Learning the meaning of verbs: what distinguishes language-impaired from normally developing children?*

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Abstract

Using evidence from both production and comprehension data, this paper addresses the question of how normally developing and language-impaired children acquire the meanings of first verbs. The spontaneous speech of seven German-speaking children (three of whom are language-impaired) at the onset of speech production was analyzed with respect to the emergence of verbs and the type of event associated with them. In addition, 64 children between the ages of two and eight, 32 of them language-impaired, were asked to judge different types of event-verb mappings. Our results suggest a substantial difference between the two groups with regard to the learning algorithms employed in acquiring the meanings of verbs. It is proposed that these findings can be accounted for in terms of violations of learnability-driven constraints, which characterize the language of impaired children but not the language of normally developing children.

1. Introduction. What the child has to learn when she acquires the meaning of verbs

Children produce their first verbs shortly after the first birthday. In light of the opinio communis that learning verb meanings is particularly difficult (Bloom 2000), this fact has to be accounted for by any theory of language acquisition. There are at least three reasons why verbs should be harder to learn than other word classes such as nouns. First, verbs refer to events that, being transient, are less readily extracted as perceptual units than are objects. Second, adults do not tend to label events as they are occurring in natural situations, often using verbs in requests or comments on action before or after the referent event has taken place. The third reason is that the relationship between verbs and the event types they designate is not only complex, but often ambiguous.

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How does the child acquire the meaning of verbs? Verbs are traditionally taken to be part of the so-called relational lexicon the members of which designate relationships between objects (via negation, quantification, predication, etc.) rather than the objects themselves (Gopnik and Meltzoff 1997 and the literature therein). The acquisition of verb meanings involves several categories of learning processes, which can be classified as child-driven, environment-driven, and language-driven (cf. Behrend 1995). Child-driven processes are perceptual, cognitive, or linguistic biases that constrain the kind of information the child considers in learning the meaning of a new verb in a given situation. Recent studies on this topic have focused on the question of whether the acquisition of change-of-state verbs is guided by a "manner bias" or a "result bias" (cf. Gentner 1978, 1982; Behrend 1990; Gropen et al. 1991; Kelly and Rice 1994; Wittek 1999). Environment-driven processes include factors such as frequency, timing, or variability as well as real-world characteristics of verb usage in the input the child is exposed to (cf. Tomasello 1995). Language-driven processes are learning algorithms that are based on the child's knowledge of the architecture of the verb lexicon. This knowledge primarily concerns the internal organization of specific modules such as argument structure and event structure as well as their interaction with syntactic, morphological, and semantic features. Much work in this area has focused on the issue of *syntactic bootstrapping*. This issue is primarily connected with work done by Gleitman (1990), Fischer et al. (1991), Naigles (1990), and related studies in which evidence is provided that children systematically employ information coded in the argument structure, in order to map the meaning of a novel verb. These findings are related to Behrend and Harris (1992), who provided evidence that the occurrence of inflectional cues such as *-ed* vs. *-ing* endings influences the child's decision as to whether a novel verb is action- or result-oriented.

The present paper addresses learning strategies that are closely connected to language-driven processes of acquiring verb meanings. We focus on a specific component of verb meaning, namely event structure, and investigate the distinction between normally developing and language-impaired children. The paper is organized as follows. Section 1 outlines the theory of event typology and the event-structural bootstrapping hypothesis, which is based on the special role of telicity and the resultative subevent in the early stages of the acquisition of event structure. A distinction will be made between the algorithms normally developing and language-impaired children employ in order to derive verb meanings. Section 2 summarizes our findings from a longuitudinal study of the acquisition of event structure during the one-word stage. Section 3 presents our experimental study, which examined the comprehension of telic events in normally developing and language-impaired children. In section 4 we discuss the results of both analyses, focusing on the distinction between normally developing and language-impaired children. It is argued that the differences between the two groups can be best accounted for in terms of "deviation," which is amenable to the hypothesis that language-impaired children fail to employ the learning strategies used by the normally developing children.

2. Learning event structure and the learner's point of view

Generally, verbs are used to denote events, that is, parts of scenes in the world that are linguistically encoded. To acquire the meaning of a novel verb, children must be able to assign a specific event type to the new sound string. In line with Pustejovsky's (1995) theoretical framework of a universal event typology, the "event type" is a [State] (e.g. "be sick" or "know"), a [Process] (e.g. "walk around" or "talk"), or a [Transition]. Transitions consist of two subevents, typically a [Process] and a [State] that results from or delimits the foregoing process. Verbs denoting transitions of this kind are generally referred to as "telic" (cf. van Hout 1996). This is, for instance, the case for events designated by change-of-state verbs of the type 'open' or 'close'. Both verbs involve some kind of motion that leads to a natural endstate.

At first glance, this event typology seems to be rather simple to acquire. However, from the child's point of view, the task of assigning a specific event type to each new verb is particularly complex. This complexity results inter alia from the characteristics of change-of-state verbs, which are ambiguous with regard to their event type. As proposed by Slobin (1981), change-of-state verbs have a special status in early vocabulary due to their conceptual prominence, which enables the child to encode verbal phrases by referring to "basic manipulative scenes" such as simple agent–affect–patient events. The "basic manipulative scenes" correspond to the experiental gestalt of a basic causal event in which an agent brings about a physical and perceptable change in a patient by means of a direct manipulation. Slobin's assumption is compatible with Spelke's (1995) findings that children are already capable of representing the concepts of cause, process, state, and result during the first year of life.

However, the class of change-of-state verbs in a language like German is by no means uniform. This fact becomes clear once we look more closely at verbs that denote results or endstates from the point of view of Pustejovsky's event typology. In general, verbs labeling resultative

actions in German may be either endstate-oriented or process-oriented (cf. Schulz et al. 2001; Wittek 1999). Consequently, we can distinguish the following two main categories:

Category 1: inherently telic verbs with an unequivocal endstate orientation. The members of this category are typically verbs such as *aufmachen* 'open' or *ausmachen* 'turn off'. These verbs are genuine [Transitions] and cannot undergo event-type shift. Leaving aside changes in the temporal and modal use of the verb, there is no context in which the members of this category may be assigned a pure process (i.e. atelic) reading.

Category 2: compositionally telic verbs. The members of this category are process-oriented verbs that may undergo an event-type shift from [Process] to [Transition]. In these cases an endstate subevent can be added to the process either by grammatical means (such as adding a determiner or a prepositional phrase) or by semantic-pragmatic means. Process verbs of consumption such as *essen* 'eat', for example, become telic [Transitions] by means of adding a determiner to the object as in (1b). Similarly, verbs of motion with deictic prefixes (such as *rauftun* 'put up there' or *hinaufgehen* 'walk up') become telic [Transitions] either due to a pragmatically intended result, (2a), or by means of adding the "prepositional copy" *auf* 'up' to the path object, (2b).

The examples in (1) and (2) illustrate the event-type shift typical of category 2.[1]

(1) a. >process, atelic with the bare object
Er hat Käse gegessen.
he has cheese eaten
'He ate cheese'

b. >transition, telic with the determiner
Er hat den Käse gegessen.
he has THE cheese eaten
'He ate THE cheese'

(2) a. >ambiguous telic/atelic
Ich bin den Berg hinaufgegangen
I am the mountain up/onto (deictic prefix) gone
'I walked up/onto the mountain'

b. >unambiguous process, telic
Ich bin AUF den Berg hinAUFgegangen
I am up the mountain up/onto (deictic prefix) gone
'I walked up/onto the mountain'

Given this classification, change-of-state verbs are highly ambiguous from the child's point of view: although all the change-of-state verbs mentioned above may refer to scenes with an endstate in the world, the underlying event structure of the individual verbs may be different. In other words, whereas the members of category 1 are genuine [Transitions] with an unequivocally telic reading, the members of category 2 may have both a [Process] and a [Transition] reading, depending on the pragmatic and syntactic context. On the view that the child has to assign to each verb the correct event structure before target lexical representations can be projected (cf. Penner et al. 1998; Schulz et al. 2001), this kind of ambiguity is certainly a potential hindrance to learning the meanings of verbs.

2.1. *The working hypothesis: event-structural bootstrapping*

How does the child resolve this ambiguity? It has been repeatedly argued that, in order to resolve the ambiguity of the primary linguistic data, the child's initial hypothesis space must be narrowed in some systematic way (cf. Woodward's 2000 overview). The child makes use of a set of biases, attentional preferences, default assumptions, and algorithmic principles such as the "subset principle," which predetermine the order of acquisition stages. Within this framework, the so-called "strong continuity hypothesis" is the most conservative approach.[2] The basic premise of this approach is that, due to the lack of negative evidence, the child's ability to revise her initial and intermediate representations is limited. In the light of this fact, the strong continuity hypothesis suggests that the child must employ a learning procedure that enables her to systematically avoid irreversibly wrong lexical decisions. The core of this proposal is that changes in the child's lexical representations should always be additive ones. That is, the child may extend her intermediate representations by adding more features or nodes to the existent ones. By contrast, any revision that requires that already existent features or nodes be deleted or replaced by new ones is excluded.

With this in mind, let us now examine what the consequences of this approach for the learning procedure might be in the case of acquiring the verb's event type. Our account is based on the "event-structural bootstrapping hypothesis" proposed in Penner et al. (1998), Schulz et al. (2001, 2002).[3] This hypothesis was originally developed in order to capture the unexpected differences between normally developing and language-impaired children we have found with regard to the acquisition of the first verbs in German. We hold that the comparison between the

two populations not only helps us to understand the nature of language disorders but also sheds more light on the learning algorithms employed by normally developing children.

The event-structural bootstrapping hypothesis says that the child may avoid target-inconsistent representations of change-of-state verbs if the semantic category she chooses to start with is systematically constrained. More precisely, we assume that the child first focuses her attention on change-of-state verbs that match events of "category 1," that is, unequivocal resultative events with a less salient process subevent. Using this strategy, the child first becomes capable of correctly generating the eventual representations of inherently telic verbs like *aufmachen* 'open' or *ausmachen* 'turn off', which refer to resultative events. As for the compositionally telic change-of-state verbs such as *essen* 'eat' or *rauftun* 'put up there', overgeneralizations of the telic reading to this category would not yield erroneous representations in the sense of the strong continuity hypothesis, since compositionally telic verbs ARE compatible with the result reading. Further eventual specification of these verbs, namely the syntactic and pragmatic conditions under which an event-type shift may take place (from atelic to telic), may follow later in the form of an incremental extension of the initial representation. In more general terms, the basic hypothesis is that the child starts out with a correct event representation of category 1 verbs that can be extended to verbs of category 2 as well. The event representation of category 2 is acquired later.

If, however, the child opts for the inverse order, irreversibly wrong decisions may emerge. More specifically, if the child starts out with the default assumption that all change-of-state verbs are of the type "category 2" (i.e. process-oriented with an optional endstate subevent), she would end up in a wrong overgeneralization. That is, she would erroneously assume that verbs of the type *aufmachen* 'open' or *ausmachen* 'turn off' allow a process-oriented reading on a par with *essen* 'eat'. In order to derive the target representation, the child would then have to reanalyze existent slots in her representation. Under the "no-negative-evidence" postulate, such a revision would not be easy to carry out.

Given these two options, the event-structural bootstrapping hypothesis gives rise to the following set of expectations with regard to the language development under normal and exceptional circumstances.

First, we predict that normally developing (ND) children, due to their adherence to the learnability-driven constraints, would employ event-structural bootstrapping from early on. Under this assumption, we expect this choice to manifest itself as a clear preference for inherently telic verbs of category 1 during the first stage of acquisition and on-target

usage of event expressions from early on in both production and comprehension. This preference has been referred to as "endstate orientation" (Schulz et al. i.p.).

As for language-disordered children, two different predictions can be made, depending on which approach to language impairments one favors. On the assumption that the deficits of language-impaired (LI) children are amenable to mere delays in the acquisition of linguistic knowledge (in the sense of the "parallelism hypothesis" discussed in Clahsen 1988; Leonard 1998, and the literature therein), we would expect the difference between the ND and the LI group to be purely quantitative. That is, we would expect LI children to be slower than the ND group but not to deviate from normal language acquisition in terms of learning procedures. If, however, we follow Penner et al. (1999) and the literature they cite[4] in assuming that LI children often resort to compensatory strategies that violate the learnability-driven constraints on language acquisition (such as the subset principle), we would expect them to deviate from the developmental path assumed to be followed by ND children. Regarding the acquisition of prosody and syntax in German, there is growing evidence in favor of the assumption that LI children indeed deviate from normal language acquisition.[5] If this deviation pattern holds for the acquisition of verb meaning as well, LI children should opt for the broader semantics of category 2 as a default setting and then overgeneralize this representation to the entire group of change-of-state verbs. Such an inverse procedure would end up in an erroneous representation, giving rise to an "irreparable mistake" in the sense of the strong continuity hypothesis. If this assumption turns out to be adequate, the acquisition data of the LI group will be the mirror image of what we expect to find in ND children, namely strong preference for the members of category 2 at the initial stage and target-INconsistent usage of event expressions from early on in both production and comprehension. If confirmed, this deviation might be one possible account for the recent findings that LI children's capacity for learning verbs falls well below that of their same-age peers (cf. Leonard's 1998 overview).

In order to examine these predictions, we conducted two studies, comparing both production and comprehension of verbs in ND and LI children.

3. The longitudinal data

This section addresses the question of how German-speaking ND and LI children log into the verb lexicon. Three main issues are related to

this general question. The first issue concerns the question of which event type the children start with, that is, which type of event do ND and LI children refer to when they produce their first event expressions. The second issue concerns the question of whether there is any crucial difference between the two groups in terms of a "bias" or a "preference" for a certain class of lexical items in the verb lexicon during the one-word stage. The third issue is connected to the correct usage of the early event expressions: to what degree does the usage of telic verbs match with resultative events?

3.1. *Participants*

The data analyzed in this section are taken from the corpora of seven monolingual German-speaking children,[6] all of whom participated in a comprehensive longitudinal study that investigated their language production in the first three years after the onset of speech. Four of the children (two girls, two boys) are normally developing, with no known history of mental, physical, or psychological impairments. They produced their first words between the ages of nine and sixteen months — the time at which they entered the study — and proceeded within normal limits according to age.

Three of the children (one girl, two boys) were classified as language-impaired. They entered the study between the ages of twenty and 26 months when they produced their first words. Having produced fewer than ten intelligible words at this age and no word combination until the age of 2;0, these children fulfill both Paul's (1993) and Rescola's (1989) criteria of late talkers. Up to their third year of life, their productive vocabulary developed very slowly. In concordance with Rescola's (1989) second criterion of late talkers, the transition from one- to two-word utterances took place between the ages of 26 and 33 months (cf. Table 1). All three children were later diagnosed by speech therapists as suffering from receptive and expressive language deficits, while exhibiting cognitive abilities within normal limits for age. Pediatric audiologists confirmed that all children displayed normal hearing abilities. A final assessment of productive vocabulary as well as syntactic and phonological development at the age of six indicated that at this age all three children scored well below their normally developing peers (Wymann n.d.).

Six of the children (three ND, three LI) were recorded in their homes during playtime activities. The sessions generally took place on a weekly basis, lasting approximately forty minutes. One of these ND children (H.), however, was recorded every day for approximately one hour. The fourth of the ND children (Er.) was studied using diary data, with a family member documenting the child's language production every day.

3.2. *The analysis*

For the purposes of the current study we focused on the development of verbs and of verb prefixes (such as *auf* in *aufmachen* 'open' or *rauf* in *rauftun* 'put up there'), which are conventionally taken to be part of the so-called "relational lexicon." Investigation began when children produced their first relational word and ended with the beginning of the two-word stage. The mean and range of ages for both language groups are presented in Table 1.

The analysis of the relational lexicon made use of the methodology and classification proposed by Tomasello and Farrar (1984), Smiley and Huttenlocher (1995), and Gopnik and Meltzoff (1987), who investigated the emergence of relational words such as *all gone*, *bye (bye)*, *down*, *here*, *more*, *no*, *off*, *oh dear*, *on*, *open*, *out*, *stuck*, *thank you*, *under*, *up*, etc. The relational words in our sample were classified as belonging to one of the following categories: (1) verbs and verb prefixes denoting events types; (2) social expressions; (3) assertive expressions (*yes*, *no*); (4) referring expressions (*here*, *there*) (5) personal-relational words (e.g. *aua*); (6) attention-getting devices (*look*, etc.). The total number of relational words in our sample (tokens) was 1012 for the ND group and 861 for the LI group. Excluding items of categories 2–6 as irrelevant for the present study, ND children produced 700 verbs and verbal prefixes compared to 437 tokens in the group of LI children. Verbs and verbal prefixes, were then classified according to the event types they denote in the target language (states, processes, and transitions). In addition, a list of correspondences was compiled between the type of scene commented on by the child and the type of verb produced by the child on this occasion.

Table 1. *Mean and range of ages (in months)*

	First relational word	First two-word utterance
ND ($N=4$)		
Mean age	12	21.6
Range	10–16	20.5–23
LI ($N=3$)		
Mean age	23.13	28.75
Range	21–26	26–33

The scenes were classified according to whether they involved an endstate (resultative or delimited scenes) or not (ongoing, incomplete scenes).

3.3. *Results*

Concentrating first on the onset of the one-word stage, a close examination of the data reveals that the two groups behave differently with regard to the choice of the verbs they employ first. The common denominator of the ND group during the initial stage of the verb lexicon is the consistent usage of members of the category we have referred to as "inherently telic verbs" (category 1). If we look at the first recordings that contain an event expression, we find that all four ND children produce the prefix part of a telic verb like *auf* (for *auf-machen* 'open'), *an* (for *an-machen* 'turn on'), and *aus* (for *aus-machen* 'turn off'). The types of event expression (i.e. verbs and verb prefixes) produced and the time of their first occurrence are summarized in Table 2. It is noteworthy that the children begin with bare resultative prefixes (*auf-*, *zu-*, etc.), which are extended to full verbs (*auf-machen*) between 1;08 and 1;10 (for a detailed discussion cf. Penner et al. 1998, and Schulz et al. 2002).[7]

A typical example of an early event expression is given in (3):

(3) L. (1;04;30). Two lego bricks are put together with an adhesive tape. The child cannot take them apart and requests the experimenter to remove the tape:
Adult: Was soll ich denn damit machen?
what should I (then) with-it do?
L: AUF
up
'open'

Table 2. *Earliest event expressions in normally developing children*[8]

Child (age)	H. (1;03;29)	Er. (1;05;25)	E. (1;03;26)	L. (1;04;06)
Item	auf	aus	auf	an
	'up'	'off'	'up'	'on'
Gloss	aufmachen	ausmachen	aufmachen	anmachen
	'open'	'turn off'	'open'	'turn on'
Item			rein	
			'inside'	
Gloss			reintun	
			'put inside'	

In contrast to the ND children, the LI children in our study start out with verbs with the so-called deictic prefixes such as *runter* (*runtertun*) 'put down, lower' or *rauf/hinauf* (*rauf-/hinauftun*) 'put up'. Table 3 presents the first occurrences of the event expressions and the time of their first occurrence.

A typical example of an early event expression used by LI children is given in (4):

(4) D. (2;03;17) wants to put a toy train on the rails
D: ufä (hinauf)
'upward, put up'

Recall that verbs with deictic prefixes of this type are instances of what we have referred to in the foregoing section as "compositionally telic verbs." In contrast to telic verbs like *aufmachen* 'up-make, open', these verbs denote process events (i.e. motion and its direction) to which a result component can be added under certain syntactic and pragmatic-semantic circumstances. During the early one-word stage the LI children do not use verbs like *aufmachen* 'up-make, open' or *abnehmen* 'take off, remove' to denote unequivocal resultative events. Instead, they resort to onomatopoetic expression such as *bum* or *tagg* (to denote the collision):

(5) D. (2;03;17) is playing with his toy train. One coach is crashing into another one.
D. bum

We now turn to the distribution of the verbs (and verb prefixes) in the children's lexicon during the one-word stage. Table 4 illustrates the distribution of inherently telic verbs and verbs with deictic prefixes relative to the total number of verbs during the one-word stage.

As shown in Table 4, during the one-word stage the ratio of inherently telic verbs and prefixes verbs to process verbs with deictic prefixes is 1.58 to 1 among the children of the LI group, compared to a ratio of 5.32 to 1 among the children of the ND group. Thus, inherently telic verbs are 3.36 times more frequent in the ND children than in the LI children.

Table 3. *Earliest event expressions in language-impaired children*

Child (age)	N. (2;02;02)	V. (1;09;13)	D. (1;11;27)
Item	runter	runter	runter/hinauf
	'down'	'down'	'down/up'
Gloss	runtertun	runtertun	runter-/hinauftun
	'put down, lower'	'put down, lower'	'put down/up'

Table 4. *The distribution of inherently telic verbs/prefixes within the verb lexicon by individual subjects*

Child	Total of event words	Inherently telic verbs/ prefixes (%)	Process verbs with deictic prefixes (%)	Rest (other verb categories) (%)	The ratio of inherently telic to process verbs with deictic prefixes	The ratio of inherently telic to all other verbs
E. (ND)	202	46.53	7.92	45.55	5.87:1	0.87:1
L. (ND)	251	79.68	13.94	6.4	5.71:1	3.94:1
H. (ND)	91	80.22	8.79	10.99	9.12:1	4.00:1
Er. (ND)	156	73.07	21.79	5.13	3.35:1	2.71:1
N. (LI)	202	47.50	30.69	21.81	1.54:1	0.90:1
V. (LI)	36	47.22	36.11	16.67	1.30:1	0.89:1
D. (LI)	199	55.77	28.14	16.09	1.98:1	1.26:1
Mean ND	–	69.87	13.11	17.51	5.32:1	2.86:1
Total ND	700	68.71	13.28	18.57	5.16:1	3.02:1
Mean LI	–	50.01	31.64	18.4	1.58:1	1.06:1
Total LI	437	51.02	29.97	18.99	1.61:1	1.04:1

Furthermore, during the one-word stage the ratio of inherently telic verbs and prefixes to all other VERBS is 1.02 to 1 within the LI group, compared to a ratio of 2.86 to 1 within the group of ND children. Put differently, inherently telic verbs are 2.80 times more frequent in the ND children than in the LI children.

The difference between the ND and the LI group becomes even clearer, once we look at the rate of correspondences between verbs and the type of scene the children referred to. Following the criteria of Smiley and Huttenlocher (1995), we examined the degree to which inherent telic verbs and verb prefixes were correctly used in resultative events (i.e. verbalized scenes that unequivocally involved an endstate). The analysis of the data reveals that LI children more frequently use inherently telic verbs and verb prefixes to denote an event that is expressed by a verb with a deictic prefix in the target language than the ND children. A typical example for such a mismatch is given in (6):

(6) D. (2;03;17) wants his mother to take an (Easter) egg out of a basket
D. us-na (aus-nehmen instead of raus-nehmen)
out-take ('exclude' instead of 'take-out of')

The matching degree between telic verbs and resultative events in the two groups is given in Table 5.

Table 5. *The correct usage of inherently telic verbs*

Child	Inherently telic verbs and prefixes relative to telic events	In %
E. (ND)	88 < 94	93.61
L. (ND)	170 < 200	85.00
H. (ND)	66 < 73	90.41
Er. (ND)	109 < 114	95.61
N. (SLI)	4 < 95	4.21
V. (SLI)	2 < 17	11.76
D. (SLI)	41 < 111	36.93
Mean ND	–	90.90
Total ND	433 < 481	90.77
Mean SLI	–	17.63
Total SLI	47 < 223	21.10

As for the ND children, the overwhelming majority of inherently telic verbs or prefixes, namely 90.1%, are correctly used to denote resultative events. This is not what we find in the LI group. Telic verbs and prefixes are used to refer to resultative events in only 17.6% of the cases. Most of the inherently telic verbs or prefixes, namely 82.4%, are used by the LI children in a context that is expressed by a verb with a deictic prefix in the target language. Interestingly enough, we have found that the LI children also use process verbs with deicitic prefixes in resultative events (16.79%). A typical example of this kind of error is given in (7). Note that such errors do not occur in the corpora of the ND group:

(7) D. (2;02;27) A toy train is driving toward the end of the rails. The train is falling OFF the ralls.
D. abä (runter)
'downwards' (instead of 'off')

In sum, the production data from the longitudinal studies reveal three main differences between ND and LI children with regard to the development of the verb lexicon during the one-word stage:

– The ND children start out with members of the category "inherently telic verbs" (verbs with resultative prefixes), while LI children choose verbs with deictic prefixes to start with. The latter are members of category 2, "compositionally telic verbs."

– Within the ND group, inherently telic verbs are 2.86 times more frequent than all other verbs during the one-word stage. No such clear "endstate orientation" (or preference) is observed in the LI group.

– In the overwhelming majority of the cases, ND children correctly map endstate events onto inherently telic verbs. By contrast, LI children do so only marginally.

These findings reflect two different orientations during the one-word stage. The data indicate that the early verb lexicon of ND children is organized around the INHERENTLY telic verbs. By contrast, the aspectually AMBIGUOUS verbs of category 2 seem to be more central for the LI group.

4. The experimental study

4.1. *Goals of the study*

According to our account of the initial stages of ND and LI children's verb acquisition in terms of event-structural bootstrapping, the two learner groups should differ at the level of comprehension as well. Therefore we designed an experimental study to investigate whether and how the qualitative differences between ND and LI children affect their comprehension of event structures. We hypothesized that ND children, adhering to an endstate orientation, should recognize that the endstate is a necessary property of inherently telic verbs. This endstate orientation should guide ND children's comprehension from early on; therefore we included a group of two-year-old children in our study. To our knowledge, to date children this age have not been tested with this type of verb-comprehension task. LI children, on the other hand, due to a lack of the endstate orientation, should not recognize that the endstate is entailed by endstate-oriented verbs. To avoid ambiguous responses we concentrated on one single inherently telic verb of category 1, namely the telic verb *aufmachen* 'open'. This verb was chosen for two reasons. First, the hierarchy of subevents is optimally transparent, because the prefix *auf* unambiguously marks the endstate as the more prominent subevent, while the process subevent is lexically marked by the light verb *machen* 'make, do' that carries little meaning on its own. Second, as shown in section 3, *aufmachen* has been documented in children's speech from very early on.

First results from this experimental study comprising fewer subject groups have been reported elsewhere (Schulz et al. 2001, 2002). In order to address the question of how persistent the deficits observed in three- and four-year-old children with LI are, we subsequently extended the database by including a group of five- to eight-year-old children with LI. We first summarize the main features of the experimental design and then discuss the results with a focus on the performance of the two groups of LI children. A comparison of their interpretation patterns to that of normally developing children between the ages of two and four serves to shed light on the delay vs. deviation controversy regarding the differences between ND and LI children.

4.2. *Method*

4.2.1. *Subjects.* Eighty subjects participated in this study: sixteen young normally developing children (ten girls, six boys, $M = 2;10$, *range* = 2;00–3;01), sixteen language-impaired children (eight boys, eight girls, $M = 3;10$, *range* = 2;11–4;10),[9] sixteen chronologically age-matched normally developing children (seven boys, nine girls, $M = 3;10$, *range* = 2;11–4;10), and a second group of sixteen older language-impaired children (twelve boys, four girls, $M = 6;09$, *range* = 5;00–8;07). Sixteen university-educated adults served as a control group (six men, ten women, $M = 37;08$, *range* = 27–66). All of the subjects were native German speakers, with no known history of physical, socioemotional, or mental impairments. The normally developing children exhibited age-appropriate speech, language, social, and cognitive functioning according to preschool-teacher and parent reports. The children with language impairment met the following criteria: (a) they were diagnosed by speech therapists as suffering from receptive and expressive language deficits, (b) their cognitive functioning is reported to be within normal limits for age, and (c) there is no report of hearing impairments. All LI-children were enrolled in preschool or school programs for children with language disorders. None had received any therapy focusing specifically on verb meanings.

The chronologically age-matched children were matched so that for each child in the first group of children with language impairment there was a child in the age-matched group within one month of age.

An additional seven children were tested but had to be excluded from analysis. One young normally developing child and three of the language-impaired children did not pass the pretest, and three young normally developing children did not complete the experiment.

4.2.2. *Materials.* For the test items, thirty-two picture sequences were created, each composed of two photographs depicting different instances of opening a container. The first photograph always depicted the closed container and a hand moving toward it. The second photograph depicted the outcome of the action: the opened or unopened container and the hand being withdrawn. Thus the picture sequence varied with regard to

the conditions *endstate* and *no-endstate*. Using a truth-value judgment task (cf. Crain and McKee 1985), we designed yes/no questions asking whether the person had opened the container. A subject who knows that the meaning of *aufmachen* 'open' entails the endstate [be open] should answer *yes* in the first case and *no* in the second case. In half of the picture sequences, the container was being manipulated by using just the hands, while in the other half the container was being manipulated with the help of a tool. This feature of the original design is not treated as an experimental condition here, as the focus is on children's sensitivity to the endstate. Therefore the results are collapsed across instrument and no-instrument items, and the manipulation will be disregarded in the following discussion (but cf. Schulz et al. 2002).

There were eight different instances of opening a container. Each subject thus saw a total of eight test trials, four each in the two conditions *endstate* and *no-endstate*. A typical story is illustrated in (8):

(8) Sample item
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 sie'se aufgemacht?[10]
has she-her.CL AUF-made.PART
'Did she open it?'
Answer [condition *endstate*]: Ja 'yes'
Answer [condition *no-endstate*]: Nein 'no'

The two conditions as well as the manipulation of the container with or without an instrument were counterbalanced across the eight test items, yielding four different versions. Possible effects of order of test items were controlled for by designing two different orders, thus arriving at eight different lists to which subjects were assigned randomly.

4.2.3. *Procedure.* Each subject was tested individually in one session lasting approximately twenty minutes. Before the actual experiment a pretest was administered to ensure that both ND and LI children were able to respond to yes/no questions appropriately. While children were given the opportunity to explore and manipulate the containers and their content depicted in the picture sequences, they were asked simple yes/no questions about the objects (e.g. *Is that a suitcase?*). Only those children who answered all four pretest questions correctly participated in the main test. The encounters with the concrete objects moreover served the purpose of guarding 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.

Followed by four practice trials, each subject was presented with the eight test items. As in the practice trials, the experimenter narrated the event. A hand puppet then asked the yes/no question.

Interspersed with the test items, there were four control items, which were also accompanied by picture sequences, each composed of two photographs. The control items contained verbs other than the test verb but were also phrased in the perfect tense. These were added to ensure that children paid attention to each item until the end and moreover to counteract processing strategies such as confirming endstate situations and rejecting no-endstate situations. Therefore two control trials showed an endstate situation but called for a *no* response, because the verbs used (*zerbrechen* 'break' and *austrinken* 'UP-drink') did not match the events displayed in the picture sequences. Two further control trials did not show an endstate but required a *yes* response, because the verbs used (*malen* 'draw' and *bauen* 'build') matched the events in the picture sequences.

4.2.4. *Predictions.* We predicted that both groups of ND children would correctly reject *aufmachen* 'open' for events in which the endstate is not reached, since they are aware that inherently telic verbs entail their endstate. Due to the age difference, we expected that performance of the three- and four-year-olds would be even better than performance of the two-year-olds. LI children, on the other hand, should accept *aufmachen* 'open' also for events in which the endstate is not reached, since it is predicted that they allow a process-oriented as well as an endstate-oriented interpretation for inherently telic verbs. Performance of the older children with LI was expected to be better than performance of the three- and four-year-olds with LI, while still not reaching adult-like behavior. 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. Performance on the control items was predicted to be high for all subjects.

4.3. *Results*

4.3.1. *Group responses to controls and test items.* Responses to the test items were coded as correct or incorrect, as described in the materials section. A correct response received a score of 1, an incorrect response received a score of 0. In order to compare the mean of the controls to

the mean of all test items, we introduced a meta-variable "item" with the conditions [control item] and [test item]. All responses were first analyzed by a (5) group × (4) version × (2) order × (2) item ANOVA, with the last factor as a repeated measure ($\alpha = 0.05$). There were no significant effects of version ($F[3,40] = 0.72$, $p = 0.544$) and of order ($F[1,40] = 0.34$, $p = 0.561$). Therefore, the between-subject factors version and order were neglected in the further analysis. All responses were then analyzed by a 5 (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 in Table 6.

There was a significant effect of group, ($F[4,75] = 9.87$, $p < 0.001$) and a significant effect of item ($F[1,75] = 35.24$, $p < 0.001$). The interaction of group and item was also significant ($F[4,75] = 11.27$, $p < 0.001$). *Post hoc* comparisons of means (using a Scheffé test) revealed that the performance of the three- and four-year-old children with LI on the test items differed significantly from that of their age-matched peers as well as from the performance of the young ND children and the adults, all three of which formed a homogeneous subset. A second homogeneous subset was formed by the three- and four-year-old children with LI and the older children with LI.

A second *post hoc* comparison regarding performance on the control items (again using the Scheffé test) indicated that none of the between-group comparisons was significant.

4.3.2. *Analysis of test items and subgroup comparisons.* The responses to the two test conditions were analyzed by a 5 (group) × 2 (endstate) ANOVA, with the last factor as repeated measure (preserving α at 0.05). The analysis revealed significant main effects of ($F[4,75] = 16.38$, $p < 0.001$) and of endstate ($F[1,75] = 21.65$, $p < 0.001$). Table 7 presents the percentage of correct responses to the two conditions *endstate* and *no-endstate*.

Table 6. *Proportion of correct responses (and standard deviation) by item type and subject group*

Item	Young ND (2;0–3;1)	Age-matched ND (2;11–4;10)	LI (2;11–4;10)	Old LI (5;0–8;7)	Adults
Control items	87.50 (15.81)	98.44 (6.25)	95.31 (10.08)	92.19 (17.60)	100 (0.0)
Test items	89.06 (13.59)	92.97 (11.15)	64.13 (11.06)	78.13 (20.16)	97.66 (6.80)

Table 7. *Proportion of correct responses (and standard deviation) by endstate and subject group*

Condition	Young ND (2;0–3;1)	Age-matched ND (2;11–4;10)	LI (2;11–4;10)	Old LI (5;0–8;7)	Adults
Endstate	100 (0.0)	96.87 (8.53)	82.81 (23.66)	92.18 (25.36)	100 (0.0)
No-endstate	78.12 (27.19)	89.06 (20.34)	45.31 (37.88)	64.06 (37.60)	95.31 (13.59)

The interaction of subject group and endstate was almost significant ($F[4,75] = 2.05$, $p = 0.095$). Figure 1 shows the interaction plot for the proportion of correct responses.

Weighted analyses of contrast were employed to examine possible distinctions between the four children groups. For the [−endstate] condition, there was a signifiant difference between the two groups of ND children and the two groups of LI children ($T[60] = 3.655$, $p = 0.001$), due to the low means of the LI groups ($M = 45.5$ and $M = 64.1$ respectively). In order to test whether performance of LI children was different from chance, the means for the [−endstate] condition were compared to the proportion anticipated by chance (50.0) using the G test. It was found that if the endstate was not reached, performance was at chance level for the younger LI children ($p = 0.69$) but not for the older LI children ($p < 0.01$). The contrast between the performance of the young and the age-matched ND children in the [−endstate] condition was not significant

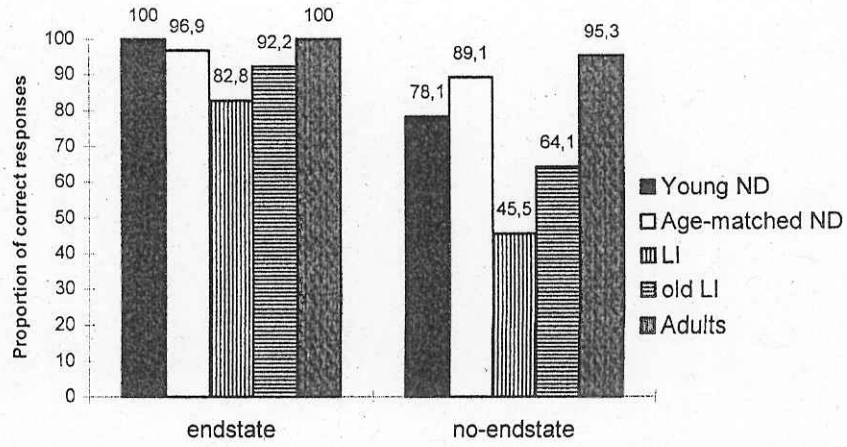

Figure 1. *Proportion of correct responses to the test items by endstate and subject group*

($T[60] = -0.987$, $p = 0.322$), nor was the contrast beween younger and older LI children ($T[60] = -1.677$, $p = 0.099$). Regarding the [+endstate] condition, the contrast between the two groups of ND and LI children was significant ($T[60] = 2.449$, $p = 0.017$), while there was no contrast between the performance of the younger and the older ND children ($T[60] = 0.495$, $p = 0.622$) and between the younger and the older children with LI ($T[60] = -1.485$, $p = 0.143$). The G test revealed that in the [+endstate] condition, both groups of LI children performed significantly above chance ($p < 0.01$).

Finally, an ANOVA with the factor endstate as repeated measures was used to assess the responses of both groups of LI children in isolation. For the three- and four-year-old LI children there was a significant effect of endstate ($F[1,15] = 6.43$, $p = 0.023$), resulting from a lower mean in the [−endstate] condition ($M = 45.31$) than in the [+endstate] condition ($M = 82.75$). For the older children with L, the effect of endstate was significant as well ($F[1,15] = 5.08$, $p = 0.040$).

4.3.3. *Analysis of individual responses.* Individual responses were examined to investigate whether the observed group differences between ND and LI children in the [−endstate] and [+endstate] condition were also found in children's individual performance. Table 8 and Table 9 show the percentage of correct answers to the [−endstate] and [+endstate] condition for each child in the four subject groups, respectively.

A chi-square analysis comparing the individual responses among ND children and among LI children (with the response types 25% and 0% correct combined) confirmed that the distribution of responses differed significantly ($\chi^2(14, N = 64) = 14.809$, $p = 0.002$).

The [−endstate] and the [+endstate] condition were considered to be mastered by a child if she gave at least three correct responses. Then

Table 8. *Percentage of correct responses in the [−endstate] condition distributed over subjects by subject group*

Percentage of correct responses (4 correct responses possible per subject)		Young ND ($N = 16$)	Age-m. ND ($N = 16$)	LI ($N = 16$)	Old LI ($N = 16$)
100	(4/4)	8	11	4	7
75	(3/4)	4	4	0	2
50	(2/4)	2	0	5	4
25	(1/4)	2	1	3	0
0	(0/4)	0	0	4	3

Table 9. *Percentage of correct responses in the [+endstate] condition distributed over subjects by subject group*

Percentage of correct responses (4 correct responses possible per subject)		Young ND ($N = 16$)	Age-m. ND ($N = 16$)	LI ($N = 16$)	Old LI ($N = 16$)
100	(4/4)	16	14	9	14
75	(3/4)	0	2	4	1
50	(2/4)	0	0	2	0
25	(1/4)	0	0	1	0
0	(0/4)	0	0	0	1

defining mastery of the verb *aufmachen* 'open' for the present purposes as passing both the [+endstate] and the [−endstate] condition, the following results emerge: twelve out of sixteen (75%) normally developing two-year-olds responded as though they had mastered the inherently telic verb *aufmachen*. Among the three- and four-year-olds, fifteen out of sixteen (93.75%) ND children and one out of sixteen (6.25%) LI children had mastered the verb. Among the older children with LI, eight out of sixteen (50%) had mastered the inherently telic verb *aufmachen*.

4.4. *Discussion*

The high number of correct responses to the control items shows that both ND and LI children had in general no difficulty understanding yes/no questions containing a verb in the perfect tense. Thus, we can conclude that children's performance on the test items, which were also worded as yes/no questions in the perfect tense, is not impeded by general problems with this format. The analysis of the children's data confirmed that both groups of ND children performed better on the test items than both groups of LI children.

Both groups of ND children correctly rejected *aufmachen* 'open' for events in which the endstate is not reached in 78% and 89% of the cases, respectively. Although not reaching significance, performance of the three- and four-year-olds was better in this condition than performance of the two-year-olds, as expected. LI children's rejection of *aufmachen* for events in which the endstate is not reached was much less frequent. While the three- and four-year-old LI children performed at chance level (46% correct), the five-to-eight-year-olds with SLI correctly rejected *aufmachen* for incompleted events in 64% of the cases, but still they did not perform significantly better than their younger LI peers. Performance of

the older group of LI children is on a par with that of ND children who are about four years younger and significantly lower than that of ND children who are about three years younger. As expected, performance of the three- and four-year-olds with LI is significantly lower than that of their one-year-younger ND juniors.[11]

Regarding the [+endstate] condition, all groups correctly accepted the inherently telic verb *aufmachen* if the picture depicted an event in which the endstate is reached. Even though both groups of children with LI performed lower than the ND children (83% correct for the younger and 92% correct for the older group), the differences in performance were not significant.

Analysis of the individual responses confirmed the differences between ND and LI children. Only 6% of the three- and four-year-olds with LI (i.e. one child) had mastered the endstate-oriented verb *aufmachen*, compared to 94% of their ND age-matched peers and to 75% of the ND two-year-olds. Even among the older children with LI, 50% of the children had still not acquired a complete understanding of the verb.

5. On the nature of developmental language disorders: delay or deviation?

5.1. *Summary of the results: production and comprehension*

A crucial step in acquiring the meaning of an unfamiliar verb is to identify the specific event type expressed by the new verb. In doing so, the child must resolve the ambiguity associated with change-of-state verbs, which can be either endstate- or process-oriented. It was hypothesized that ND children are successful in this task by virtue of employing the event-structural bootstrapping procedure. By contrast, it was predicted that LI children fail to do so due to their limited accessibility to this kind of learnability-driven constraint.

Results from our production and comprehension studies are consistent with this hypothesis. The linguistic behavior patterns of the LI children were shown to be clearly different from those of their ND peers in both domains. The findings from the longitudinal study indicate three substantial differences between the ND and the LI group:

– The ND children start out with members of the category "inherently telic verbs," while LI children choose "compositionally telic verbs" to start with.

– During the one-word stage, the ND but not the LI children display a clear "endstate orientation" (or preference).

– The ND, but not the LI children's usage of inherently telic verbs is consistent with the target language.

The results from the comprehension study complement the findings of the longitudinal studies. The most important outcome of the experiment depicted in the foregoing section is that two-year-old ND children are capable of interpreting inherently telic verbs in a target-consistent manner. They know that members of first-category change-of-state verbs are inherently telic and thus reject *aufmachen* 'open' whenever there is no evidence for a result of the action. LI children, on the other hand, are willing to accept the inherently telic verb *aufmachen* 'open' even if the action does not lead to a visible result. Crucially, the difference between ND and LI children holds for both group and individual analysis. This clearly indicates that the ND and the LI children in our study form two distinct populations with regard to their linguistic behavior.

The findings for the ND children are in accordance with the German data in Behrens (1993) and Wittek (1999). In her experiments, Wittek found that inherently telic verbs like *aufmachen* 'open', *zumachen* 'close', *abmachen* 'pick', and *ausmachen* 'extinguish' are interpreted correctly by four- and five-year-olds in 80% to 100% of the cases. As for English, our results are in line both with Behrend's (1990) experiment on novel-verb learning and the elicitation experiment conducted by Kelly and Rice (1994). As shown in Behrend (1990), the result subevent is the most salient semantic component for ND children in verb-learning tasks. Kelly and Rice (1994) argued for a similar result preference for the ND children in situations with novel-verb learning.

However, the results from our longitudinal and comprehension studies do not confirm the so-called "manner bias hypothesis" proposed by Gentner (1978, 1982) and Gropen et al. (1991), according to which ND children up to five years of age are more manner- than result-oriented in learning novel verbs for events of change of state. The results from our LI group are in agreement with the findings in Kelly and Rice (1994), who argued that five-year-old LI children, as opposed to their age-matched ND peers, do not show a clear preference in applying a novel verb to either a pure process or a change-of-state event. Similarly, Watkins and Rice (1991) showed that LI children perform significantly worse than ND children on the supply of resultative particles, as in "kick off the shoe" (cf. also Ingham et al. 1998).

5.2. *Delay or deviation?*

These findings raise the question concerning the underlying developmental pattern that yields the entirety of these systematic differences between

ND and LI children at both the production and comprehension level. In section 1 two possible answers to this question were presented. The first account is a purely quantitative one in the spirit of the "parallelism hypothesis."[12] According to this hypothesis, LI children employ the same learning procedure as the ND children. However, being less efficient language learners, they start late, learn slowly, and may stagnate in an intermediate stage of normal development. The other account is the "deviation hypothesis" (cf. the discussion in Penner et al. 1999), which postulates that LI children use learning procedures that are fundamentally different from the ones observed in normal language acquisition. It is postulated that these atypical learning procedures yield not only delays and stagnation in language development, but also genuine deviations in linguistic behavior patterns.

Admittedly, some of our findings can be accounted for in terms of both "delay" and "deviation." For instance, lack of a clear "endstate orientation" (or preference) in LI children can be explained in both qualitative and quantitative terms.

There are, however, certain facts that clearly support the deviation hypothesis. Two findings are crucial in this regard. First, it is evident that the ND and LI group behave differently with regard to how the children log into the verbal lexicon: instead of confining themselves to the inherently telic verbs, the LI children choose verbs with deictic prefixes to start with. Second, we have found that the young LI children's performance in the comprehension task is at chance level. Of particular interest is the result that the older LI children's performance (up to the age of eight years), although minimally improved, still falls below that of the young ND children. It is evident that this kind of overgeneralization cannot be observed in the course of normal language acquisition.

These observations suggest that the linguistic behavior of the LI children cannot be accounted for in terms of a pure quantitative delay within the normal range of linguistic knowledge. One plausible explanation for these findings would be that the two groups acquire the lexical representation of change-of-state verb by means of two different learning procedures (or default settings). ND children seem to log into the verb lexicon with an explicit representation of the inherently telic verbs (category 1), which they correctly associate with the target lexical items and the corresponding events in their surrounding. Verbs for other event types seem to be less important to the children during the initial stage. This strategy clearly manifests itself in the longitudinal data, where there is overwhelming evidence for both a clear preference for inherently telic verbs and a tight correlation between resultative events the child verbalizes and the usage of inherently telic verbs. This assumption is further confirmed by

the comprehension data, which reveal a high level of performance from early on in interpreting the inherently telic verb *aufmachen* 'open'. As shown in detail in Penner et al. (1998), process-oriented change-of-state verbs like *malen* 'draw' or *essen* 'eat' are added to the child's lexicon at a later stage.[13] This indicates that the child extends her lexicon to include change-of-state verbs of category 2 only after she has established the representation of inherently telic verbs of category 1.

As for the LI children, the data obtained from both studies suggest that they opt for the inverse learning procedure. By "inverse" we mean that the LI children start out with the eventual structure of category 2 ("compositionally telic verbs") as a default setting for the whole class of change-of-state verbs. The first manifestation of this particular choice is the LI children's clear preference for verbs with DEICTIC prefixes during the initial stage. We assume that this choice is by no means random. As alluded to above, verbs with deictic prefixes in German of the type *runternehmen* 'downward-take' or *raufun* 'upward-put' are change-of-location verbs. In contrast with inherently telic prefix verbs of the type *aufmachen* 'open' (category 1), these verbs denote processes to which an endstate can be compositionally added by either syntactic or semantic means. Given these facts, we hypothesize that, in contrast with the ND children, the LI children log into the verb lexicon with the event type "category 2" as a default representation. The LI children's comprehension errors observed in the later stages of lexical development corroborate our assumption that this overextension goes well beyond the initial stage, tending to become persistent.

5.3. *A learnability account*

From a learnability point of view, ND children can be said to proceed in an extremely conservative way in the sense of the strong continuity hypothesis. They adhere to the dictum "avoid irreversibly wrong lexical decisions" in that they start out with the inherently telic verbs of category 1, extending their verbal repertoire to include the more ambiguous change-of-state verbs of category 2 at a later stage. By virtue of this procedure, the ND children do not risk irreversibly wrong lexical decisions, since even an initial overgeneralization of the telic reading to all change-of-state verbs would be compatible with the verbs of category 2, which permit both process and endstate reading. This acquisition procedure, which we referred to as event-structural bootstrapping in section 2, allows a piecemeal extension of the lexical representation of the verb without any genuine reanalysis of existent representations.

Contrarily, the procedure observed in the LI group clearly VIOLATES the maxim "avoid irreversibly wrong lexical decisions." In overextending the event structure of category 2 as a default setting to category 1, they project a lexical representation that is INcompatible with the semantics of inherently telic verbs, since the latter do not permit a process reading.

From a learnability point of view, this state of affairs ends up as a "developmental cul-de-sac," since the child cannot revise this initial wrong hypothesis in the absence of negative evidence. This account predicts that the inability of LI children to consistently distinguish between inherently telic verbs and compositionally telic verbs in German becomes persistent. The question of whether minimal improvement of the older LI children's performance on the comprehension task is amenable to compensatory strategies must be left open here. One immediate result of the LI children's false overgeneralization is their reduced ability to acquire the semantics of change-of-state verbs. Given the special status of these verbs in the early stages of the verb lexicon, the question arises as to what extent this deficit may affect the LI children's capacity of learning new verbs in general.

5.4. *Implications: the source of language impairments*

If our analysis is basically correct, then the difference between the lexical development in ND versus LI children is best captured in terms of deviation at the level of learning algorithms rather than in terms of a pure delay. What are the general implications of these findings for the characterization of the underlying deficit of LI children? As already alluded to in the introductory section, the fact that the LI children fail to employ event-structural bootstrapping as an algorithm for learning the meaning of change-of-state verbs might be considered a special case of a more general deficit in applying learnability principles. As shown in Penner et al. (1999), the data from early lexical development are by no means an isolated case of violating learnability constraints in LI children. Our findings in a narrow domain of the verb lexicon go hand in hand with a comparable deficient linguistic behavior of LI children observed in the development of word prosody and syntax. Penner et al. (1999) argue that these deficits can be best accounted for in terms of violations of Weissenborn's (1994) "local well-formedness condition." This learnability constraint, originally proposed to account for the data of early German sentential syntax, is a variant of the subset principle, which was designed as a constraint on parameter setting. The "local well-formedness condition" requires that any intermediate representation of the child be

locally well-formed, that is, included as a substructure within a higher projection. The event-structural bootstrapping algorithm seems to be a special manifestation of the "local well-formedness condition," since it guarantees that the child's event representation is a licit variant of the target representation at each point of the acquisition process, excluding any erroneous overextensions. On this assumption, the LI children's failure to stick to the specific order imposed by the event-structural bootstrapping algorithm can be interpreted as a special case of violating more general learnability constraints such as the "local well-formedness condition." With this in hand, the deficient linguistic behavior of LI children can be conceived of as being rooted in a strong deviation from normal language acquisition at the abstract level of the learning principles.

This account would cast a new light not only on the lexical delays and general limitations observed in LI children (cf. Leonard's 1998 summary), but also on more particular findings regarding LI children's verb-learning capacities (cf. Kelly and Rice 1994; Watkins and Rice 1991; Ingham et al. 1998).

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Notes

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1. Note that the examples are all in the present perfect form. Modal or temporal changes in the sentences may invoke shifts in the event structure.
2. Cf. Weissenborn (1994) and Penner and Weissenborn (1996) and the literature therein.
3. The term "bootstrapping" is used here in a narrow sense. Conventionally, the term "bootstrapping" is used to refer to cases in which the child uses information from one module of language in order to gain insight into another module (e.g. using prosodic information in order to learn about word order). In our case, the term "bootstrapping" refers to the assumption that the child uses a particular feature of a given semantic category (the result subevent in inherent telic verbs) in order to correctly apply a specific learning algorithm. We thank one of our anonymous reviewers for drawing our attention to this point.
4. Cf. also Grimm (1999) for arguments within a different theoretical framework.
5. For a detailed overview cf. Penner et al. (1999).
6. These children speak different varieties of German. The children of the LI group are speakers of Swiss German. E. and L. of the ND group are speakers of Southern German dialects. Except for minor lexical and phonetic regional particularities of the

prefixes, there are to our knowledge no differences in the individual input of the children that would influence the organization of their early verb lexicon in any substantial way. This is confirmed by diary data of Swiss German ND children (cf. Penner 1994).

7. Note that verbal prefixes such as *auf* (for *auf-machen* 'open') or *an* (for *an-machen* 'turn on') may occur in isolation in adult German. This is often the case in imperatives such as *Tür auf* 'door up' = 'open the door'.
8. These data are in accordance with the results of Kauschke (1999, 2000, and p.c.). Kauschke studied ten-minute transcriptions of 32 children at the ages of 1;1, 1;3, 1;9, and 3;0. Her data confirm our observation that in German-speaking children prefixes of inherently telic verbs are the first attested. The children in her study begin to produce telic verbal prefixes (*ab, an, auf, aus, weg*) at the age of 1;3. Deictic prefixes are first attested at the age of 1;9. It is noteworthy that, in addition to the telic verbal prefixes in our corpus, we found in E.'s first recording a multiple occurrence of the deictic prefix *runter* 'down'. It must be emphasized, however, that in contrast with the telic verbs and verbal prefixes that continuously occur during the one-word stage after 1;5, the occurrence of the deictic prefix is isolated until 1;8.
9. The greater 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.
10. Note that the perfect tense used in the questions is the standard form to refer to past events in colloquial (Southern) German, spoken by all participants. To avoid inferences of the definite object, all test questions contained the reduced form of the object pronoun in referring to the container.
11. One of the reviewers raised the question of whether the difference between the LI and the ND group could result from a potential difficulty of the LI children to correctly segment the verb *aufmachen* into a prefix and a stem. In our data we do not find evidence for this hypothesis. The production data clearly show that both the LI and the ND children correctly realize both parts of the compound verbs. This holds for resultative verbs of the *aufmachen* type as well as for the verbs with a deictic prefix of the type *runternehmen*. If the compound verb undergoes truncation, only the prefix is realized, whereas the stem is dropped. This is probably due to the prosody of compound verbs in German of the type *aufmachen* in which the prefix is clearly more stressed than the stem.
12. For a detailed discussion cf. Leonard (1998).
13. According to Penner et al. (1998) the first change-of-state verbs of category 2 occur during the two-word stage.

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