Brain and Language 77, 407–418 (2001)
doi:10.1006/brln.2000.2411, available online at http://www.idealibrary.com on IDEAL®

The Early Acquisition of Verb Meaning in German by Normally Developing and Language Impaired Children

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Published online February 21, 2001

The research reported here focuses on the early acquisition of event structure in German. Based on longitudinal studies from 5 normally developing (ND) and 6 language-impaired (LI) children, a model of "event structural bootstrapping" is presented that spells out how ND children log into the verb lexicon. They project a target-consistent event tree, depicting the head-of-event of transitions. Young LI children, failing to employ this bootstrapping strategy, resort to radically underspecified event representations. The results from a truth–value judgment experiment with 16 ND and 16 LI children showed that ND children perform correctly on transitional verbs, while LI children perform at chance level on the same tasks. These findings are accounted for by the model of event structural bootstrapping to the extent that LI children lack an explicit representation of the head-of-event.

Key Words: endstate; event structure; German; language impairment; normally developing children; truth–value judgment; verb lexicon.

INTRODUCTION

The question of how the child acquires the meaning of verbs has been extensively discussed in recent literature. It is still unresolved, however, how the child can succeed in this task. The lexical representation of a verb consists of three components: core meaning, argument selection, and the type of event designated by the verb (i.e., state, process, or transition, cf. Pustejovsky, 1995). Even if the child is aware that a verb refers to an action or a situation, she faces numerous challenges in learning verb meanings.

First, there is the lack of joint attention: In learning object labels, children can rely on joint visual attention. This is more difficult in the case of events, since they are typically fleeting, and, moreover, labeling the event often does not coincide with the

This research was supported by a grant from the Deutsche Forschungsgemeinschaft to the University of Konstanz, Germany (SFB No. 471). We thank the audiences at the Language Acquisition and Language Breakdown Conference in Utrecht, at the University of Amherst, and at the University of Salzburg, as well as the members of the SFB No. 471 for comments on earlier versions of this work. Discussions with Harald Clahsen, Jill de Villiers, Peter Pause, Tom Roeper, Angeliek van Hout, Juergen Weissenborn, and Angelika Wittek and the suggestions of the reviewer were especially helpful. We are grateful to the teachers of the day-care centers in Stuttgart, Germany, and the speech therapists in Bern, Switzerland, who allowed us access, and to the children for their willing participation in the study. We also thank Paul Abbott for lending his native eye to the English.

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0093-934X/01 $35.00

time at which the event happens. Second, the relation between verb and "scene" is ambiguous, as a verb usually refers to a specific aspect of the scene. A verb of movement, for instance, can refer to the manner of the process (e.g., *roll*) as well as to the path of an action (e.g., *enter*) or to the outcome of an action (e.g., *arrive*). Third, in contrast to names for objects, verbs are subject to considerable parametric variation. At the level of the lexicon–syntax interface, for example, languages differ as to how event types are marked in syntax and in word formation. Apart from verbs with an inherently telic event type (e.g., *ankommen,* arrive; or *finden,* find), the telicity of the predicate often depends on event-semantic properties of other elements in the sentence (cf. van Hout, 1996; Hollebrandse & van Hout, 1998). In German, noninherent telicity in transitions is assumed to be marked by quantized objects (cf. Krifka, 1989). The incremental verb of consumption *essen* (eat) for instance refers to an atelic event of the type "process" when selecting a bare mass noun as an object (see example 1a). If the object is marked by a determiner, however, the predicate is interpreted as referring to a telic event of the type "transition" as in example (1b) (cf. Verkuyl, 1972, 1993):

(1) a. Er hat Käse gegessen.
"he has cheese eaten"
He ate cheese.

b. Er hat *den* Käse gegessen.
"he has the cheese eaten"
He ate the cheese.

In contrast to incremental verbs of consumption, incremental verbs of removal such as *fegen* (sweep) and verbs of creation such as *bauen* (build, construct) can be associated with both an atelic and a telic interpretation, the preferred interpretation being telic. Nonetheless, with the exception of bare plurals, in all cases a determiner must occur with the direct object.

Besides marking the event type via determiners, German can mark the event type by verb prefixation. The prefixes *auf* or *aus,* for instance, mark the events as telic, as shown in example (2):

(2) a. *essen* (eat) (atelic) vs. *aufessen* (AUF-eat, eat up) (telic)
b. *waschen* (wash) (atelic) vs. *auswaschen* (AUS-wash, wash out) (telic)

Note that this kind of prefixation does not obligatorily correlate with telicity. The prefix *auf* is therefore the telicity marker in *aufessen* (example 2a), but not in the verb of creation *bauen,* since *aufbauen* (AUF-build, build up) can be interpreted as atelic. Again, the extent to which verbal prefixes may contribute to event type marking seems to depend on the semantic type of the verb and its object. In sum, the interdependence between parametric properties of event type marking and the semantic type of the predicate is very intricate.[1]

Given these input ambiguities, we might expect that verbs are difficult to learn. However, words referring to events occur very early in children's speech.[2] This raises the question of how and to what extent the child masters the challenges presented by the input when acquiring the meanings of verbs. Three main proposals are found in the literature. On the one hand, biases in event perception have been attributed to language learners. Analogous to Markman's (1994) "assumptions" and Landau's (1994) "shape bias" as guiding principles of early object naming, it has been hypothesized that children may have certain preferences in the perception of events. Behrend (1990a), for example, argues for a preference for the outcome interpretation of com-

[1] Experimental studies of van Hout (1997) and Kortschak (1999), for example, demonstrate that Dutch- and German-speaking children fail to use determiners as telicity markers until late in the fifth year of life.

[2] For an overview regarding verb acquisition, see Woodward and Markman (1998) and Behrens (1999).

plex events. Gentner (1978, 1982), Gropen, Pinker, Hollander, and Goldberg (1991), and Behrend (1990b), in contrast, claim that children are guided by what they call a "manner or instrument bias." The evidence on which these approaches rely comes from experimental studies with 4- and 5-year-olds and thus does not account for the initial knowledge of the verb lexicon. Landau and Gleitman (1985) and Gleitman (1990), on the other hand, put forth syntactic bootstrapping strategies. Although the use of syntactic information in the interpretation of novel verbs has been repeatedly confirmed in a number of studies (cf., e.g., Naigles, Fowler, & Helm, 1992; and Naigles, Gleitman, & Gleitman, 1993), research has yet to determine precisely which meaning components are inferred from syntax by children. It has been noted that the verb meaning cannot be derived from the syntactic frame alone, without taking into account the meaning of the other elements of the sentence (e.g., Pinker, 1994). Additionally, many verbs allow multiple subcategorization frames, thus requiring generalizations across various syntactic frames. In short, there is no direct evidence that 1- and 2-year-olds learn verb meanings by first focusing on their syntactic frames (cf. Woodward & Markman, 1998; and Behrens, 1999, and the literature cited there).[3] Finally, Wittek (1998, 1999) advances the "Adverbial Modification Cue Hypothesis": 4- to 7-year-old children were shown to make use of scope properties of adverbial event modifiers such as *wieder* (again) in learning event types. While these hypotheses have been examined in a number of experimental studies with older children, they do not shed light on the child's early knowledge of the verb lexicon.

EVENT STRUCTURAL BOOTSTRAPPING

In Penner, Wymann, and Dietz (1998) and Penner, Schulz, and Wymann (1999), we proposed a model of "event structural bootstrapping" that provides an account of how the child logs into the verb lexicon shortly after her first birthday.[4] This model is based on longitudinal studies of 11 German-speaking children, 5 normally developing (ND) children, and 6 children with language impairment, who have been recorded from the onset of word production. We argue that German-speaking ND children proceed in a "piecemeal" fashion in order to overcome the input ambiguity in the domain of the verb lexicon without violating the Local Wellformedness Constraint (cf. Weissenborn, 1994). This requires that each interim representation be included within the target representation. At the initial state, the child focuses on the event structure rather than on the verb's core meaning or argument selection. More specifically, she confines herself to the so-called "head-of-event," i.e., to the semantically most prominent subevent of a transition (Pustejovsky, 1995). Roughly speaking, in atelic transitions the head-of-event is the process subevent, and in telic transitions the head-of-event is the endstate subevent. In other words, the child first assesses whether the verb denotes a telic or an atelic type of event. In order for this selective strategy to be employed successfully, the child must log into the verb lexicon with a verb whose event structure is unambiguous in terms of its event type. In German, prefix verbs of the type *aufmachen* (AUF-make, open) and *zumachen* (ZU-make, close) meet this requirement best, since, unlike incremental verbs of removal or creation, they obligatorily have a telic interpretation. Moreover, the internal hierarchy

[3] Naigles (1990) shows that 2-year-old children conjecture different verb meanings depending on their presentation in varying syntactic frames. Since the variation was limited to transitive versus intransitive frames, however, these findings cannot be extended to the acquisition of verb meaning in general.

[4] The question of how mapping relations between verb frames and event types are acquired has recently been addressed by Hollebrandse and van Hout (1998). They proposed an "aspectual bootstrapping" strategy via light verbs.

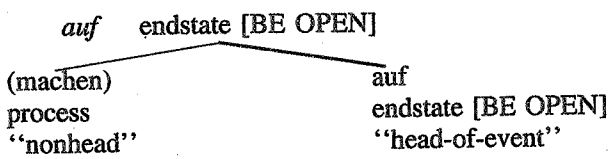
TABLE 1
First Verbal Prefixes in Five ND Children

Child (Age):	H (1;03,22)	K (1;06,01)	E (1;04,16)	L (1;03,11)	J (1;02,18)
Prefix	auf	auf	auf	zu/auf	zu
Gloss	AUF-make	AUF-make	AUF-make	ZU/AUF-make	ZU-make

of the transition-type event is optimally transparent, for the prefix *auf* unambiguously marks the endstate as the "head-of-event." Last, the dummy light verb *machen* (make, do) lexically marks that the process subevent is semantically less prominent. In other words, the manner interpretation of verbs like *aufmachen* is excluded.

Once the child has picked an *aufmachen*-type verb out of the input, she first establishes an economical representation of the event type, as illustrated in example 3 below.

(3)



This initial representation consists of the endstate, which the child has identified as the head-of-event. Lexically, this initial representation is overtly spelled out by the bare prefix *auf* or *zu* of the complex verb *auf-* or *zumachen.* Table 1 gives a brief overview of the emergence of bare prefixes among the ND children in our longitudinal studies.

During this initial stage, the components of core meaning and argument selection remain unspecified. According to Pause and Heitz (1999), the core meaning of the verb *aufmachen* is roughly that someone causes the content of a container to become accessible by manipulating a closure. None of the predicates or the arguments in this definition are explicitly specified in the child's early lexicon. Thus, while the 1- and 2-year-old children in our studies seem to consistently interpret *auf* as the outcome of an action, they fail to distinguish between events of making a content accessible (OPEN) and events of making a content inaccessible (CLOSE). What is more, our data suggests that the usage of *auf* by these children refers both to events of moving part of a closure (OPEN) and to events of removing an object from a surface (CUT, PEEL, or CLEAR). A few weeks after the emergence of the bare prefix expressions, the light verb *machen* occurs; i.e., a successive extension of the event structure tree takes place so as to include the process subevent and then the selected arguments. Complex predicates with quantized Determiner Phrases (DPs) are productive around the age of 2;6.

Language-impaired (LI) children exhibit a very different acquisition pattern. In addition to being delayed with regard to the emergence of verbal items, which they first produce after the age of 2;2, LI children seem to log into the verb lexicon by means of qualitatively different strategies. Instead of using verb prefixes such as *auf* and *zu,* the LI children in our longitudinal studies start out with the so-called "deictic prefixes" of the type *runter, rauf,* or *(he)raus,* as sketched in Table 2.

TABLE 2
First Verbal Prefixes in Four LI Children

Child (Age):	D (2;00,17)	V (2;00,26)	N (2;04,16)	R (2;00,07)
Prefix	runter/rauf	runter/rauf	runter/rauf	rauf
Gloss	(R-down/R-up)	(R-down/R-up)	(R-down/R-up)	(R-up)

There is an essential semantic difference between these deictic prefixes and the telic prefixes *auf* and *zu* in *auf-* and *zumachen.* Crucially, deictic prefixes do not refer to a specific subevent and thus do not mark a given event as telic or atelic. Instead, deictic prefixes express the speaker's perspective on the event. As such they may take wide scope over the entire event and are *per se* unspecified with regard to the head-of-event.[5] We assume that the preference of deictic over telic prefixes reflects the fact that LI children are not endowed with the knowledge associated with the hierarchy of event structures, and are hence incapable of successfully employing the event structural bootstrapping strategy observed in ND children. As a consequence, LI children are forced to resort to a radically underspecified event structure tree that lacks an explicit representation of the head-of-event. In the resulting semantic representation, the head-of-event may be associated with any subevent in the transition.

What are the consequences of this initial state? On the one hand, we expect LI children to display specific deficits with regard to event type marking at the production level, i.e., to mix up the prefixes or to use dummy elements instead. As shown in Penner et al. (1998) this is indeed the case for German. Our data indicate that in elicitation tasks LI children frequently confuse deictic prefixes such as *hinauf* or *rauf* with telic prefixes such as *auf* and, furthermore, systematically fail to produce Verb Phrases (VPs) with full-fledged DP objects that compositionally denote events of the transition type. In a recent study of elicited production of complex resultative expressions (e.g., *The man knocked the box off the table*) with 5- to 8-year-old English speaking LI children, Ingham, Fletcher, Schelletter, and Sinka (1998) showed that the difficulties these children experience with regard to the projection of event structures persist through preschool and school age. Beyond production disabilities, our account of the initial stage of LI children's verb acquisition predicts analogous deficits at the level of comprehension.

THE EXPERIMENTAL STUDY

The experimental study was designed to investigate in detail whether and how the qualitative differences between ND and LI children with regard to event representations affect their comprehension of event structures. We hypothesized that the initial absence of an explicit representation of the head-of-event might prevent LI children from acquiring the knowledge necessary to interpret telic transitional verbs as entailing their endstate. LI children should therefore incorrectly accept telic verbs for events in which the endstate is missing. ND children, on the other hand, having profited from the event structural bootstrapping strategy, should recognize that the endstate is a necessary property of telic verbs such as *aufmachen.* Thus, they were expected to reject telic verbs for events in which the endstate is not achieved. A further expectation was that ND children would not be misguided in their judgment even if the less prominent subevent, i.e., the process subevent, was made more salient. Consequently, we predicted that the response patterns of ND children would not be influenced by whether the process of opening was made salient or not. We concentrated on the verb *aufmachen,* as it serves as a good example of a telic verb for the aforementioned reasons and, moreover, because it has been documented in children's speech from very early on.

[5] As argued in Stegmann (1997), the telic versus atelic distinction is marked by means of doubling the prepositional component of the deictic prefix:

(i) Ich ging den Berg *hinauf.* (telic or atelic) "I walked the mountain HIN-up/onto"

(ii) Ich ging *auf* den Berg *hinauf.* (unambiguously telic) "I walked on the mountain HIN-up/onto"

Method

Subjects. The participants in this study were 48 monolingual German speaking subjects with no known history of physical, socio-emotional, mental, or psychological impairments: 16 young ND children (10 girls, 6 boys, *M* = 2;10, *range* = 2;00–3;01), 16 LI children (8 boys, 8 girls, *M* = 3;09, *range* = 2;11–4;10),[6] and 16 university-educated adults as a control group (6 men, 10 women, *M* = 37;08, *range* = 27–66). The ND children were enrolled in day-care programs. They exhibit age-appropriate speech, language, and social and cognitive functioning according to preschool teacher and parent reports. The LI children met the following criteria: (a) they have been diagnosed by speech therapists as suffering from receptive and expressive language deficits, (b) the cognitive functioning is reported to be within normal limits for age, and (c) there is no report of hearing impairments. Four ND children had to be replaced, since one child did not pass the pretest and three children did not complete the experiment. Three of the LI children failed the pretest and were replaced in the experiment.

Test stimuli. Using a variant of the truth–value judgment task (Crain & McKee, 1985), a controlled comprehension experiment was designed. Thirty-two picture sequences were created, each composed of two photographs depicting different instances of opening a container, e.g., a suitcase or a cardboard box. The first photograph always showed the closed container and a hand moving toward it. The second photograph depicted the outcome of the action, either the opened or the still closed container and the hand being withdrawn. Being asked whether the person opened the container, a subject who knows that the meaning of *aufmachen* entails the endstate [BE OPEN] should answer *yes* in the first case and *no* in the second case.

Since we hypothesized that ND children's interpretation of endstate-headed events would not be influenced by manipulation of the process subevent, we designed the picture sequences so that half of them depicted an opening event in which the process was made salient by using a tool to open the container. For instance, instead of using the hands a box was opened with the help of a ruler. Consequently, each picture-sequence varied with regard to the variables ENDSTATE [+/−] and PROCESS [+salient/−salient]. There were eight different instances of opening a container. Each subject thus saw a total of eight test trials, two each in the four conditions. An example of the condition [−endstate, −salient] is given in example (4):

(4) Sample item [−endstate, −salient]
Diese Mutter wollte mit ihrem Kind spielen. Guck, da siehst du ihre Hand, und hier ist die Schachtel. Und dann . . .
This mother wanted to play with her child. Look, there you can see her hand, and here is the box. And then. . . .

Test question:	*Hat siese aufgemacht*?[7]	*Nein*
	"has she-her.CL AUF-made.PART"	
	Did she open it?	No

All test questions were worded in the perfect tense, with perfect tense being the standard tense form with which to refer to past events in colloquial (Southern) German, spoken by all participants.[8] By showing each container only once to the subject, we controlled for a bias of the test item itself. Furthermore, the four conditions were counterbalanced across the eight test items, yielding four different versions. Possible effects of order of test item were controlled for by designing two different orders, thus arriving at eight different lists to which subjects were assigned randomly.

Procedure. Each subject was tested individually in an environment familiar to the child, either in a quiet room at school or at home. The group of ND children and the group of LI children were each tested by the same experimenter. Preceding the actual experiment, children had an opportunity to manipulate all containers depicted in the picture sequences. These encounters with the concrete objects were intended to guard the child from basing her responses to the test trials merely on her previous world knowledge regarding the shape and the closure of the respective containers. Simultaneously, a pretest was adminis-

[6] The higher age of the LI children is due to the fact that, unlike ND children, they could not be subjected to tests involving yes/no questions until about their third birthday.

[7] To facilitate comparison across test items, the reduced form of the object pronoun is used in referring to the container. In the last sentence of the preamble, the name of the container is mentioned again to provide an unambiguous referent for the pronoun.

[8] De Swart (1998) argues that the English simple past carries no aspectual operator. Consequently, if there is no aspectual operator, the state, process, or transition expressed in the VP is simply anchored in the past. Assuming that in South German, perfect tense is the equivalent of simple past tense in English, we can conclude that there is no (grammatical) aspect in the type of sentence we used in our experiment.

tered asking simple yes/no questions that were related to the objects (e.g., *Is that a suitcase*?). The goal was to ensure that both ND and LI children are able to respond to yes/no questions appropriately. Only those children who answered all four pretest questions correctly participated in the main test.

Followed by four practice trials, each subject was presented with the eight test items. As in the practice trial, the experimenter narrated the event and introduced the important items in each picture sequence. A hand puppet then formulated the yes/no question, phrased in perfect tense. Interspersed with the test items there were four control items that were also worded in perfect tense but did not contain the test verb. These were added to counteract processing strategies and to ensure that children paid attention to each item until the end. Instead of *aufmachen,* the verbs *zerbrechen* (break), *austrinken* (AUS-drink), *malen* (draw), and *bauen* (build) were used.

Predictions. We predicted that the ND children would perform better overall than the LI children. More specifically, the ND children should correctly reject *aufmachen* for events in which the endstate is not reached, since they are aware that telic verbs entail their endstate. LI children, on the other hand, should incorrectly accept *aufmachen* in these cases. In short, the condition [−endstate] should yield significantly more correct responses for the group of ND children than for the group of LI children. Furthermore, with regard to the condition [+endstate], we expected that all groups would correctly accept the endstate verb *aufmachen* if the picture depicts an event in which the endstate is reached. As for the process subevent, we predicted that ND children's responses would not vary according to whether the process is made salient or not, whereas LI children's responses would be influenced by making the process salient.

Scoring and data analysis. Responses to the test items were coded as correct or incorrect, as described in the test stimuli section. A correct response received a score of 1, an incorrect response received a score of 0. Then for each subject, the total number of correct responses for each of the four conditions and for the controls was calculated. In order to compare the mean of the controls to the mean of all test items, we introduced a variable "item" with the conditions [control] and [test item]. In addition, we calculated the total number of correct responses for the [−endstate] and [+endstate] conditions.

Results[9]

Controls and test items. The responses were first analyzed by a (3) group × (4) version × (2) order × (2) item ANOVA, with the last factor as a repeated measure ($\alpha = .05$). There were no significant effects of version (F [3,24] = 1.72, $p = .19$) or of order (F [1,24] = .06, $p = .808$). Therefore, the control factors were neglected in the further analysis. All responses were then analyzed by a 3 (group) × 2 (item) ANOVA, with the last factor as a repeated measure. The proportion of correct responses for the test items and the controls is presented by subject group in Table 3.

There was a significant effect of group, (F [2,45] = 22.75, $p < .001$) and a significant effect of item (F [1,45] = 18.90, $p < .001$). The interaction of group and item was also significant (F [2,45] = 17.68, $p < .001$). A *post hoc* comparison using a Scheffé procedure ($p < .05$) revealed that the means of the test items of the LI children differed significantly from the means of the test items of both ND children and adults, which formed a homogeneous subset. Each of the means for the controls was then compared to the proportion anticipated by chance (50.0) using the G Test. It was found that the proportion correct was significantly higher than chance level ($p < .01$ for both ND and LI children), indicating a very good understanding of the controls.

Test items analysis and subgroup comparisons. In a next step, performance in the four test conditions was examined, preserving α at .05. The responses were analyzed by a 3 (group) × 2 (endstate) × 2 (process) ANOVA, with the last two factors as repeated measures. The mean correct score for the test items is presented by subject group in Table 4. Each subject received two items for every cell of the experimental design; thus the maximum mean was 2.00.

The analysis revealed a significant effect of group (F[2,45] = 41.89, $p < .001$) and of endstate (F[1,45] = 13.87, $p = .001$), but not of process (F[1,45] = 1.99, p

[9] For a more detailed description of the statistical results see Schulz, Wymann, and Penner (1999).

TABLE 3
Proportion of Correct Responses (and Standard Deviation) by Item Type and Subject Group

Item	ND children	LI children	Adults
Controls	87.50 (15.81)	92.19 (.60)	100.00 (.0)
Test items	89.06 (13.59)	63.28 (11.60)	97.66 (6.80)

= .165). The significant main effects of group and endstate are illustrated in Fig. 1. With regard to the two-way interactions, only the interaction between group and process was significant ($F[2,45] = 4.89, p = .012$).

As can be inferred from Table 4 and Fig. 1, adults performed very well on all conditions. Hence only children's data was analyzed further. A two-way analysis of variance comparing the responses of the ND and the LI children with endstate and process as within-subject variables found significant main effects of group ($F[1,30] = 33.27, p < .001$) and of endstate ($F[1,30] = 12.38, p = .001$), but not of process ($F[1,30] = 2.60, p = .117$). As for the two-way interactions, only the interaction of group and process was significant ($F[1,30] = 5.43, p = .027$), due to the low mean in the [−salient] condition for the LI children ($M = 54.69$), compared to the mean for the ND children ($M = 90.63$). The three-way interaction of group, endstate, and process was not significant ($F[1,30] = .83, p = .369$). In order to test whether performance of the LI and ND children was better than chance, each of the means for the two groups of children in Table 4 was compared to the proportion anticipated by chance (1.0) using the G test. The G test revealed that ND children performed significantly above chance on all conditions, while LI children performed significantly above chance only on the [+endstate] conditions. If the endstate was not reached, performance was at chance level ($p = .27$ for [−endstate, +salient] and $p = .92$ for [−endstate, −salient]).

Finally, a 2 (endstate) × 2 (process) ANOVA with the two factors as repeated measures was used to assess the responses of the LI children in isolation. There was a significant effect of endstate ($F[1,15] = 5.77, p = .030$), resulting from a lower mean in the [−endstate] condition ($M = 45.31$) than in the [+endstate] condition ($M = 81.25$). The factor process was significant ($F[1,15] = 7.35, p = .016$), because the mean for the nonsalient process ($M = 54.69$) was lower than the mean of the salient process ($M = 71.88$). The interaction of endstate and process was not significant ($F[1,15] = .58, p = .456$). This was due to the fact that the salient process led to more correct responses than the nonsalient process, independently of the variable endstate.

TABLE 4
Mean of Correct Responses (and Standard Deviation) by Test Condition and Subject Group

Test condition				
Endstate	Process	ND children	LI children	Adults
+Endstate	+Salient	2.00 (.0)	1.75 (.58)	2.00 (.0)
	−Salient	2.00 (.0)	1.50 (.63)	2.00 (.0)
−Endstate	+Salient	1.50 (.82)	1.13 (.81)	1.88 (.34)
	−Salient	1.63 (.62)	0.69 (.87)	1.94 (.25)

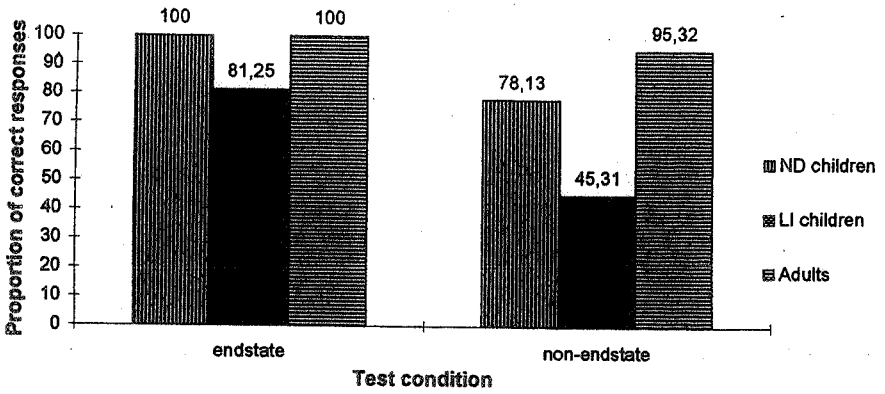


FIG. 1 Proportion of correct responses to the test items by endstate and subject group.

DISCUSSION AND IMPLICATIONS

The high number of correct responses to the controls showed that both ND and LI children and adults in general had no difficulty understanding yes/no questions worded in perfect tense. Thus, we can conclude that children's performance on the test items was not impeded by problems arising from the interpretation of the typical German past interpretation, for both controls and test items were phrased in perfect tense.

The analysis of the children's data confirmed that ND children performed much better than the LI children: The results indicate that LI children's rejection of *aufmachen* for events in which the endstate is not reached was at chance level (M = 45.31), while the ND children, who are about a year younger than the LI's, correctly rejected *aufmachen* for events in which the endstate is missing in 78% of the cases. They clearly performed above chance in this condition, thus differing significantly from the LI children. This corroborates our prediction that ND children but not LI children recognize that the endstate is a necessary property of telic verbs such as *aufmachen.* These results, taken together with our findings from spontaneous production at earlier stages, substantiate our hypothesis that the qualitative differences between ND and LI children persist in later comprehension of event structures. What is more, these findings are consistent with our proposal that LI children have an initially underspecified event structure, resulting from the unavailability of the event structural bootstrapping strategy. A closer look at the individual data of the LI children reveals that performance worsens as the LI children grow older, thus supporting the findings of Schöler (1992) and Schakib-Ekbatan and Schöler (1995) regarding the decrease in performance of LI children over time.

A question that remains to be explained, then, is why the ND children did not perform at ceiling in the [−endstate] condition, even though presumably they possess an explicit representation of the head-of-event of telic verbs. Evidence from individual data suggests that this may be an artefact of the experimental design. A comparison with the findings from an informal act-out task suggests that presenting the child with picture sequences might have placed additional demands on the young 2-year-olds, thus obscuring their underlying competence. In a study with older ND children, who are age-matched with the LI children, we are currently examining whether this age effect holds.[10] A further finding that calls for an explanation is the imperfect

[10] The 12 children we have tested so far (range 3;02–4;07) performed almost at ceiling in the [−endstate] condition (M = 89.58).

performance of children with LI in the [+endstate] condition ($M = 81.25$). We speculate that this response pattern might be due to a failure to specify the head-of-event, thus leading to insecurity with respect to the verb's overall event structure. Finally, as predicted, ND children's performance was not influenced by manipulating the process of the *aufmachen* event, whereas the children with LI performed in general better when the process was made salient, independently of the endstate. Further research is called for to investigate whether the visual clue provided by a tool may help the LI child to correctly interpret *aufmachen* as telic.

In short, the experimental findings are in concordance with the model of event structural bootstrapping, first delineated in Penner et al. (1998) and Penner, Schulz, and Wymann (1999). The results from the group of LI children, moreover, confirm previous studies with older English speaking children (Kelly & Rice, 1994; Ingham et al., 1998), which pointed to a difficulty that these children have with change-of-state verbs and complex resultative expressions, respectively.

At the same time, both the production and the comprehension data challenge recent proposals regarding the acquisition of verb meaning. Most notably, our results are not compatible with a "manner bias" suggested for older English speaking children (cf. Gentner, 1978, 1982; Behrend, 1990b; Gropen et al., 1991), for the ND children in our studies clearly paid attention to the endstate. It is likely that the selection of verbs, including verbs with incremental themes (e.g., *fill, mix*), has affected the outcomes of previous studies considerably. This hypothesis is corroborated by Wittek's (1998, 1999) results that suggest that nonincremental verbs such as *zumachen* and *aufmachen* are learned earlier than incremental verbs such as *vollmachen* (full-make, fill). In addition, children learning English have to cope with monomorphemic words that do not express the endstate as transparently as do complex predicates like *aufmachen* (cf. also Wittek, 1999).

CONCLUSIONS

The problem of how the child can log into the verb lexicon despite the numerous ambiguities of the input still awaits a conclusive solution. As a first step, we advanced a model of event structural bootstrapping which emphasizes the role of the verb's event structure, rather than the role of core meaning or argument selection, in that process. More specifically, we argued that the initial representation of the verb's event structure in ND children is restricted to the most prominent subevent, while LI children lack this bootstrapping strategy and hence resort to underspecified event representations.

The predictions of this model were borne out with regard to both early longitudinal production data and experimental comprehension data. The first verbal prefix used by ND children is unambiguously telic, while the first verbal prefix produced by LI children is deictic and thus ambiguous with regard to its event type. Furthermore, ND children recognize that the endstate—by virtue of being the head-of-event—is entailed by a telic verb. LI children, by contrast, do not acknowledge the head-of-event of telic transitions. Therefore, verb acquisition seems to be a further area in which LI children are not merely delayed but rather deviate from the acquisition path of their ND peers (cf. also Penner, Wymann, & Schulz, 1999). Future studies with older LI children will have to show whether the initial deviation with respect to event structure persistently affects the comprehension of complex events.

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