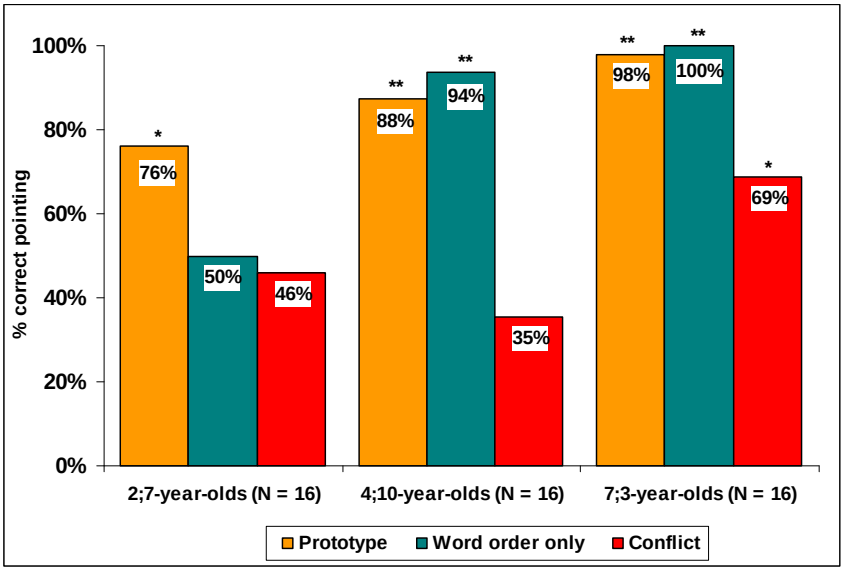


Figure 26: Mean proportion of correct pointing

Thus, all analyses reflect a developmental trend whereby German children first acquire prototypical grammatical marking, followed by word order and only

very late do they show an adult like reliance on case marking when this conflicts with word order.

Hence, I was interested in which strategies young German children use to interpret transitive sentences with patients in first position. Therefore, I analysed all children's responses to the conflicting sentences as to whether they oriented towards word order or case marking or whether they used neither strategy and avoided selecting a scene (usually through pointing to both scenes). A 3 (Age) X 3 (Strategy) mixed factorial analysis of variance (ANOVA) revealed main effects for both Strategy (F (2, 90) = 23.473, $p < .001$) and Age (F (1, 45) = 21025.000, $p < .001$). However, these must be interpreted in the context of a significant Strategy * Age interaction (F (4, 90) = 6.362, $p < .001$). Post-hoc tests with a Bonferroni correction for three comparisons showed that the 4;10-year-olds relied significantly more on word order than the 7;3-year-olds (t (30) = 2.622, $p < .05$) and that the 7;3-year-olds relied more on case marking than the 4;10-year-olds (t (30) = -2.879, $p < .05$) and the 2;7-year-olds (t (30) = -3.922, $p < .001$, see Figure 27).

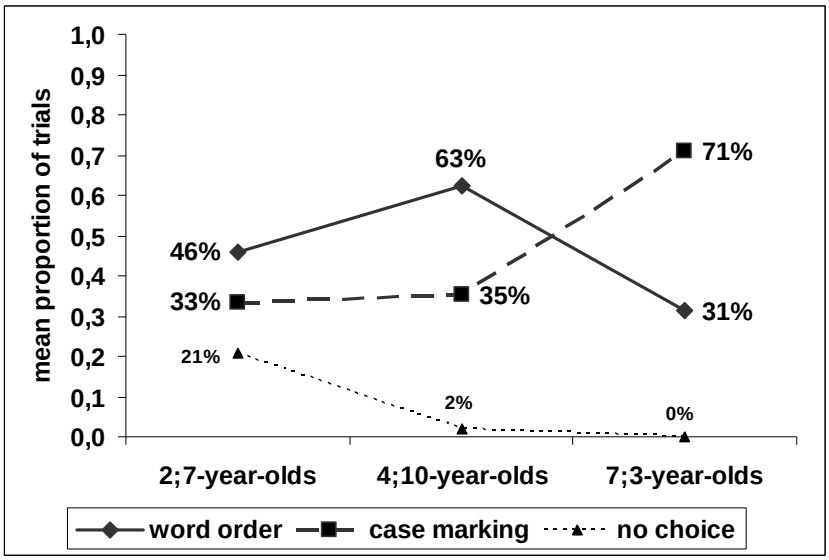


Figure 27: Strategies used during trials with conflicting cues

Furthermore, I found that the 4;10-year-olds' performance in the conflict condition was related to their state of morphological knowledge (plural morphology). Children who performed poorly on the morphological productivity test relied more strongly on word order in our experiment and therefore pointed incorrectly in the conflict condition (M = 17% correct pointing) than children with more robust morphological knowledge (M = 54% correct pointing, t (14) = -2.460, $p < .05$). The 'low morphology' group of children even showed below chance performance with the conflict condition (t (7) = -5.372, p = .001) which indicates a word order strategy when asked to point to the corresponding scene of a transitive sentence. Similar findings come from the group of 7;3-year-olds which showed above chance performance with the conflict condition (t (7) = 3.122, $p <$ .05) for the 'high morphology' children whereas the 'low morphology' group of children performed still at chance. Therefore it may be the case that German children pass through a stage in which they rely solely on word order and ignore case marking when these cues conflict before they learn to rely solely on case marking such as adults do.

The findings from study 3 thus support the hypothesis that transitive sentences with a subject-first word order and with unambiguous case marking are acquired earlier by German children than are transitive sentences with a subject-first word order but ambiguous case marking. Furthermore, at age five German children have still problems correctly comprehending transitive sentences with object-first word order even when these are clearly case marked. By age seven, they have solved this problem.

5.3 Discussion

The last two studies paint a fairly clear picture of how young German children come to comprehend transitive sentences. At around 2.5 years of age, if

assessed with an act-out task (study 2), they comprehend transitive sentences with familiar verbs but not novel verbs. This finding is in general agreement with the production study of Wittek and Tomasello (2005) in suggesting fairly verb-specific knowledge early in development. However, when a less demanding pointing task is used (study 3, and compare also study 1), German children at this same age show solid comprehension of prototypical transitive sentences in which both word order and case marking indicate who was doing what to whom redundantly – even with novel verbs, suggesting more verb-general knowledge at 2.5 years. That they could show their knowledge only in the experiment using a pointing task and not in the act out experiment might be due to the difficulty that the memory load of the act out method per se creates for small children (Munakata et al., 1997; Hirsh-Pasek & Golinkoff, 1996b).

But, importantly, these children comprehend transitive sentences only in their prototypical form with redundant marking of agent and patient. Even with the less demanding pointing measure, they do not comprehend transitive sentences for which diagnostic case marking is absent, or those in which the word order is non canonical (object-first). They thus cannot use either cue by itself, and they suffer when either is absent. These findings suggest that in languages like German children do not begin by attending to single cues, but rather they learn to comprehend the prototype and have difficulty whenever there is deviation from it. The prototypical form in German is also the most frequent (chapter 4), presumably a common pattern cross-linguistically for case marking languages. The role of subject-verb agreement in this process (and animacy as a semantic cue) should also be investigated.

The 4;10-year-old children present me with a puzzle. In both studies, using both methods, they seem to comprehend transitive sentences mostly in terms of word order. In both Studies 2 and 3, their performance with word order is

as high as with the full prototype including case marking (both near ceiling), and they choose at random in response to sentences in which word order and case marking conflict – with a number of children in Study 3 actually ignoring case and going with word order only. This finding is a puzzle because on the two standard measures of input in the Competition Model – cue availability (how often the cue is available in relevant sentences) and cue reliability (how reliable the cue is, when it is present, in indicating the correct interpretation) – word order shows no advantage in availability (87% versus 86% for case marking), and indeed its cue reliability as standardly computed is lower (79% versus 100% for case marking).

One possible explanation of this finding is that the way we are thinking about grammatical cues is not fully adequate. Specifically, it may be that cue availability and reliability as calculated here for word order and case marking miss aspects of the input that are important for language learning children. First, as noted in the input analysis (chapter 4), there is the issue of what should be counted for the word order cue. It may be that German children do not use the word order cue as the positional relation between the two nouns in the sentence (first noun = agent; second noun = patient) but as the positional relation between the noun and the inflected verb (noun before verb = agent; noun after verb = patient). That would mean that the word order cue is also available in fragment sentences and hence more often available (100%) than case marking (86%). It is also possible that German children do use the word order cue as the positional relation between the two nouns but do not take fragment sentences (with subject or object ellipsis) as part of the transitive domain. Also then the word order cue would be more often available (100%) than the case marking cue (89%). Second, as also alluded to in the input study (chapter 4), it may be that German children do not use case marking in a completely general way. Thus, because German has

three noun classes nominative case marking, for example, has three different forms in the singular and another in the plural. If children at a particular age have not yet discovered the case equivalence of these different forms, then the way that cue reliability is typically calculated is not fully adequate. That is, the children in the current studies were tested on the particular case markers *der* and *den* used as determiners (masculine nominative and accusative) which appear in only 21% of all transitive sentences (see chapter 4), and their comprehension of these may not benefit from their experience with case marking using other forms in other genders – so that the cue availability of these particular forms is not particularly high. But, of course, as children learn to connect the different case-equivalent forms (e.g, the nominative form for determiners *der* (the[+nominative]) and the nominative form for personal pronouns such as *er* (he), the cue availability of case marking will go up for the language learning child (even if the input stays exactly the same).[4] However, calculating cue availability of case marking in this way results in the availability of case being much lower (21%) than that of word order (87%) even when assuming that word order is not available in fragment sentences.

Both alternative approaches of calculating cue availability for the two grammatical cues which I used in my experiments leads to the conclusion that availability might indeed be higher for word order than for case marking. Under this analysis, it would not be unexpected anymore for the 4;10-year-old children to rely more on word order than on case marking. This suggests that young German children rely on different input parameters at different stages of development, specifically they rely more on cue availability (basically frequency) early in development and more on cue reliability later in development (see Sokolov, 1988 for similar findings). In support of this view, many studies have demonstrated the importance of frequency in early language development (see

[4] Although 'der' is often used in spoken German (including the child-directed speech analysed here) to mean 'he' (as is 'den' to mean 'him').

Lieven & Tomasello, 2008, for a review). It is also important that in online sentence processing, German adults show faster reaction times when the test sentence has only a cue with high availability rather than one with high reliability (Kempe & MacWhinney, (1999) – even though in offline (less time-pressured) agent identification tasks they rely more on the cue with high reliability. Thus, cue availability is not only an important factor for children's language processing (see also the artificial language learning task by Matessa & Anderson, 2000).

Complicating matters further, many of the case markers in German are either not diagnostic within the transitive (*die* is both the nominative and accusative feminine; *das* is both the nominative and accusative neuter) or else ambiguous with forms outside the transitive (e.g., the masculine nominative form used in the current study, *der*, is also the feminine dative and genitive). And furthermore, the most frequent agents in German transitive sentences are not lexical noun phrases at all, but rather pronouns, some of which are identical to the determiners (e.g. 'der' = both masculine nominative determiner and masculine nominative personal pronoun) but many of which are not. At the moment, there is no agreed-upon way to take account of these added complications in calculating the cue availability and reliability of German word order and case marking. But they do suggest the possibility that German word order is somehow a more straightforward cue for younger, less grammatically sophisticated children than is German case marking, which has so many different and ambiguous forms for the same grammatical function.

There are other studies which show that cue reliability values also do not appear to fully predict the order of acquisition but it is easily influenced, for instance, by cue costs as a study by Devescovi, D'Amico & Gentile (1999) shows. Whereas Italian adults relied heavily on subject-verb-agreement, Italian children relied until age nine more on animacy cues in a transitive sentence although

animacy is a less valid cue than subject-verb agreement in Italian. The authors claimed that younger children might postpone the use of highly valid agreement information, due to the memory costs that such cues exact ('distributed' agreement cue versus 'local' animacy cue).

But it must also be noted that the finding that German 4;10-year-olds rely more on word order than case does not accord well with Slobin's (1982) Local Cue Hypothesis, which would predict the 'local' case marking cue to be easier to process than the 'distributed' word order cue. There have also been other studies which suggest that the Local Cue Hypothesis may have limitations, at least for German. In two studies comparing young English and German children's ability to produce novel passive and active transitive constructions, German 2;10-year-olds performed equally poorly as English children (Brooks & Tomasello, 1999b) although they had the additional case marking cue and could already demonstrate productivity with case marked noun phrases (Wittek & Tomasello, 2005). However, German case marking differs in two ways from case marking in languages such as Turkish or Hungarian on which the Local Cue Hypothesis was based (Slobin & Bever, 1982 for Turkish; MacWhinney et al., 1985 for Hungarian). First, whereas in Turkish and Hungarian case is marked by suffixes on the noun, in German case is marked on the determiner or adjective which precedes the noun. Therefore, one might claim that case marking is not as local as in Turkish or Hungarian. Secondly, as just noted, the form of the German masculine nominative determiner *der* and accusative determiner *den* is ambiguous with determiner forms outside the domain of transitive sentences. Both factors, "less-locality" and "ambiguity", may influence the ease of sentence or cue processing in German transitive sentences compared to Turkish or Hungarian.

Finally, I come to the 7;3-year-olds. I myself was very surprised that it was only at this late age that children succeeded in the conflict condition,

weighing the case marking cue over the word order cue as adults do (Study 3). However, even adults have difficulties processing non-canonical word orders, at least as measured by reaction times (Ferreira, 2003) if no pragmatic context is given (Kaiser & Trueswell, 2004). This is also the case for German adults; that is, when they are confronted with OVS sentences which are ambiguously marked on the first noun phrase, German adults initially interpret these as SVO sentences until they hear the second noun phrase (Weber, Grice, & Crocker, 2006). Moreover, in point of fact my current findings do not conflict greatly with those of other studies that have used familiar verbs. In the studies of Primus and Lindner (1994) and Schaner-Wolles (1989) it was not until children were five years of age that they correctly comprehended transitive sentences with familiar verbs with conflicting word order and case marking cues. As my studies show, resolving conflicting cues in sentences with novel verbs takes even longer. Why this is so is not exactly clear; it might be either a different processing burden or lexically-based cue knowledge. One indication that it is the difficult processing of such sentences that made the 4;10-year-olds in the current study perform poorly comes from a study by Smith and Mimica (1984). They found out that aphasic patients responded unsystematically when cues to agent-patient relations occurred in competition with one another but when there was a convergence of cues their performance approached that of normal subjects. This could mean that conflicting cues per se already provide a high cognitive load, and with the additional processing of an unknown verb the 4;10-year-olds were cognitively overloaded.

In terms of cue availability and reliability, following the reasoning from above, children by this late age should know the grammatical equivalence of all (or at least most) of the different case forms serving the same grammatical function (and should ignore ambiguities based on other information). For 7;3-year-olds, then, the cue reliability of case marking is thus something close to that

computed here, and so they finally rely on case marking over word order, as German adults would do. Another important factor is that knowledge about reliabilities of cues in languages such as German, in which they are often redundant, is only learned by experience with sentences in which cues conflict (McDonald, 1986). This account fits well with my measures from child directed speech because sentences with conflicting cues are much less frequent in the German input than sentences with non conflicting cues (21% versus 79%). One might argue that 21% object-first sentences in the input is quite a lot of exemplars for learning about conflicting cues before the age of five. However, two other factors must be taken into account. First, object-first sentences occur in pragmatically marked contexts, with stress on the initial noun – which might mark them for children as a separate construction from prototypical transitive sentences without such stress. Second, almost all of the object-first sentences in German child directed speech have pronouns, not lexical nouns with determiners, in the pre or post verbal position (96%), and most of these (76%) are first and second person personal pronouns with which the child is highly familiar (*ich* for I and *du* for you[+nominative] in postverbal or *mich* for me and *dich* for you[+accusative] in preverbal position). This means that the child can comprehend the vast majority of object-first transitive sentences on the basis of well-entrenched knowledge of specific pronoun forms and meaning but need not use case marking per se. Furthermore, the majority of the remaining 4% of the object-first sentences without pronouns provided an additional animacy cue to the child, i.e., an animate agent versus an inanimate patient, despite the patient appearing in sentence-initial position. Only 1% of all object-first sentences were based solely on the pure competition between the grammatical cues of case marking and word order. Therefore, in actual fact young children hear very few conflict sentences in which they really are forced to decide between case marking and word order. This does

not mean that the children in my experiments heard odd or ungrammatical sentences, just very infrequent ones if frequency is counted at the level of specific forms such as pronouns and particular case-markers.

The overall process by which German children learn to comprehend transitive sentences in a verb-general way may thus be summarized as follows. They begin somewhere after the second birthday by comprehending the prototypical form of such sentences (even with novel verbs) with redundant marking of agent and patient by means of word order and case marking. Between ages two and four they learn to use word order by itself, as well as a number of specific lexical forms like personal pronouns that appear in different case-marked versions. But it is only by sometime after age five that they become adult-like in weighing case marking over word order in sentences in which these cues conflict. Interestingly, this same process may help to explain why English-speaking children takes so long to comprehend and produce sentences with novel verbs in experiments such as those summarized by Tomasello (2000). The prototypical transitive sentence in English potentially has animacy cues, a case marked subject pronoun (such as *I* or *he*), and subject-verb agreement – in addition to canonical SVO word order. In most of the experiments all of these cues were neutralized except word order. Following the reasoning of the current study, then, the prediction would be that English-speaking children should do better at an earlier age with prototypical transitive sentences including redundant cues. What this means is that all children learning all languages take time to learn the significance of individual cues when those cues occur most often in combination with other redundant cues. This accords with the coalition model by Hirsh-Pasek and Golinkoff (1996b) who suggested that children might master grammar by noting redundancies of cues for comprehension and with much recent theorizing in adult psycholinguistics in which the process of comprehension is seen as learning to

integrate a great diversity of multiple probabilistic cues to language structure (e.g., cue integration approach by Christiansen & Monaghan, 2006).

In any case, the current studies have demonstrated that even for what many considered the most straightforward syntactic construction of all, the simple transitive construction, at least in some languages it is a fairly long and drawn-out process for young children to fully achieve adult-like mastery of the specific roles of each of the different grammatical cues and processes instantiated in the particular sentences they hear. This mastery depends on their attention to basic aspects of their linguistic experience, such as the frequency, consistency, and complexity of those cues in particular utterances. Frequency, consistency and complexity have also, of course, been centrally important in theories of children's non-linguistic cognitive development and inductive learning (see Siegler, 1996). Our finding of the importance of the prototype and the long process of 'unpacking' it into the different cues it contains, also finds resonance with much recent discussion of the relationship between prototypes and exemplar-based models in adult categorization learning (see, for instance, Anderson, 1991; Chandler, 2002; Hampton, 1997; Ross & Makin, 1999). While there is a great deal of theoretical and empirical work to be undertaken to make the links between these research fields more explicit, my results suggest to me that this aspect of children's language learning shows close parallels with essential characteristics of human learning more generally.

Chapter 6: Study 4 – Young German children's syntactic competence: A preferential looking study.

So far we know from study 1 and study 3, that German 2;6 year olds are able to comprehend correctly transitive sentences in which case marking and word order converge. However, I found conflicting results when using the act out method. This indicates a task dependence of children's performance in syntax acquisition tests. Thus, when making the task easier children even younger than two years old might be able to show some kind of abstract knowledge of the transitive construction. Therefore, in the following study I used a preferential looking paradigm based on a study by Gertner et al. (2006) who were able to demonstrate that English speaking 21 month olds correctly interpreted transitive sentences under particular training circumstances (see section 2.2.2 for a description of their study). When they showed the two preferential looking stimuli to the children, Gertner et al (2006) used scenes in which the two participants acted out two different transitive actions. This is in particular new to other preferential looking studies and appears to make the task easier for the children as when agents and patients perform the same action. As I could not find above chance looking with 2;1- and 2;6-year-olds in study 1 (chapter 3) of this thesis I adapted this method change for the following study .

6.1 Method

6.1.1 Participants

All children were monolingual speakers of German, who were brought by a caregiver to a child lab in a medium-sized German city. Forty-eight 21-month-olds (range = 20 – 22 month; 25 girls, 23 boys) were included in the study. A further 18 children were tested but excluded from the study due to either showing

a side bias (3), fussiness (11), bilingualism (1), experimenter error (1), or because they did not participate in the additional vocabulary comprehension test (2).

6.1.2 Apparatus

The children sat on their parent's lap in front of two 30 x 47 cm monitors which were 76 cm away from the child. The monitors were 30.5 cm apart from each other and at eye level of the child. A centre light and a hidden camera to record the child's eye movements were placed between the screens. The sound tracks were presented centrally from behind the wall. The parents were asked to close their eyes during all training and test trials which the experimenter controlled through the camera.

6.1.3 Materials

The children watched two videos simultaneously which depicted people costumed as a frog and a monkey. I chose these animals because they are of masculine gender in German and therefore unambiguously case marked with nominative in subject position and accusative in object position, e.g., *Der Frosch wäscht den Affen*. (The[+nominative] frog is washing the[+accusative] monkey) and this kind of transitive sentence is found to be easier for young German children to interpret than transitive sentences in which the children have to rely on word order alone (see section 5.2). The pre recorded sound tracks were spoken by a female native German speaker. Four familiar German verbs and two novel verbs with German sound patterns were used in the experiment. All verbs referred to causative-transitive actions, involving direct contact between a volitional agent and an affected patient. The four familiar verbs and actions were *waschen* (to wash), *füttern* (to feed), *küssen* (to kiss) and *kitzeln* (to tickle), the two novel verbs were *wiefen* and *tammen*. The novel verb *wiefen* referred either to an animal

wheeling the other animal which lay on a wagon back and forth or to an animal tipping the other animal in a funny looking rocking chair. These were the same events Gertner et al. (2006) used in their first and second experiment. The novel verb *tammen* referred either to an animal bending the other animal back and forward by pulling and pushing his shoulders or to an animal rotating the other animal on an office chair by pulling a band around his waist. These were the same events Gertner et al. (2006) used in their third and fourth experiment (see Appendix E). All children were tested on full transitive sentences containing a novel verb.

6.1.4 Design

Before testing the children were assigned randomly to one of two conditions so that finally twenty-four subjects participated in each condition. To one group of children familiar verbs were presented in full transitive constructions, e.g., *the frog is washing the monkey* [condition TRAINING], to the other group of children familiar verbs were presented only in citation form, e.g., *this is called washing* [condition NO TRAINING]. Children of both between subject conditions had exactly the same mean age of 21.5 months.

After the experiment all children got an additional vocabulary comprehension test (not standardized) in which they had to point to one out of four objects and I also asked the parents to fill out the ELFRA-1 (Grimm & Doil, 2001), a shortened German version of the MacArthur Communicative Development Inventory (Fenson et al., 1994). The children achieved a mean score of 285 (TRAINING = 298; range 170 - 381 / NO TRAINING = 271; range 147 – 375) from a maximal score of 395 in the ELFRA-1 and a mean score of 5 (both conditions; range 1 – 9) from a maximal score of nine in the vocabulary comprehension test.

6.1.5 Procedure

Following Gertner et al. (2006) I presented the stimuli in three phases: character identification, training on familiar verbs and test on novel verbs. All children got the same order of phases.

6.1.5.1 Character identification phase

During the character identification phase first one of the animal characters appeared waving on one screen while the other screen remained blank and the child heard the name of the animal on the screen: *Guck mal, das ist der Frosch*. (Look, that's the frog.). After a two seconds break with both screens remaining blank, the other animal appeared waving on the other screen: *Guck mal, das ist der Affe*. (Look, that's the monkey.) These videos lasted five seconds. In the next two trials which lasted eight seconds each the waving monkey and frog appeared simultaneously and the children heard in one trial: *Wo ist der Frosch? Such mal den Frosch*. (Where is the frog? Find the frog.), and in the other trial: *Wo ist der Affe? Such mal den Affen*. (Where is the monkey? Find the monkey.).

6.1.5.2 Training phase

During the training on familiar verbs the child saw two different familiar actions with the same agent and patient performing the actions. Initially, the children watched a preview of the two events individually and they heard *Guck mal da*! (Look, there!) to familiarise them with the events they are going to see. These videos lasted five seconds. Then both screens remained blank for five seconds and the child heard depending on her condition either: *Der Frosch wird gleich den Affen waschen*. (The frog is going to wash the monkey.) [TRAINING] or: *Du wirst gleich waschen sehen*. (You are going to see washing.) [NO TRAINING]. While the child heard the sentence modelled in the future form the

centre light flashed three times. Afterwards the two different familiar events ran simultaneously on both screens for eight seconds and the child heard either: *Der Frosch wäscht den Affen. Der Frosch wäscht den Affen*. (The frog is washing the monkey.(x2)) [TRAINING] or: *Das heißt waschen. Das heißt waschen*. (This is called washing. (x2)) [NO TRAINING] while seeing on one screen the frog washing the monkey and on the second screen the frog feeding the monkey so that the child needed to use knowledge of the verb to identify the matching screen. Then the screens remained blank again for another five seconds and the child heard the sentence modelled in past tense: *Der Frosch hat den Affen gewaschen*. (The frog washed the monkey.) in the TRAINING condition and *Du hast waschen gesehen*. (You saw washing.) in the NO TRAINING condition and the centre light flashed again three times. Finally the both scenes appeared again simultaneously for eight seconds and the child heard either: *Der Frosch wäscht den Affen. Such mal waschen*! (The frog is washing the monkey. Find washing!) [TRAINING] or *Das heißt waschen. Such mal waschen*! (This is called washing. Find washing!) [NO TRAINING]. In a second familiar verb trial a different familiar verb was presented to the child (kissing or tickling) and the other animal (the monkey) was now the agent in both familiar actions (and the frog the patient). The procedure was the same as described above.

6.1.5.3 Test phase

During the test on novel verbs all children independent of training condition got the same two test trials in counterbalanced order. Following the procedure as described above for the training phase children saw a pair of different novel caused-motion events but now with reverse semantic roles, i.e., one screen depicted an event in which the frog was the agent and the monkey the patient and vice versa on the second screen.

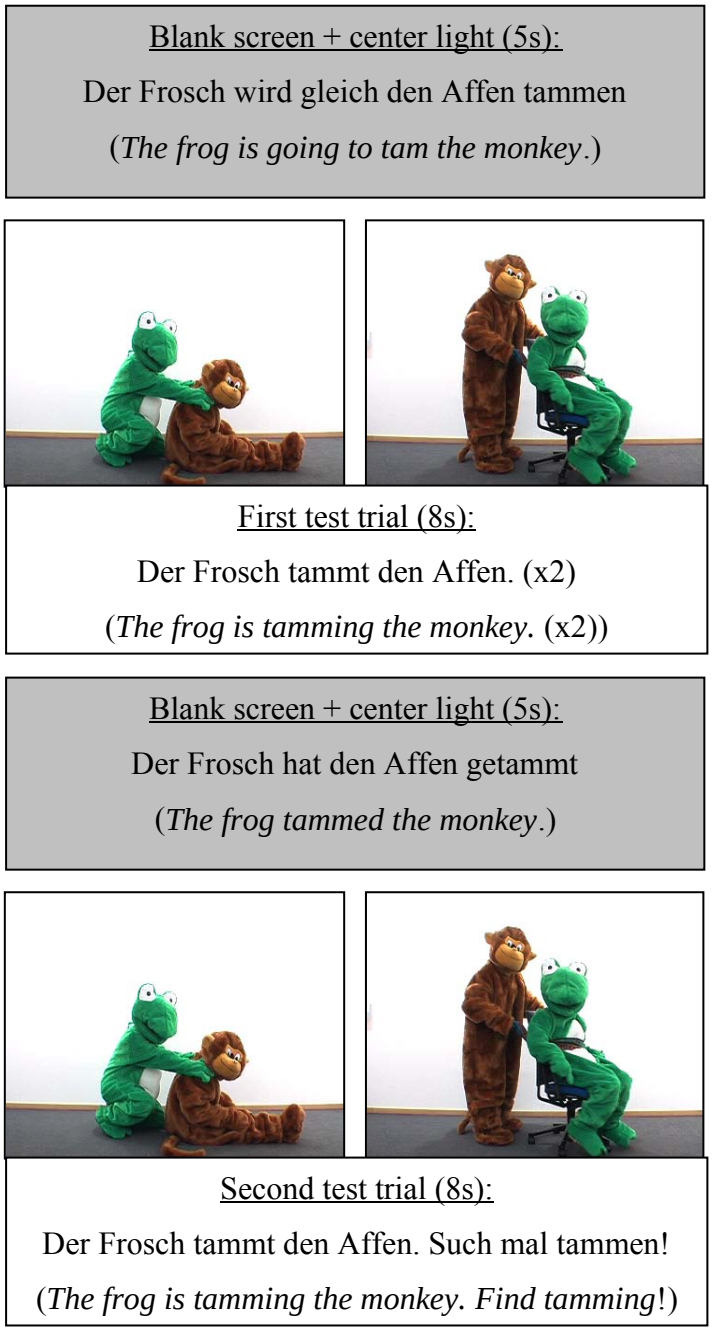


Figure 28: Procedure of test trials (study 4)

All children heard the novel verbs modelled in full transitive sentences with the frog and the monkey as participants of the event (see Figure 28, above). In the second test trial the children saw a different pair of novel caused-motion

events with again the frog and the monkey as agents and patients.

6.1.6 Counterbalancing

I counterbalanced within subjects the side of the matching screen (left vs. right), the direction of the action (50% of the trials the agent acted from the left to the right and 50% of the trials vice versa) and which animal was agent in the target event.

I counterbalanced between subjects the order of verb pairs within each phase, the order of which animal was agent first within each phase, which familiar action was target (50% of the children got washing and 50% feeding as the target action and the same for the familiar verb pair kissing and tickling) and which novel verb event was target so that I could be sure that the looking results could not be influenced by one scene being more salient than the other. However, I did not find any item effects at all.

6.1.7 Coding

The eight second trials were coded frame by frame (each frame = .04 seconds), in terms of whether the child looked to the left or to the right screen. All children were coded by myself, and a second coder coded 17% of the data for reliabilities with high agreement with me (Cohen's Kappa = .9850). I calculated the proportion of time spent looking to the matching screen, out of total looking time to the two screens. An individual trial was treated as missing if the child looked away for more than half of the trial or recording failed. Due to this reason I had to exclude 13 trials out of 480, these were two animal identification trials, eight familiar verb trials and 3 novel verb trials. Empty cells were filled up with 0.5 which is assumed to be chance level.

6.2 Results

I tested the proportion of total looking time of both groups (TRAINING and NO TRAINING) against chance and found that only the group of children who got the training on full transitive sentences with familiar verbs were able to perform above chance in the preferential looking task (mean = .55, $t(23) = 2.266$, $p < .05$) whereas the group of children who merely heard the familiar verb modelled in the citation form while watching the familiar transitive events did not show above chance looking in the novel verb test trials (mean = .51, $t(23) = .307$, n.s.). Similar to Gertner et al. (2006) I did not find any correlation between the children's performance in this task and vocabulary scores and also no group differences when comparing high and low vocabulary children.

Following Gertner et al. (2006) I wanted to know how quickly German children were able to detect a corresponding event when hearing a transitive sentence with a novel verb and therefore analyzed the proportion of looking to the matching screen in each two-seconds segment of the both test trials. The children who received the training on full familiar verb transitives showed a stronger preference for the matching screen than expected by chance during the last two-seconds (mean = .64, $t(23) = 2.876$, $p < .05$) but for the children who heard familiar verbs only in the citation form during training no above chance looking was found at any two-second segment (see Table 3). Furthermore, I was interested in whether the children showed a learning effect between the novel verb trials. Therefore I analyzed for order effects and found that the children in the TRAINING condition indeed showed above chance performance with the second novel item they were tested on (mean = .57, $t(23) = 2.552$, $p < .05$) but not with the first novel item. Children in the NO TRAINING condition did not show this order effect (see Table 4).

Table 3: Mean proportion of looking time to the matching screen during the test trials collapsed over both trials and both items (total look) and within each of the eight two-second-intervals of the first and the second trial (collapsed over both items)

		interval analysis							
		first trial				second trial			
condition	total look (both trials)	0-2 s	2-4 s	4-6 s	6-8 s	0-2 s	2-4 s	4-6 s	6-8 s
TRAINING	.**55***	.47	.50	.57	.52	.57	.54	.56	.**64***
NO TRAINING	.51	.43	.39	.60	.55	.50	.54	.57	.51

*significant above chance, $p < .05$

Table 4: Mean proportion of looking time to the matching screen during the test trials with the first novel item and the second novel item

condition	item 1	item 2
TRAINING	.52	.**57***
NO TRAINING	.51	.51

*significant above chance, $p < .05$

6.3 Discussion

The results of the current study were very clear. First, using a novel verb methodology almost identical to that of Gertner et al. (2006), I extended their English results to young children learning German. This is significant because German transitive sentences, as heard in normal child directed speech, provide different information about syntactic marking than do English transitive sentences. In approximately 21% of the transitive sentences that German children hear, the object/patient comes before the verb, and the subject/agent comes after the verb – with the only cue to syntactic role being case marking. In addition, another 11% have case marking that is ambiguous (because of homophonous forms), and so the only cue is word order (see section 4.2.6). What I presented to

children here was the prototype with both cues present, which they hear about two-thirds of the time. The basic finding was that 21-month-old German children also looked more to the matching screen in the Gertner et al. (2006) experimental paradigm, thus suggesting a quite young age of sensitivity to abstract, verb-general syntactic marking for a newly tested language.

However, the second finding was that for this experimental paradigm to work children had to undergo an initial practice/training phase in which they heard the same nouns they would later hear at test used for the same syntactic roles with the same syntactic marking (only with familiar verbs). Specifically, the current results were that when this practice/training phase was absent - that is, when a more neutral training phase exposing children to the general materials and methods of the study was used instead (language models comprising only verbs) - children did not look more to the matching video during the test phase. Moreover, even with the practice/training phase, children were only above chance in looking at the matching video with their second test verb. What these findings suggest is that the children did not come to the experiment with abstract syntactic knowledge of the type needed to succeed in the test, but rather they had to go through some kind of learning (or priming) period in which they had some additional linguistic experiences that somehow prepared them for the test.

There are two main types of possible explanations for how this additional linguistic experience in the practice/training phase facilitated children's performance: learning and priming. First, recall that the sentences used in the practice/training phase were identical to those used in the test phase except for the verb. During the practice/training phase when the child heard "the frog" in sentence-initial position, s/he also saw that it was the frog that was moving or acting because both events watched by the child on the two screens during that phase depicted the frog acting on the monkey – and so on for the other training

sentences in which the frog was the patient, the monkey was the agent, and so forth. The child learned these connections. Then later, in the test trial, the child saw the frog acting on the monkey again – this time on only one of the two screens. Hearing, for example, "the frog" again in sentence-initial position directed the child's attention again to the screen in which the frog is actor – based on having learned this connection in the practice/training phase. Furthermore, the noun in the sentence-final position might have directed the child's attention in particular to the patient during the practice/training phase. (This would apply also for Gertner et al.'s (2006) second and fourth study in which only the patient argument was available.) In this explanation, no syntactic knowledge is needed for children to succeed in the test, only the learning of the connection between sentence position and causal source during the practice/training phase. A related learning explanation is that the children actually learned the full transitive construction and its marking patterns from the practice/training phase. This seems unlikely, but not impossible as focused training with multiple exemplars close together in time can lead to learning of the transitive construction in children about six months older (albeit with many more exemplars: Childers & Tomasello, 2001; Abbot-Smith et al., 2004). However, for older children learning of novel constructions happens very rapidly as Casenhiser & Goldberg (2005) showed in their experiment with 4-year-olds who learned the meaning of a new construction after hearing only eight exemplars.

Also possible are priming explanations; that is, the basic idea is that children come to the experiment with some kind of syntactic knowledge which is somehow activated by the practice/training trials. In the Gertner et al. (2006) studies and the current study this priming could have been based at least partly on the particular nouns used, since, again, the same nouns were used in training and test. Or possibly the priming was of the transitive construction on a purely

structural level (so-called structural priming, Bock & Loebell, 1990), with the matching of the nouns across training and test being irrelevant. To test this possibility one would need to have a training phase with full transitive sentences with no lexical overlap to any of the test sentences. But this possibility is fairly unlikely because priming experiments of essentially this type – although with overt child utterances as the outcome measure – only find purely structural priming in children more than a year older than the children in these preferential looking studies (Huttenlocher et al., 2004; Savage et al., 2003).

One can also formulate a kind of hybrid account based on the insight that learning and priming may not be as different as is typically thought. Recent formulations of the usage-based account have employed an exemplar model in which children's syntactic abstractions are based on accumulating individual exemplars, in this case of transitive sentences of different kinds (e.g., Abbot-Smith et al., 2004; Abbot-Smith & Tomasello, 2006). In this account, children would begin abstracting from the beginning of meaningful linguistic experience based on patterns they discern in this linguistic experience, with the resulting representations becoming fully abstract only very gradually (see, for instance, McClure, Pine, & Lieven, 2006). Different experimental methodologies require children to have representations of different "strengths" - that is, abstractions based on different numbers of exemplars (Munakata et al., 1997) – so that, for example, preferential looking requires only fairly weak representations, whereas elicited production requires fairly strong representations. The current results would suggest that, in addition, the exposure children have to linguistic material immediately before they are tested could also have special importance in the acquisition process due to some kind of recency effect (see Chang, Dell, Bock, & Griffin, 2000; Bock & Griffin, 2000; Savage, Lieven, Theakston, & Tomasello, 2006 for the argument that priming is implicit learning).

It is important to note, however, that these results also suggest that much more needs to be done to work out the precise implications of varying methodologies and results in the preferential looking paradigm. Thus, mean proportion of looking time to the matching screen in the test conditions differed between the Gertner et al. (2006) study and my own: In my study children looked to the matching screen for a mean looking time of 55% which, although this is significantly better than chance, is not as high as the looking time of the children (70%), in Gertner et al.'s study 3. This study tested the same age group as mine (21-month-olds) but used different video stimuli in which real persons (boy and girl) acted instead of costumed ones. However, when Gertner et al. tested children using video stimuli in which persons in animal costumes performed the action, those children (aged 25 months) performed equally to mine and showed only 56% looking time to the target. In addition, I only found a significant looking preference in the last two seconds of the trial whereas Gertner et al.'s children's best performance was on the first two seconds. Finally my significant effect was on the second test item whereas Gertner et al.'s was present on the first test item. These differences could, of course, be due to the fact that I was testing German children using sentences marked for both case and word order. As noted above, it is possible that since neither of these is a perfect cue and they can sometimes conflict, it takes German children longer to become sensitive to them. However, it might also be the case that the preferential looking methodology per se is sensitive to many factors other than the linguistic stimuli (for instance, duration of trials, number of trials, and the video stimuli, e.g., persons in animal costumes or real persons). Therefore, much more needs to be done to interpret differences in the extent of these sensitivities and their time course.

What kinds of linguistic experience children need to perform well in different experimental assessments – including as a special case linguistic

experience in some training phase just prior to test – is an empirical question that may in fact have different answers for different specific syntactic constructions in different languages. There are thus many different practice/training phases that could be used to investigate precisely what information children of this age need during this initial phase to learn what they need to perform accurately in the test phase. For example, as noted above, one could use the Gertner et al. (2006) training materials but with different nouns/objects to see if perhaps they could attune to the transitive pattern just on the basis of hearing a number of transitive sentences of the type that they hear in their everyday linguistic interactions with others (structural priming). Or one could give them a practice/training phase with transitive sentences containing only pronouns, which, in English, would give them a practice with case marking – a different grammatical cue than in the test condition. This could either help or hinder them when encountering the test phase. Furthermore, using ambiguous pronouns (e.g, '*Sie wäscht sie*' (She is washing her.) in German or '*It is washing it.*' in English) in the practice/training phase would allow children to be trained on full transitive sentences but without giving them the possibility either to detect agent and patient or to learn grammatical marking in particular from the practice/training phase. In any case, the use of a practice/training phase presents the opportunity of exploring what kinds of immediate experience and/or learning contribute to children's syntactic competence as expressed in this preferential looking methodology.

It is important to recognize in all of this that there is no support for the radical theory that children have innate categories of subject and object and only need to link these to their particular language, on the basis of just one or a few exemplars, in order to have full syntactic competence. In both the usage-based account and rule-based account, children are constructing linguistic categories based on their linguistic experience in their particular language. The point of

contention is simply what kind of "head start" they have in the abstraction process in terms of general conceptual categories concerning transitive actions, semantic roles, and so forth (Fisher, 2002a). The current study contributes to this debate by helping to specify what kinds of linguistic experience are necessary for children to acquire and display their syntactic knowledge.

Chapter 7: Conclusion, general discussion and further directions

7.1 Summary of the results and comparison to other recent studies

With four experimental studies I investigated how children start to learn about identifying agents and patients in transitive sentences using word order and / or case marking cues. In study 1, I tested 2;1-year-old and 2;6-year-old German and English children as to whether they can correctly assign agents and patients to prototypical transitive sentences which either contained familiar or novel verbs using a pointing paradigm. The children of both languages and age groups correctly interpreted transitive sentences if these contained familiar verbs. But when the younger two year olds were confronted with novel verb transitives, they had problems assigning agents and patients correctly. Thus, they showed clear verb specific behaviour (Tomasello, 2000, 2003). In contrast, the 2;6-year-old English and German children were able to explicitly identify agents and patients of transitive sentences even if they heard a sentence with a novel verb. They have thus acquired a more general knowledge about the transitive construction.

In study 2 and 3, I tested when German children start to understand the two grammatical cues case marking and word order independently of each other. In these studies I presented to the children (a.) prototypical transitive sentences as in study 1, (b.) sentences which contain only word order as the exclusive grammatical cue (as for the English children in study 1), and (c.) sentences in which case marking and word order conflict. All sentences contained only novel verbs. The children had to either act out the sentence (study 2) or to point to the corresponding scene of the sentence (study 3). 2;6-year-olds were able to correctly assign agents and patients only to the prototypical sentences and only when they participated in the pointing task and not when they had to act out the sentence. Thus, their knowledge about the transitive construction still seems to be easily disrupted when they have to do a more complicated task than pointing. 4;10-year-

olds could interpret correctly all sentences which followed the canonical German word order, however, they had problems interpreting correctly sentences in which word order and case marking conflict. The children performed equally well independently of which task (act out or pointing) was used. Some children actually weighed word order more than case marking and thus overgeneralized this grammatical cue. Only, at seven years of age most – but not all – of the German children relied on case marking over word order as German adults would do if they are asked to assign agent and patient roles to transitive sentences in which case marking and word order conflict.

In study 4, I investigated whether German children younger than two (21-month-olds) are able to detect the corresponding scene to prototypical transitive sentences with novel verbs in a preferential looking paradigm. They indeed looked longer to the correct scene when they received previously a special training on familiar verb transitives. The same holds true for English speaking 21-month-olds (Gertner et al., 2006). However, the German children did not look longer to the corresponding scene without the previous training.

Thus, the developmental picture of the acquisition of the transitive construction might be as follows (see Figure 29): English as well as German children first correctly interpret agents and patients in sentences which contain familiar verbs. They can show this knowledge very early in preferential looking (with 17 months, see Hirsh-Pasek & Golinkoff, 1996b, experiment 3) but at 25 months also in a pointing task. As they also use familiar verb transitives very early in their spontaneous speech (e.g., Pine et al., 1998; Tomasello, 1992) one can assume that English and German children indeed go through a stage of verb specific knowledge of agents and patients (e.g., knowledge that the hitter comes before the verb hit and the hittee afterwards, see Tomasello, 2000). This verb specific knowledge appears to exist previously to the development of an abstract

syntactic knowledge of the transitive construction (e.g., the knowledge about word order and case marking).

Abstract syntactic knowledge of the transitive construction might begin at the end of the second year of life and is at first not more than a weak representation of it which helps children to detect a corresponding scene to a transitive sentence they hear. However, the representation is so weak, that children can show their knowledge only in preferential looking with a particular type of previous training. Around two and a half years of age this knowledge manifests itself and children can explicitly decide who is doing a particular action to whom using the abstract syntax of a transitive sentence. However, children's knowledge can still be easily disrupted by task demands (e.g., act out instead of pointing) or when the transitive sentences do not follow the prototypical grammatical sentence structure. Therefore, German children of this age need to be provided with more than just the word order cue. They need at least two converging grammatical cues, here case marking and word order, to interpret correctly agents and patients of a transitive sentence whereas for English children around two and a half the word order cue alone is sufficient.

There are still big gaps in the picture (Figure 29) of the development of transitive sentences. One occurs between the ages of 2;6 and five and opens up the question how children come from comprehension of sentences with multiple cues first to the understanding of single cues and later to the understanding of conflicting cues. A second gap occurs earlier around the second birthday when children come from verb specific behaviour to showing some abstract knowledge of the transitive construction. In the following sections I will try to shed light on these two not very well understood developmental stages using ideas from the prototype account.

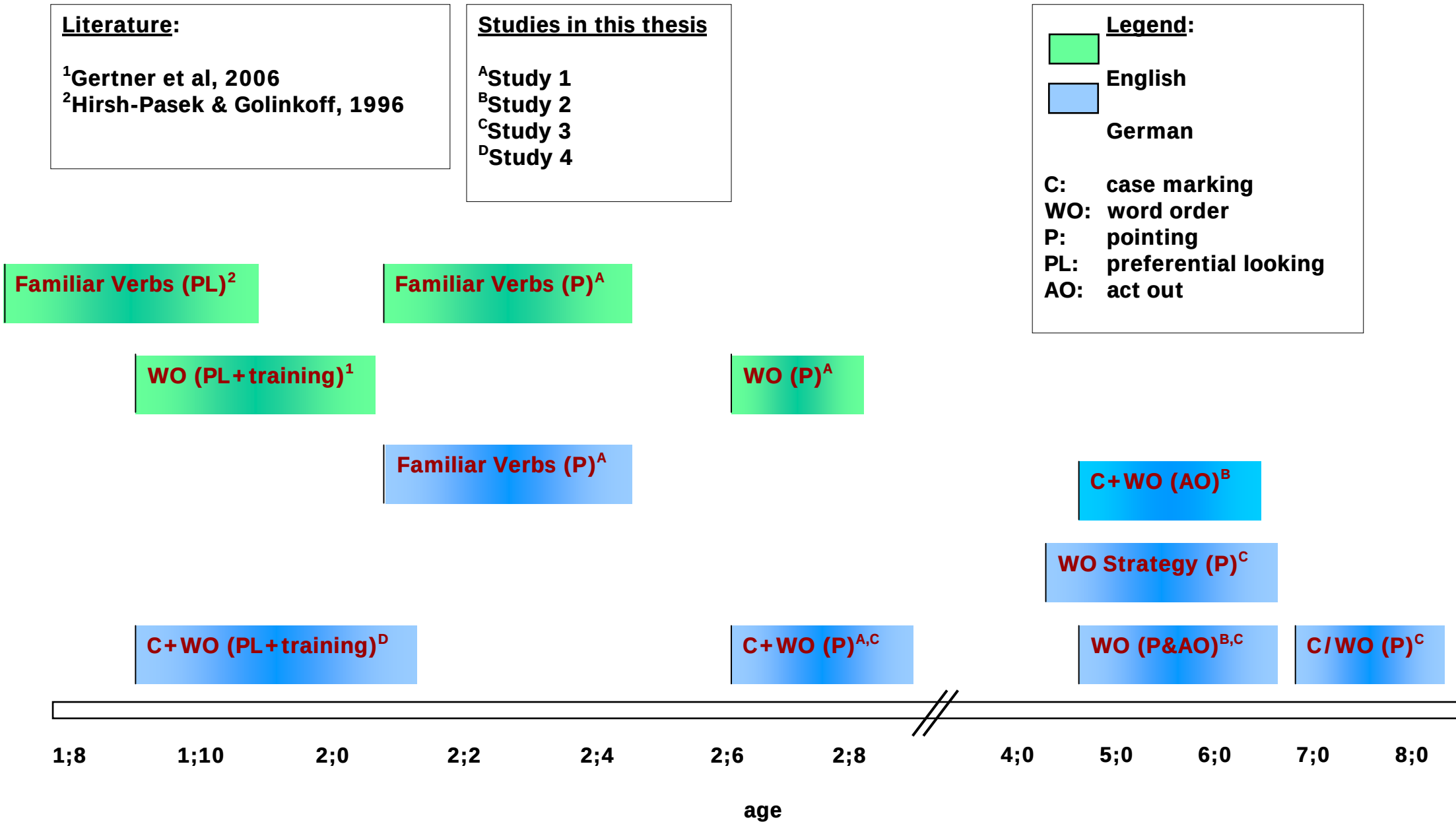


Figure 29: Development of comprehending transitive sentences

7.2. The role of prototypes in the acquisition of the transitive construction

The notion of prototypes was introduced into the categorization literature by Rosch and colleagues (e.g., Rosch & Mervis, 1975). In their account they define a category not only by a set of necessary features but rather they assign a graded structure with "fuzzy boundaries" to a category in which some members play a privileged role and are more prototypical than others. Thus, prototypes are central elements or best examples of an idealized semantic or perceptual category. A prototypical bird, for instance, is one that shares the most features with other birds and is maximally distinct from non birds: A sparrow would be a very prototypical bird, an ostrich clearly not. However, some birds are in between. A duck is more prototypical than an ostrich but not as much as a sparrow. Prototypes help to describe and to relate other members to the category. Prototypical elements of a category are acquired earlier and are more rapidly available to participants in experiments than peripheral or questionable members (Rosch, 1973).

Similarly, in language we find more and less prototypical clauses. The transitive construction, for instance, means prototypically that a volitional animate actor affects an inanimate patient in which both have contact to each other (Goldberg, 1995; Hopper & Thompson, 1980). A structure that phrases this meaning, i.e., two noun phrases that describe the two participants, will be more prototypical than a structure with only one noun phrase due to subject or object omission. Lakoff (1987) applied the notion of prototype to both lexical semantics and grammatical construction and claimed that we must attend not only to the function but also to the linguistic form of a particular grammatical construction. This idea was continued by Goldberg (1999; 2006) saying that also a given form often has a prototypical meaning. Early in acquisition children, for instance, apply

mostly the meaning "*give*" to the ditransitive construction and only later to other verbs until they assign a more general transfer meaning.

Thus, we can assume, that a prototypical transitive construction, on the one hand, has a prototypical meaning, i.e., an (animate) agent intentionally instigating an action that directly affect the (inanimate) patient with the two participants of this action being maximally semantically distinct in terms of their roles. This results, on the other hand, in the grammatical form of a prototypical transitive construction. As said above, two noun phrases are needed to express the two semantic roles. Further, to clearly distinguish agent and patient they should be marked by their proper markers (e.g. in German, nominative and accusative case, the subject showing agreement with the verb but not the object and a subject-before-object word order). Therefore, more prototypical constructions are marked redundantly with multiple cues (see the coalitions-as-prototypes approach by Bates & MacWhinney, 1987). However, Ibbotson and Tomasello (2009) claimed that early in development when the type/token ratio is low, the prototype will be closer to the most frequent item. Only when the type/token ratio increases with more instances of the category, the average will stabilize and the prototypical form of the transitive construction will become entrenched. This conforms also with the idea that prototypes are derived from high frequency exemplars (e.g., Goldberg, 2006; Taylor, 1998).

Thus, frequency and redundant (maximally) marking might play very different roles in language acquisition. In the following sections I want to address the question of whether cue redundancy or frequency is the aspect which helps children during language learning.

7.2.1 Redundant and conflicting information in the acquisition of the transitive construction

As noted above and shown in figure 29 there are still two gaps with open questions in the developmental picture of the transitive construction. Work by Chan, Lieven & Tomasello (2009) addresses the first question of how children come from comprehension of sentences with multiple cues first to the understanding of single cues and later to the understanding of conflicting cues to some extend. They tested German, English and Cantonese children on transitive sentences which contained the two cues ***word order*** and ***animacy contrast*** to mark agents and patients. They showed that 3;6-year-olds of all three languages – also the German children – preferred the word order cue over animacy contrasts, i.e. the children largely chose the first noun of the sentence as the agent independently of whether it was animate or inanimate. This is interesting insofar as the majority of the 3;6-year-old German children chose the first noun even when it was inanimate. Thus, knowledge about word order also develops in German children well before the fifth birthday and it is strong enough to win over the assumption that agents must be animate. Here it would be very interesting to test 3;6-year-olds on transitive sentences in which case marking and word order conflict to see whether German children of this age generally weigh word order over all other grammatical cues. I would expect this, because the slower developing 4;10-year-olds (with lower morphology scores) in study 3 of this thesis showed this overgeneralization of the word order cue.

Chan et al. (2009) also presented transitive sentences with animate agents and inanimate patients (e.g., *the horse is tamming the present*) to the children, i.e., sentences in which two cues (word order and animacy contrast) support each other in identifying agents and patients. This kind of sentence could be comprehended correctly even by the youngest tested age group (2;6-year-old) of German children. Thus, German 2;6-year-olds do <u>not</u> need an additional case marking cue

to identify the first noun as the agent, but they get the same information from animacy supporting the word order cue. Nevertheless, these children show that they do not rely solely on animacy, because when presented with conflicting cues they do not always rely on the second (animate) noun to be the agent. In study 3 of this thesis I found a similar phenomenon: The 2;7-year-old children did not rely solely on case marking when presented with conflicting case marking and word order information although case marking was an important cue in addition to word order to understand transitive sentences. Table 5 summarizes the results of Chan et al. (2009) and Dittmar, Abbot-Smith, Lieven & Tomasello (2008, study 3 of this thesis).

Thus, it might not be so important which cues are presented to 2;6-year-old children but rather the number of redundant (supporting) cues is important (one cue in addition to the word order cue). Here it would be very interesting to test whether children of 2;6 are also able to rely on subject-verb agreement in addition to word order. If so, this could mean that (German) children of 2;6 years of age generally know about all four possible agent markers (animacy, case, word order and agreement) but still are not able to use them individually maybe because of only weak representations of the cues. They need the information of each summed up at least with the information of a second one to identify agent and patient of a transitive sentence. Further interesting evidence for this comes also from Chan's study which showed also that the English 2;6-year-olds who can already rely solely on word order (78% first noun choices) perform even better, when they get sentences with an additional animacy cue (86% first noun choices, Chan et al., 2009).

This conforms with a study by Abbot-Smith, Lieven and Tomasello (2008) who ran an elicited production study with German and English 2;4-year-olds who heard transitive sentences describing causative scenes which were 'weirdly'

linked so that the patient was the first noun (and marked with nominative in the German sentences).

Table 5: Comparison of cue competition studies, focusing on the acquisition of the transitive construction (only novel verb studies)

age	condition	cues	language	Reliance on 1st noun	notes
2;6	redundant cues	case + word order	German	76%*	both cues assign agency to the 1st noun → children understand correctly the transitive
		animacy + word order	*German*	*71%**	
			English	*86%**	
	conflicting cues	case / word order	German	54%	children do not show any preference for one of the 2 cues → they answer randomly
		animacy / word order	*German*	*57%*	
			English	*58%*	
3;6	*redundant cues*	*animacy + word order*	*German*	*88%**	
			English	*98%**	
	conflicting cues	*animacy / word order*	*German*	*79%**	children rely on word order over animacy (no data from case / word order)
			English	*97%**	
4-5	redundant cues	case + word order	German	88%*	
		animacy + word order	*German*	*96%**	
			English	*100%**	
	conflicting cues	case / word order	German	65%	individual differences: some children still overgeneralize word order, some weigh case more than word order
		animacy / word order	*German*	*95%**	reliance on word order over animacy
			English	*97%**	

*significant above chance, data in italics is originated from Chan et al. (2009)

They argue that the relative speed with which an initially weak constructional representation will strengthen depends on the number of syntactic cues which collaborate in indicating the same semantic role. German 2;4-year-olds produced correctly linked transitives significantly more often than did their English

contemporaries. Thus, redundancy of cues appears to be a very important factor in the acquisition of transitive sentences (Shady & Gerken, 1999; Christiansen & Monaghan, 2006; but see also the Coalition Model by Hirsh-Pasek & Golinkoff, 1996b; and the coalitions-as-prototypes account by Bates & MacWhinney, 1987).

7.2.2 High frequency exemplars in the acquisition of the transitive construction

Closely related to the last section on the importance of redundant information in the acquisition of the transitive is the question how high frequency exemplars of the transitive construction influence children's comprehension of agents and patients. Therefore, to identify the nature of the actual prototypical transitive constructions in German child directed speech, I will analyse the frequencies of the different patterns. As I already showed in the input analysis (chapter 4 of this thesis), it happens very rarely that word order and case marking appear together and are the only cues to semantic role interpretation. Thus, usually the child gets more than two grammatical cues in a transitive sentence. Table 6 shows how the number of cues is distributed in German transitive sentences in child directed speech.

Table 6: Distribution of number of cues in transitive sentences in German CDS

Number of cues in the transitive sentence	**% of all transitive sentences**	
3 supporting cues, no conflicting cue	31%	**75%**
4 supporting cues, no conflicting cue	30%	
3 supporting cues, 1 conflicting cue	14%	
2 supporting cues, 1 conflicting cue	9%	
2 supporting cues, no conflicting cue*	9%	
1 cue alone*	4%	
2 conflicting cues*	3%	

*Patterns tested in study 3 of this thesis

It reveals that a German child mostly hears transitive sentences with at least three supporting cues (75% of all transitive sentences they hear in the input).

Table 7: Prototypicality of transitive sentences patterns in German CDS

frequency rank (prototypicality)	cue pattern	% of all transitive sentences
1.	AGR + WO + ANI + CM Der Mann trägt die Kisten. (The$_{nominative}$ man carries the boxes.)	30%
2.	WO + ANI + CM Der Mann trägt die Kiste. (The$_{nominative}$ man carries the box.)	14%
3.	AGR + ANI + CM / WO Die Kisten trägt der Mann. (The boxes carries the$_{nominative}$ man.)	13%
4.	AGR + ANI + CM Der Mann trägt (fragment sentence). (The$_{nominative}$ man carries.)	9%
5.	ANI + CM / WO Die Kiste trägt der Mann. (The box carries the$_{nominative}$ man.)	7%
6.	AGR + CM + WO Der Mann trägt die Kinder. (The$_{nominative}$ Mann carries the children.)	7%
7.	ANI + WO* Die Frau trägt die Kiste. (The woman carries the box.)	6%
9.	CM + WO* Der Mann fängt den Jungen. (The$_{nominative}$ man catches the$_{accusative}$ boy)	2.5%
14.	WO* Die Ziege tritt die Kuh. (The goat kicks the cow.)	0.7%
15.	ANI / WO* Die Kiste trägt die Frau. (The box carries the woman.)	0.7%
16.	CM / WO* Den Jungen fängt der Mann. (The$_{accusative}$ boy catches the$_{nominative}$ man.)	0.5%

Only the 6th most frequent patterns of transitive sentences in German CDS and the patterns tested in novel verb competition model studies (*) are listed here (AGR = subject-verb agreement, WO = word order, ANI = animacy contrast, CM = case marking)

Thus, a common German transitive sentence comprises at least three different cues to semantic role identification. A further more detailed look into the data, i.e., which cues in particular appear mostly together in German child

directed speech transitive sentences, shows, that usually even all four cues go together in a transitive sentence. The most common patterns are presented in Table 7 above.

As shown, the sentence patterns which have been tested so far in novel verb competition model studies (Dittmar et al., 2008; Chan et al., 2009) are very low in frequency and therefore actually far away from being 100% prototypical. The coalitions-as-prototypes approach (Bates & MacWhinney 1987, 1989) suggests that prototypes are in particular formed when several forms map redundantly on a single function, i.e., when cues support each other. On the other hand, assuming that early in development prototypes are derived from high frequency exemplars (Ibbotson & Tomasello, 2009; Goldberg, 2006), prototypical German transitive sentences can also contain conflicting information. Sentences which contain animacy contrasts, case marking and subject-verb agreement as converging cues conflicting with word order are more frequent in German than sentences that contain only case marking, agreement and word order as supporting cues (compare line 3 and 6 in Table 7). Therefore, we need more studies which test explicitly whether prototypicality based on frequency or redundancy of information or both is the factor which eases comprehension and language acquisition.

However, a particular cue pattern is not the only requirement to make a transitive sentence prototypical. Generally objects tend to be inanimate and subjects tend to be given referents (e.g., Mak, Vonk, & Schriefers, 2006; Du Bois, 1987). This conforms with the input analysis in chapter 4 which shows that agents of transitive sentences are mostly expressed by personal pronouns assigning humans such as *ich* (I), *du* (you) and *wir* (we), whereas patients are more often marked with demonstrative pronouns assigning objects such as *das* (that). Thus, sentences which show the contrast between a personal pronoun in subject position

and a demonstrative pronoun in object position are more prototypical than sentences which contain full noun phrases (determiner + noun) as subjects and objects.

All these points can help to answer what happens around the second birthday (the second and earlier big gap in Figure 29, above) when children come from verb specific behaviour to showing some abstract knowledge of the transitive construction. So far the tested transitive constructions were very low in prototypicality which might be the reason for the observed late acquisition. Novel verb competition model studies with pronouns as well as studies with transitive sentences with more than just two cues could yield new results.

7.4 The acquisition of the transitive construction and the competition model

The competition model proposes that language acquisition, in particular the comprehension of linguistic cues to semantic role interpretation, is influenced by statistical properties of these cues, such as cue reliability, cue availability and cue validity (e.g., Bates & MacWhinney, 1987). Many studies have shown that children and adults rely more on cues which have higher cue validity values than on cues with low cue validity (e.g., MacWhinney et al., 1984). However, these studies are usually done in a cross-linguistic framework, i.e., they compare the behaviour of different language speakers, yielding results such as, that English children and adults rely more on word order than Turkish children and adults, because word order in English is a more valid cue than in Turkish (Slobin, 1982; Slobin & Bever, 1982). Studies which are carried out within one language but with different age groups found that the particular aspects of cue validity which children follow appear to change over development (Sokolov, 1988; McDonald, 1986). Initially in language development cue availability plays a stronger role in sentence interpretation whereas older children and adults rely more on cue

reliability. Further, adult cue usage corresponds to conflict sentence validity instead of overall cue validity, as defined by Bates and MacWhinney (compare also section 2.2.3). Table 8 shows a ranking of the four statistical properties of cues to transitive sentence interpretation in German child directed speech, extracted from the input analysis in chapter 4, in particular from the sections 4.2.5 and 4.2.6.

Table 8: Ranking of grammatical cues in German CDS concerning their statistical properties

Cue availability:	WO > ANI & CM > AGR
Cue reliability:	CM & ANI & AGR > WO
Cue validity:	ANI & CM > WO & AGR
Conflict validity:	CM > ANI > AGR > WO

(A cue is assigned to be "bigger as" (>) in availability, reliability or validity when it is at least 10 % higher in their value than the other cues)

This table shows that calculating cue availability, reliability and validity does not always result in clearly distinguishable differences between the single cues. For instance, the reliability value of the three cues case marking, animacy and subject-verb-agreement is very similar in German child directed speech so that reliability does not predict cue use very well. Similarly, the cue availability and cue validity of animacy and case marking does not show sufficient difference to make predictions as to which cue might be learned earlier (cue availability) or weighed more in comprehension (cue validity). Therefore, these statistical properties are not always very helpful and it is very hard to tell which is the one that has most influence on language acquisition. However, analyses of the statistical properties of cues to agent identification in other languages than German might bring clearer results.

For German it is the concept of conflict validity (McDonald, 1989, 1986, 1987) that reveals the most explicit differences between the four cues to agent

identification. However, study 3 of this thesis has shown that children at five years of age still do not rely on case marking over word order and therefore are not geared to conflict validity values. Thus, conflict validity makes predictions about language use of older children and adults but not about early language acquisition. For young children availability might be the best statistical value to predict cue use. Both, Dittmar et al. (2008, study 3 in this thesis) and Chan et al. (2009) showed that young children tend to overgeneralize word order over case and animacy. Here we also need studies on subject-verb-agreement. If young children really focus on cue availability they should ignore agreement when it conflicts with word order or case marking because it is much lower in its availability.

7.5 Different methods and graded representations

In my four experiments I used different methods to find out about young children's knowledge of word order and case marking cues: German 21-month-olds were tested with preferential looking and showed a weak understanding of transitive sentences after a training phase on familiar verb transitives. 25-month-olds who participated in a pointing experiment without previous training did not show such knowledge. I found a similar effect of different methods within the group of 30-month-olds who could correctly identify agents and patients in a pointing paradigm but not when ask to act out a particular transitive sentence. These results fit well with the ***graded representations theory*** of syntactic development (Abbot-Smith & Tomasello, 2006). Their account follows from usage based theories which assume that the basic level units of grammar are sentence types or constructions (e.g., Goldberg, 2006). They claim that the syntactic representations are graded in strength, depending on the amount of relevant input exposure. Thus, as the child processes sentence pairings such as

"The boy kicked the dog" and "Peter threw the ball", these stimulate similar activation patterns because of their similarities both in terms of meaning and sentence form. When the child has only learned a small number of exemplars, it will not yet be obvious which semantic and distributional features are crucial because there will not yet have been enough overwriting of more idiosyncratic elements. This would predict that initially sentences with familiar verbs should be much easier to comprehend (and produce), because they show the greatest degree of relational similarity to previously learned exemplars. However, that does not mean that the child has no access to a more abstract, verb general representation at this stage. The exemplars are stored in a similar fashion, so the presentation of a novel utterance which shares crucial similarities with this category of sentence-scene exemplars will activate the group as a whole and consequently also the more abstract category which is basically the sum of these similarities (Shanks, 1997).

Strong representations allow 'clean' signalling to the rest of the cognitive system, allowing successful performance even in tasks which burden executive functions (act out, pointing for younger children). Weak representations can be accessed to support behaviour which does not burden executive functions, such as looking or pointing for older children.

Not only which kind of task (looking, pointing or production) is used plays a role but especially preferential looking studies are easily influenced by the stimuli presented to the children. As already said above, using two different actions appears to make the looking task easier than showing the same action on the two screens. Further evidence comes from the fact that Gertner et al. (2006) changed their stimuli from "bunny acting on duck" to "girl acting on boy" when they tested a younger age group. This increased the agentivity of the agent participant (human instead of animal). That the children can identify the matching

event of a transitive construction only with particular semantic roles indicates that the knowledge about the transitive construction in these young children (21 months) is not very robust.

The robustness of syntactic knowledge in children before and around their second birthday is a very interesting question for future research. One way to investigate this would be to vary the types of training stimuli in preferential looking paradigms. So far 21-month-old English- and German speaking children who get lexically identical training and test sentences, that is, are trained on "The frog is washing the monkey" and tested on "The frog is tamming the monkey.", can identify the matching event of a transitive sentence although it contains a novel verb. In contrast, German children who are trained on causative events but with neutral linguistic stimuli such as "This is called washing" cannot find a matching event of a novel verb transitive. A new interesting condition to test would be to train children for instance on familiar verb transitive sentences but with different animals performing these actions as in the test trials. Then there would be a structural but no lexical overlap between training and test. When trained on sentences such as "The cat is washing the dog" the children might be able to map between the preverbal noun phrase and the acting animal in the scene. This could help the children to do the mapping also in the test. This mapping possibility could be neutralized if we trained children on sentences with ambiguous pronouns in subject and object position (*It's washing it.*). Testing children under different training conditions could help to improve the picture of children's earliest syntactic competence.

However preferential looking as a method to measure knowledge has to be viewed somewhat critically because as a group the children can look at the mismatching screen 40% of the time but still pass the test (Gertner et al., 2006; Dittmar et al., 2008). Clearly, to correctly comprehend or produce a sentence in an

adult-like manner, however, children have to decide in favour of either one or other interpretation. This is the reason why a computational model of adult sentence production can capture the fact that success in elicited production lags behind success in preferential looking studies (Chang, Dell & Bock, 2006). Therefore, future research should also focus on active behavioural methods. For instance, the pointing paradigm as used in study 1 and 3 of this thesis is well suited to varying different training and test stimuli as suggested above for the preferential looking paradigm. Thus, running study 1 of this thesis again with the 2;1-year-olds but showing them two different actions in the test trials or training them before on the transitive construction might bring positive results also in a pointing task.

7.6 Conclusion

This thesis shows the different stages that children pass through when acquiring the transitive construction, i.e., how they learn to correctly identify agents and patients in transitive sentences. They go step by step through weak and verb specific representations to more abstract ones. But to understand the correct meaning of abstract transitive sentences young children still need multiple grammatical cues. Prototypicality and redundancy of information play a role for a long time until children reach adult linguistic competence. There is no evidence for a sudden and abstract acquisition as proposed by linguistic nativists. The results of this thesis can thus be interpreted as converging evidence for the usage-based approach to language development.

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Appendix

Appendix A: Test sentences used in study 1*

a. with familiar verbs:

English stimuli	German stimuli
The lion is pushing the bear.	*Der Löwe schubst den Bären.*
The monkey is washing the bunny.	*Der Affe wäscht den Hasen.*
The elephant is brushing the dog.	*Der Elefant kämmt den Hund.*

b. with novel verbs:

English stimuli	German stimuli
The dog is weefing the lion.	*Der Hund wieft den Löwen.*
The bear is tamming the elephant.	*Der Bär tammt den Elefanten.*
The frog is baffing the monkey.	*Der Frosch bafft den Affen.*

Appendix B: Test sentences used in study 2*

a. Prototype condition

Der Hund wieft den Löwen.

(The$_{masculine\cdot nomiative}$ dog is weefing the$_{masculine.accusative}$ lion.)

Der Bär tammt den Elefanten.

(The$_{masculine\cdot nominative}$ bear is tamming the$_{masculine.accusative}$ elephant.)

b. Word-order-only condition

Die Katze wieft die Ziege.

(The$_{feminine}$ cat is weefing the$_{feminine}$ goat.)

Das Schwein tammt das Zebra.

(The$_{neuter}$ pig is tamming the$_{neuter}$ zebra.)

c. Conflict condition

Den Tiger wieft der Bär.

(The$_{masculine.accusative}$ tiger is weefing the$_{masculine.nominative}$ bear.)

Den Hasen tammt der Frosch.

(The$_{masculine.accusative}$ bunny is tamming the$_{masculine.nominative}$ frog.)

d. Familiar verb condition

Der Tiger schubst den Hund.

(The$_{masculine\cdot nomiative}$ tiger is pushing the$_{masculine.accusative}$ dog.)

Appendix C: Test sentences used in study 3*

a. Prototype condition

Der Hund wieft den Löwen.

(The$_{masculine\cdot nomiative}$ dog is weefing the$_{masculine.accusative}$ lion.)

Der Bär tammt den Elefanten.

(The$_{masculine\cdot nominative}$ bear is tamming the$_{masculine.accusative}$ elephant.)

Der Frosch bafft den Affen.

(The$_{masculine\cdot nominative}$ frog is baffing the$_{masculine.accusative}$ monkey.)

b. Word-order-only condition

Die Katze wieft die Ziege.

(The$_{feminine}$ cat is weefing the$_{feminine}$ goat.)

Das Schwein tammt das Zebra.

(The$_{neuter}$ pig is tamming the$_{neuter}$ zebra.)

Das Schaf bafft das Pferd.

(The$_{neuter}$ sheep is baffing the$_{neuter}$ horse.)

c. Conflict condition

Den Tiger wieft der Bär.

(The$_{masculine.accusative}$ tiger is weefing the$_{masculine.nominative}$ bear.)

Den Hasen tammt der Frosch.

(The$_{masculine.accusative}$ bunny is tamming the$_{masculine.nominative}$ frog.)

Den Hund bafft der Elefant.

(The$_{\text{masculine.accusative}}$ dog is baffing the$_{\text{masculine.nominative}}$ elephant.)

*Half of the children heard the sentences with reversed agent and patient

Appendix D: Novel and familiar actions and apparatuses used in Study 1, 2 and 3

D.1 Novel verbs

a. to tam / tammen

b. to weef / wiefen

c. to baff / baffen

D.2 Familiar verbs

a. to push / schubsen

b. to wash / waschen

c. to brush / kämmen

Appendix E: Visual stimuli in Study 4

E.1 animal identification task

a. Affe (monkey)

b. Frosch (frog)

E.2 familiar actions

a. kitzeln (to tickle)

b. küssen (to kiss)

c. waschen (to wash)

d. füttern (to feed)

E.3 novel actions

a. wiefen 1

b. wiefen 2

c. tammen 1

d. tammen 2

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Anhang zur Dissertation

Zusammenfassung der Ergebnisse

In der vorliegenden Dissertation geht es um den frühen Syntaxerwerb. Im Speziellen gehe ich der Frage nach, wie Kinder transitive Sätze interpretieren und den beiden Argumenten (den Nominalphrasen) im Satz die jeweilige korrekte semantische Rolle zuordnen, d.h. welcher Teilnehmer einer kausalen Handlung das Agens, also der Handelnde, ist und welcher das Patiens, also derjenige mit dem etwas passiert. Um dazu in der Lage zu sein, müssen Kinder gelernt haben, welche grammatischen Formen, z.B. die Kasusmarkierungen oder die Wortstellung im Satz, welche semantische Rolle beschreibt.

Wie diese Verknüpfung zwischen Form und Funktion vonstatten geht, ist ein stark umstrittenes Feld im Spracherwerb. Hier stehen sich nativistische Theorien, die annehmen, dass Syntax per se angeboren ist (Chomsky, 1957; Pinker, 1984), und Theorien, die annehmen, dass sich Sprache aus der Mutter-Kind Interaktion entwickelt ('Usage-based approach' z.B. von Tomasello, 2003) gegenüber.

In meiner Doktorarbeit werden vor allem verschiedene Forschungsansätze des ’Usage-based approach’ untersucht, d.h. im genauen, welche Rolle der sprachliche Input, den ein Kind bekommt, spielt und inwieweit frühe Äußerungen der Kinder lexikalisch spezifisch sind und diesen Input widerspiegeln.

Im Rahmen des ’Usage-based approach’ wird angenommen, dass sich Sprache aus ihrer Anwendung heraus entwickelt. Kinder geben ihrer Sprache eine Struktur, indem sie die Sprache, die sie tagtäglich hören, analysieren und daraus Schemata ableiten. Wie Kinder nun genau diesen sprachlichen Input nutzen und statistisch analysieren, damit beschäftig sich das Wettbewerbsmodell (‚Competition Model’) von Bates & MacWhinney (1987). Dieses Modell basiert auf der Annahme, dass Kinder grammatische Hinweise (‚cues’) im Satz zuerst

erlernen, wenn deren Validität (‚cue validity') sehr hoch ist. Das sind grammatische Hinweise (z.B. Kasusmarkierung oder Wortstellung), die zum einen sehr häufig im Input vorkommen (‚cue availability') und zum anderen ihre grammatische Funktion sehr verlässlich markieren (‚cue reliability'). Validitäten von grammatischen Hinweisen unterscheiden sich crosslinguistisch. So ist zum Beispiel die Wortstellung im Englischen ein sehr verlässlicher Hinweis auf das Agens (immer die erste Nominalphrase im Satz), wohingegen sie im Deutschen nicht so sehr verlässlich ist, da es auch Sätze gibt, die mit dem Patiens (Objekt) beginnen. Experimente im Rahmen des Wettbewerbmodells haben gezeigt, dass sich Kinder, die eine bestimmten Sprache lernen, tatsächlich an den häufigsten und verlässlichsten grammatischen Hinweisen ihrer Sprache orientieren und diese zuerst erlernen (z.B., Bates et al., 1984; Bates, McNew, MacWhinney, Devescovi, & Smith, 1982; MacWhinney et al., 1985). Alle diese Studien wurden jedoch mit transitiven Sätzen durchgeführt, deren Verben den Kindern wohl bekannt waren (z.B., mit "to push" / „schubsen"), so dass es nicht klar ist, ob das Wissen der Kinder über die getesteten grammatischen Hinweise nicht eng mit diesen spezifischen Verben verbunden ist (siehe unten Abschnitt über die Verb-Insel Hypothese) und ein generelles Wissen über diese grammatischen Hinweise im Satz nicht eventuell viel später erworben wird. Ein Hinweis darauf geben drei Studien zum Wettbewerbmodell mit deutschen Kindern, die jeweils verschiedene bekannte Verben in ihren transitiven Sätzen verwendet haben und deren Ergebnisse sich darin unterscheiden, in welchem Alter Kinder diese Sätze richtig interpretieren (Mills, 1977; Primus & Lindner, 1994; Schaner-Wolles, 1989). Weiterhin wird beim Wettbewerbsmodell angenommen, dass Kinder z.B. transitive Sätze früher interpretieren können, wenn der Satz einem prototypischen transitiven Satz in der jeweiligen Sprache entspricht. Prototypische transitive Sätzen sind solche, bei denen möglichst viele grammatische Hinweise

„zusammenarbeiten“. In einem deutschen Satz wie z.B. „Der Bär schubst den Frosch.“ weisen zwei grammatische Hinweise (Kasus und Wortstellung) im Satz darauf hin, dass die erste Nominalphrase (der Bär) Agens ist und die zweite Nominalphrase (der Frosch) Patiens der Handlung ist, wohingegen in einem Satz wie z.B. „Die Kuh schubst die Giraffe.“ die Kinder sich nur an der Wortstellung im Satz orientieren können, um die Kuh korrekt als Agens und die Giraffe korrekt als Patiens zu identifizieren (‚Coalitions-as-Prototypes-Account von Bates & MacWhinney, 1987). Ganz besonders schwierig scheint es außerdem für Kinder zu sein, einen Satz richtig zu interpretieren, wenn mehrere grammatische Hinweise nicht zusammen, sondern gegeneinander arbeiten ('conflicting cues', McDonald, 1986). Dieses wäre der Fall in dem deutschen transitiven Satz „Den Bären schubst der Frosch.“, in welchem die Wortstellung der beiden Nominalphrasen darauf hinweist, dass der Bär Agens ist, dagegen die Kasusmarkierungen für den Frosch als Agens sprechen.

Crosslinguistische Unterschiede können nicht nur in der Validität der grammatischen Hinweise oder der Prototypizität eines transitiven Satzes auftreten, sondern auch, wenn man die Verabreitungskapazität, die ein bestimmter grammatischer Hinweis im Satz benötigt, in Betracht zieht. Es wird angenommen, dass Kinder transitive Sätze in Sprachen, die Agens und Patiens mit Hilfe von Kasus markieren, schneller verstehen lernen als transitive Sätze in Sprachen, deren korrekte Interpretation vor allem auf der Wortstellung beruht. Man sagt, dass diese Kasusmarkierungen einfacher zu verarbeiten sind, da sie punktuell an einem Ort im Satz auftreten (‚local cues’) und daher weniger Arbeitsgedächtnisspeicher notwendig ist als bei ‚verteilten’ grammatischen Markierungen (‚distributed cues’) wie Wortstellung, bei denen das Kind den gesamten Satz im Gedächtnis behalten muss, um die Beziehung zwischen erster und zweiter Nominalphrase im Satz korrekt zu interpretieren ('Local-Cues-

Hypothesis' von Slobin, 1982). Auch die ‚Local-Cue-Hypothesis' wurde anhand crosslinguistischer Experimente mit Kindern überprüft (Lindner, 2003; Slobin & Bever, 1982), jedoch fehlen auch hier wieder Experimente mit Kunstverben.

Im Rahmen des ‚Usage-based-approach' geht man außerdem davon aus, dass frühe Syntax sehr lexikalisch spezifisch ist, also hochfrequente Äußerungen des Inputs widerspiegelt (Pine & Lieven, 1993) und sich erst im Laufe der weiteren Sprachentwicklung über Kategorienbildung zwischen diesen lexikalisch spezifischen Äußerungen eine abstrakte produktive Grammatik entwickelt, die das Kind kreativ auch auf neue Äußerungen anwenden kann. Eine Theorie in diese Richtung ist die Verb-Insel Hypothese (Tomasello, 1992), die besagt, dass Kinder grammatische Strukturen zuerst um bestimmte Verben herum bilden, d.h. wenn sie z.B. mehrere Sätze mit dem Verb ‚schubsen' hören, dann entwickeln sie um diese Verb herum das Wissen, dass die Nominalphrase, die vor dem Verb steht und eventuell mit Nominativ markiert ist, denjenigen bezeichnet, der schubst, während die Nominalphrase, die hinter dem Verb steht und eventuell mit Akkusativ markiert ist, denjenigen bezeichnet, der geschubst wird. Werden solche Schemata um viele verschiedene Verben herum gebildet, so bekommt das Kind nach und nach ein abstraktes Konzept von ‚Agens Verb Patiens'. Doch dieser Prozess wird als sehr langwierig angenommen und wie Studien mit Kunstverben von Tomasello und Mitarbeitern in den letzten Jahren gezeigt haben (z.B. Akhtar & Tomasello, 1997; Wittek & Tomasello, 2005), scheint es so, dass Kinder erst spät in ihrer Sprachentwicklung, nämlich erst um den dritten Geburtstag herum, abstraktes grammatisches Wissen über transitive Sätze entwickeln können.

Diese Studien werden jedoch stark von Vertretern nativistischer Spracherwerbstheorien kritisiert (vgl. Debatte Fisher, 2002a; Tomasello, 2000), die der Meinung sind, dass die von Tomasello und Mitarbeitern angewandten Methoden (Ausagieren vorgesprochener transitiver Sätze mit

Spielzeugcharakteren und elizitierte Produktion) in ihrer Ausführung zu schwierig seien und daher die schlechte Leistung der getesteten Kinder zu erklären sei. Diese Seite nimmt sogar an, dass sich syntaktisches Wissen sehr viel früher bei Kindern ausbilde bzw. angeboren sei und dass die Syntax beim Erwerb neuer Wörter, vor allem beim Verblernen, eine wichtige Rolle spiele ('Syntactic-Bootstrapping-Hypothesis' z.B. von Fisher, 2000a). Um sehr frühes syntaktisches Wissen nachweisen zu können, wenden sie passive Verstehensmethoden, wie zum Beispiel Preferential Looking an (Hirsh-Pasek & Golinkoff, 1996a), um andere benötigte exekutive Funktionen während des Tests möglichst gering zu halten. Und tatsächlich zeigt eine aktuelle – jedoch nicht unumstrittene – Studie, dass amerikanische Kinder aus der Anordnung der Nominalphrasen im Satz und damit aus der Zuordnung von Agens und Patiens auf die Verbbedeutung schließen können (Gertner et al., 2006).

Mithilfe dreier experimenteller Studien und einer Inputanalyse wird in der vorliegenden Dissertationsschrift untersucht, wann und wie Kinder abstraktes Wissen über die transitive Konstruktion zeigen können und ob sie dabei eine lexikalisch spezifische Phase durchlaufen oder ob Hinweise auf angeborenes syntaktisches Wissen zu finden sind. Um zusätzlich benötigte exekutive Funktionen klein zu halten, werden Methoden verwendet, die schon von kleinen Kindern leicht auszuführen sind. Daher bekommen die Kinder in den Experimenten entweder ein Video-Zeige-Paradigma präsentiert, bei welchem sie die richtige Szene aus zweien auswählen müssen oder es wird die Preferential Looking Methode angewandt. Alle Experimente werden mit Kunstverben durchgeführt, um sicher gehen zu können, dass die Kinder ein abstraktes Wissen über transitive Sätze zur Bewältigung der Aufgaben anwenden müssen.

Die erste Studie untersucht, inwieweit Deutsch und Englisch sprechende Kinder auch im Verstehen von transitiven Sätzen eine verbspezifische Phase

durchlaufen und wenn ja, wie diese sich im Laufe der Sprachentwicklung verändert. Dazu nahmen 92 Kinder aus beiden Sprachgruppen und zwei unterschiedlichen Altersgruppen (2;1 Jahre und 2;6 Jahre) an einem Experiment teil, bei welchem sie transitive Sätze sowohl mit bekannten als auch mit Kunstverben interpretieren sollten. Den Kindern wurden zeitgleich zwei Videos präsentiert, bei welchen die gleiche Handlung ausgeführt wurde, jedoch die Rollen von Agens und Patiens vertauscht waren. Sie hörten z.B. den Satz „der Bär schubst den Löwen“ und sahen dazu die beiden Szenen „Bär schubst Löwe“ versus „Löwe schubst Bär“. Die Testsätze der deutschen und der englischen Kinder unterschieden sich darin, dass die deutschen Kinder zusätzlich zur Subjekt-Verb-Objekt-Wortstellung noch Kasusmarkierungen als grammatische Hinweise auf Agens und Patiens fanden („**Der** Bär schubst **den** Löwe**n**.“), während die englischen Kinder nur die Wortstellung zur Verfügung hatten („The bear is pushing the lion.“). Während der Videopräsentation wurde das Blickverhalten der Kinder mit einer Kamera aufgezeichnet und am Ende wurden sie aufgefordert auf die zum Satz passende Szene zu zeigen. Die Kinder beider Sprach- und beider Altersgruppen zeigten überzufällig oft zur richtigen Szene, wenn sie transitive Sätze mit bekannten Verben hörten (DEU (2;1): $t(23) = 4.053$, $p = .000$; DEU (2;6): $t(23) = 4.252$, $p = .000$; ENG (2;1): $t(22) = 3.598$, $p = .001$; ENG (2;6): $t(22) = 2.802$, $p < .05$; einseitig). Eine 2 (Kunstverb / bekanntes Verb) x 2 (Altersgruppe) x 2 (Sprachgruppe) ANOVA zeigte ausserdem eine signifikante Interaktion zwischen Alter und Verbbedingung ($F(1,90) = 10.067$, $p < .05$). Nur die älteren Kinder beider Sprachgruppen wählten überzufällig oft die richtige Szene in der Kunstverbbedingung (DEU: $t(23) = 4.377$, $p = .000$; ENG: $t_{22} = 3.057$, $p < .05$; einseitig), nicht jedoch die Jüngeren. Die Blickzeitanalyse der Kinder ergab leider keine so deutlichen Ergebnisse, da von keiner Alters- oder Sprachgruppe eine klare Präferenz für eine der beiden Szenen im Blickverhalten

sichtbar wurde. Trotzdem konnte eine Korrelation nachgewiesen werden. Die Kinder, die während der Videopräsentation richtig schauten, zeigten auch anschliessend eher zur richtigen Szene als solche Kinder, die schon während der Videopräsentation zur falschen Szene geschaut haben (Pearson Korrelation: r =.270, N = 564, p = .000, Spearman's Rho: r = .268, N = 564, p = .000). Dieser Effekt ist noch stärker bei den jüngeren Kindern. Das besagt, dass das Blickverhalten das darauf folgende Zeigeverhalten unterstützt und gerade in der jüngeren Altersgruppe bedeutend dafür ist die richtige Entscheidung, wer im Satz Agens und wer Patiens ist, zu treffen.

Die zweite Studie dieser Dissertationsschrift besteht aus zwei methodischen Zugängen. Im ersten Teil geht es darum, den Input, also Kind-gerichtete-Sprache, im Deutschen zu analysieren und in Anlehnung an das Wettbewerbsmodell die Validität der einzelnen grammatischen Hinweise in transitiven Sätzen zu ermitteln, um Vorhersagen treffen zu können, in welcher Reihenfolge deutsche Kinder die verschiedenen grammatischen Hinweise erwerben und bewerten. Diese Vorhersagen sollen dann im zweiten Teil experimentell an deutsch sprechenden Kindern überprüft werden. In den Experimenten wird wieder das Verstehen transitiver Sätze getestet, nun werden aber in unterschiedlichen Bedingungen die beiden grammatischen Hinweise Wortstellung und Kasusmarkierung in den Sätzen variiert. Die Kinder erhalten drei verschiedene Bedingungen mit drei verschiedenen Satzmustern. Ihnen werden ‚prototypische' Sätze präsentiert, d.h., Sätze, in denen beide grammatische Markierungen dieselbe Nominalphrase als Agens markieren. Ein Beispiel wäre der Satz: „Der Löwe schubst den Hund." Nominativmarkierung und erste Satzposition sprechen hier beide dafür, dass ‚der Löwe' Agens ist, während Akkusativmarkierung und zweite Satzposition dafür sprechen, dass ‚der Hund' Patiens der Handlung ist. Eine zweite Bedingung wäre, dass die Kinder als

einzigen grammatischen Hinweis im Satz die Wortstellung zur Verfügung haben, wie in dem Satz „Die Kuh schubst die Giraffe“. Hier sind die Kasusmarkierungen für Nominativ und Akkusativ gleich und helfen daher nicht bei der Zuordnung von Agens und Patiens. In einer dritten Bedingung werden die beiden grammatischen Markierungen, Kasus und Wortstellung, in einen Konflikt gebracht. Das bedeutet, dass nun die Wortstellung weiterhin dafür spricht, dass die erste Nominalphrase im Satz das Agens ist und die zweite das Patiens, Kasusmarkierung dagegen die zweite Nominalphrase als Agens markiert und die erste als Patiens, so wie in dem Satz: „Den Tiger schubst der Bär.“ Alle Testsätze enthielten Kunstverben. Insgesamt nahmen 80 Kinder an dieser Studie teil: 32 2;7-jährige, 32 4;10-jährige und 16 7;3-jährige. Auch bei dieser Studie wurden wieder verschiedene Methoden verwendet und diese miteinander verglichen. 16 der 2;7-jährigen und 16 der 4;10-jährigen wurden aufgefordert, die verschiedenen Testsätze mit Spielzeugtieren auszuagieren und mussten dazu aus zwei Tieren auswählen, welches als Agens und welches als Patiens agieren sollte. Die übrigen Kindern wurden mit dem Video-Zeige Paradigma aus der ersten Studie getestet. 2;7-jährige, die an der Act-out Aufgabe teilgenommen haben, konnten in keiner der drei Satzbedingungen sicher zeigen, dass sie Agens und Patiens richtig zuordnen konnten. Sie wählten zufällig eines der beiden Tiere als Agens aus. Die 4;10-jährigen wählten sicher das richtige Agens in den Bedingungen der prototypischen Sätze ($t (15) = 3.576$, $p < .05$) und der Sätze, in welchen nur die Wortstellung als grammatischer Hinweis vorhanden war ($t (15) = 3.478$, $p < .05$). Sätze, in welchen Wortstellung und Kasusmarkierung miteinander im Konflikt standen, konnten sie nicht richtig interpretieren. 2;7-jähre die an der Video-Zeige Aufgabe teilgenommen hatten, konnten hingegen prototypische transitive Sätze mit Kunstverben überzufällig oft richtig interpretieren und zeigten auf die richtige Szene ($t (15) = 4.354$, $p = .001$). 4;10-jährige wählten überzufällig oft die richtige

Szene in der Prototyp ($t (15) = 9.121$, $p < .001$) und der Wortstellungsbedingung ($t (15) = 13.174$, $p < .001$), konnten aber wiederum die Konfliktsätze nicht lösen. 7;3-jährige schliesslich waren in der Lage alle drei Arten von transitiven Sätzen im Deutschen richtig zu verstehen und Agens und Patiens richtig zuzuordnen. Sie erreichten einen Deckeneffekt in der Prototyp- und Wortstellungsbedingung und zeigten auch in der Konfliktbedingung überzufällig oft zur richtigen Szene ($t (15) = 2.249$, $p < .05$).

Die ersten beiden experimentellen Studien in dieser Doktorarbeit haben gezeigt, dass zweieinhalbjährige deutsch sprechende Kinder transitive Sätze mit Kunstverben korrekt verstehen können, solange Kasusmarkierung und Wortstellung im Satz sich gegenseitig unterstützen. Trotzdem findet man andere Ergebnisse, wenn man anstatt der Video-Zeige Methode eine Act-out Methode verwendet. Das lässt darauf schliessen, dass das Wissen über die transitive Konstruktion in diesem Alter noch sehr methodenabhängig und dementsprechend wenig robust ist. Daher findet man eventuell ein abstraktes Wissen über die transitive Sätze auch schon bei jüngeren Kindern, wenn man die Testaufgabe noch vereinfacht. Mit der dritten Studie meiner Dissertation soll daher erforscht werden, ob schon sehr junge deutsche Kinder die grammatische Struktur eines Satzes benutzen, um die Bedeutung eines Verbs zu lernen und ob man dieses Wissen mit Hilfe von Blickzeitmessungen sichtbar machen kann. Bei diesem Preferential Looking Experiment sahen 48 1;9-jährige zwei verschiedene transitive Handlungen mit vertauschten semantischen Rollen. Sie hörten nun einen transitiven Satz mit einem Kunstverb und sollten dieses Kunstverb einer der beiden Handlungen zuordnen, in dem sie sich daran orientierten, wer Agens und wer Patiens im Satz ist. Sie hörten z.B. „Der Frosch tammt den Affen.“ und sahen auf einem Bildschirm, wie der Frosch den Affen in einem Schaukelstuhl schaukelte und auf einem zweiten Bildschirm, wie der Affe den Frosch auf einem

Wagen hin und her schob. Da laut transitivem Satz der Frosch Agens der Handlung sein muss, bedeutet „tammen“ folglich das Schaukeln im Schaukelstuhl. Die Hälfte der Kinder bekam, bevor Ihnen die Testsätze präsentiert wurden, ein Training zu transitiven Konstruktionen. Sie hörten transitive Sätze mit bekannten Verben, z.B. „Der Frosch kitzelt den Affen.“ und sahen dazu parallel zwei Szenen, auf welchen einmal der Frosch den Affen kitzelte und einmal der Frosch den Affen fütterte. Kinder einer zweiten Gruppen bekamen dieses Training nicht. Sie sahen zwar ebenfalls die beiden Szenen, hörten dazu aber keine transitiven Sätze, sondern nur das Verb der Handlung im Infinitv: „Das heißt kitzeln.“ Nur die Kinder, die vorher das Training bekommen hatten, schauten überzufällig häufig zur richtigen Szene ($t (23) = 2.266$, $p < .05$), nicht aber die andere Gruppe von Kindern ($t (23) = .307$, n.s.). Diese Ergebnisse geben einen Hinweis darauf, dass ein abstraktes Wissen über transitive Sätze bei solch kleinen Kindern vorhanden ist, dieses aber nicht sehr robust ist und nur sichtbar wird, wenn eine einfache Methode gewählt wird, und zusätzlich Trainingssätze dieses Wissen erwecken.

Diese drei experimentellen Studien zeichnen ein deutliches Bild über die Entwicklung der transitiven Konstruktion während des Spracherwerbs. Diese Arbeit untersucht ausserdem die verschiedenen Faktoren, welche die grammatische Entwicklung bei Kindern beinflussen und unterstützen.

Vorveröffentlichungen

Aus dieser Dissertation sind bisher zwei Vorveröffentlichungen hervorgegangen:

1. Dittmar, M., Abbot-Smith, K., Lieven, E., & Tomasello, M. (2008). Young German children's early syntactic competence: A preferential looking study. *Developmental Science, 11*(4), 575 - 582.

2. Dittmar, M., Abbot-Smith, K., Lieven, E., & Tomasello, M. (2008). German children's comprehension of word order and case marking in causative sentences. *Child Development, 79*(4), 1152 - 1167.

Lebenslauf

Der Lebenslauf ist in der Online-Version aus Gründen des Datenschutzes nicht enthalten

Curriculum Vitae

For reasons of data protection, the curriculum vitae is not included in the online version

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