The Interaction of Lexical-Semantics, Syntax, and Discourse in the Acquisition of Factivity

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1. Introduction

In this paper I propose a compositional approach to the acquisition of factivity, which is based on the observation that factivity results from the complex interaction of lexical-semantic, syntactic, and discourse-semantic factors. This compositional approach is shown to account both for the order in which factive structures emerge in children's speech and for their specific interpretation patterns of factive complements.

Section 2 sketches a compositional model of factivity. In section 3 I outline the implications of this model for language acquisition and link them to previous acquisition studies. Section 4 describes the analysis of two longitudinal corpora. Sections 5 and 6 present two comprehension studies and their results. Section 7 summarizes the main findings of the present research.

2. Theoretical background

According to Kiparsky & Kiparsky's (1971) lexical-semantic definition of factivity, factive predicates have the semantic property that the complex sentence containing that predicate presupposes the truth of the embedded clause. Thus, (1a) but not (1b) with the indeterminate verb *think* presupposes that Mary bought cake.

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(1) a. Mary forgot that she bought cake.
b. Mary thought that she bought cake.

Examples such as in (2), however, pose a problem for that account: Despite the presence of the supposedly factive verbs *forget, remember,* and *mention*, none of the statements presuppose that Mary bought cake. (2a) contains a negative-implicative, (2b) a positive-implicative, and (2c) an indeterminate verb-complement structure.

(2) a. Mary forgot to buy cake.
b Mary remembered to buy cake.
c. Mary mentioned buying cake

The structures above indicate that a factive interpretation requires a specific type of matrix predicate and a specific type of complement clause. Therefore, I proposed a semantic-syntactic account of factivity (Schulz, 1999), stating that only if the complement is marked for tense and/or aspect can potentially factive predicates induce the presupposition that the complement clause is true.

This account of factivity implies that the ability to induce a presupposition surfaces in the linguistic representation of the factive sentence. This assumption is supported by a discourse-semantic framework (Heim, 1982; van der Sandt 1989, 1992), which regards factive complements as anaphoric expressions that are linked to some previously established event in the discourse. This event binding is triggered by the interaction of a tense/aspect marked complement clause and a potentially factive matrix predicate. Stated more formally, the head of a factive CP, $fComp_{[+tense/aspect]}$, δ-binds the event variable and the factive predicate selects complements with the event variable already bound (3a), yielding a discourse-semantic interpretation as in (3b) (cf. also Hegarty, 1992):

(3) selects δ-binds

a. Mary forgot $[_{CP<>}$ $fComp_{[+tense]}$ $[_{IP<e>}$ she $I_{[+tense]}$ bought cake]]
b. regarding δe [buy(Mary,cake,e)], Mary forgot that δe holds

This representation of factive sentences also accounts for the syntactic restrictions of factive complements regarding long adverbial *wh*-movement (e.g., Cattell, 1978; Hegarty, 1992) and Neg-raising (e.g., Rooryck, 1992). At LF, the event binder fComp induces a barrier and thus blocks long *wh*-extraction (4) and Neg-raising (5) out of factive complements.

(4) $Why_{j/k}$ did Mary forget t_j that she bought cake $*t_k$?

(5) Mary forgot that she cannot buy cake.
≠ Mary did not forget that she can buy cake.

Consequently, factivity requires a compositional approach that acknowledges the multiple dimensions of factivity. Only if the lexical-semantic requirement of a potentially factive matrix predicate and the syntactic requirement of a tense/aspect marked complement clause are met is a factive interpretation of a complex sentence possible. Discourse-semantically, factive complements are anaphoric expressions and a factive interpretation of a complex sentence is represented as δ-binding the embedded event variable via fComp. The presence of the δ-binder fComp in turn gives rise to the syntactic restrictions of factive complements regarding long adverbial *wh*-movement and Neg-raising.

3. The acquisitional perspective

In view of continuity assumptions for language acquisition (e.g., Pinker 1984), the compositional approach to factivity outlined in the previous section makes specific predictions for acquisition.

First, owing to the multidimensionality of the phenomenon children are expected to acquire the concept of factivity stepwise and not in an all-or-nothing fashion. Second, the semantic-syntactic approach to factivity predicts that children should be sensitive to the contributing lexical-semantic factor 'type of matrix predicate' and the syntactic factor 'type of complement' from early on. Third, given that factivity is reflected in the discourse-semantic representation, children should assign truth-values to complement clauses based on discourse-semantic properties rather than according to pragmatic measures such as the perceived level of probability. Fourth, children should recognize the syntactic restrictions of factivity regarding long adverbial *wh*-movement and Neg-raising only after they have established fComp as a δ-binder in factive complements at the level of LF.

Investigating the syntactic restrictions of factivity, Roeper, de Villiers and their colleagues (Roeper & de Villiers, 1992; de Villiers, Curran, DeMunn & Philip, 1997) found that children recognize the barrierhood regarding long adverbial *wh*-movement around age 7. Similarly, studies by Phinney (1981) indicated recognition of the barrierhood regarding Neg-raising around age 8.

The bulk of previous acquisition research, however, investigated how children interpret factive constructions (cf. Johnson & Maratsos, 1977; Johnson & Wellmann, 1980; Scoville & Gordon, 1980; Abbeduto & Rosenberg, 1985; Moore & Davidge, 1989; Falmagne, Gonsalves & Bennett-Lau, 1994), claiming mastery of factivity as early as 4 (Abbeduto & Rosenberg, 1985) and as late as 14 (Scoville & Gordon, 1980).

These studies remain inconclusive with regard to the predictions derived from the model of factivity proposed above, because they have underestimated the complexity of the acquisition task. First, all studies focused on the interpretation of factive and non-factive verbs embedding *that*-complement clauses. As a consequence, the role of the type of complement clause in achieving a factive interpretation of a complex sentence has not been examined.

Moreover, to date research on the acquisition of factivity has exclusively employed accommodation scenarios where an appropriate discourse referent has to be created when processing a factive sentence in isolation. Put differently, one of the core features of factive constructions, referring back to some previously established event in the discourse, has been neglected.

In order to test the first three predictions of the model and relate them to the fourth prediction, I analyzed data from two longitudinal corpora and conducted two comprehension experiments. I developed experimental designs that took into account the role of the complement clause by presenting the subject with different types of complement clauses and that incorporated the function of the discourse background by supplying different types of discourse background.

4. Longitudinal data

The prediction of a stepwise acquisition pattern was examined by analyzing two longitudinal corpora (Abe, cf. Brown, 1973, and Adam, cf. Kuczaj, 1976). The Adam-corpus comprises Adam's spontaneous language production between the ages of 2;03 and 4;10 and consists of 55 recordings with each session lasting about 60 minutes. The Abe-corpus encompasses Abe's spontaneous language production between the ages of 2;05 and 5;00 and consists of 210 recordings, with each session lasting between 30 and 60 minutes.

I analyzed all utterances containing the matrix verbs *try, want, think, tell, forget, say, remember, hope,* and *wish*. The selection of verbs was based on three criteria. First, verbs differed as to whether they only subcategorize non-finite (*try, want*) or finite complements (*think*) or whether they select finite and non-finite complement clauses (*tell, forget, say, remember, hope, wish*). Furthermore, the verb-complement structures were chosen so as to clearly represent the main semantic verb classes FACTIVE (*forget that, remember that*), NEGATIVE-IMPLICATIVE (*forget to*), POSITIVE-IMPLICATIVE (*remember to,*), and INDETERMINATE (*think, tell, say, hope, wish*). Finally, all verbs selected have been reported in previous language acquisition studies to be acquired in the third and fourth year of life.

I argued above that the concept of factivity is multidimensional and that the type of matrix predicate as well as the type of complement clause contribute to a factive interpretation. Consequently, a stepwise acquisition pattern implies that instead of producing factive complements right away, children might produce potentially factive matrix predicates before they use factive tensed complement clauses. Note that for the purposes of the current work, I focus on the age at which a certain form first occurs in the child's speech while disregarding the intricate question of how to define mastery, i.e. productivity of a certain form (for a discussion, cf. Naigles & Hoff-Ginsburg, 1998).

Tensed factive complements were first produced by Adam and Abe at about four, as illustrated in examples (6) through (9) below:

(6)	Adam:	I forgot I gave you some dollars.[1]	(4;00)
		gi(ve) my dose dollars. [...]	
	Mother:	it's alright.	
(7)	Adam	you remember I broke my window.	(4;01)
	Mother:	how did you break your window?	
(8)	Abe:	I ate all my cereal.	(3;09)
	Father:	did you drink your orange juice?	
	Abe:	I forgot that # I didn't.[2]	
(9)	Father:	did he hurt himself?	
	Abe:	I remember he never hurts himself except if he falls really hard.	(4;04)

As shown in examples (10) through (12), tensed complement clauses embedded by non-factive verbs occurred much earlier.

(10)	Mother:	oh # think a minute. [...]	
	Adam:	think that go on. (attaches train to tractor)	(2;11)
(11)	Ursula:	have you been to the doctor?	(3;04)
	Adam:	yeah.	
	Ursula:	what did he say?	
	Adam:	say # he examine me.	
(12)	Mother:	yeah, we'll make popcorn, Abe.	
	Abe:	My mommy said that we make popcorn.	(2;07)

Thus, the delay of factive sentences cannot be attributed to the general absence of tensed complement clauses in the children's speech. Nor can it be ascribed to the absence of factive matrix predicates as potentially factive verbs such as *forget* and *remember* with an NP object were already used by the children before age 4 (Abe: 2;07; Adam: 3;05).

In sum, the prediction of a stepwise acquisition pattern was confirmed by the data. Tensed complements as well as potentially factive matrix predicates such as *forget* and *remember* emerge in children's speech at about age 3, but

1. Since information on the intonation contour of the sentences is not available, syntactic subcategorization as given in the transcription is taken as indication of embeddedness. Note, however, that the complementizer *that* is optional in many cases and therefore the decision whether a second clause following the main clause is indeed a complement clause is generally difficult (for further discussion, cf. Schulz, 1999).

2. # indicates incomprehensible elements in the recording.

tensed factive complements are not produced before age 4, i.e. after the emergence of the Theory of Mind, which enables children to distinguish between mentally represented and actual events.[3]

Neither factive infinitival nor gerundial complements occur in Abe's and Adam's speech until the end of the recordings at age five. This finding is predicted by the specific properties of these structures that make it more difficult to infer the relevant features (tense/aspect marking and δ-binding, respectively) from the input.

5. Experiment 1

The first experiment tested whether children are sensitive to the factors 'type of matrix predicate' and 'type of complement clause' (cf. Schulz, 1997, 1999, 2000).

5.1. Subjects

The experiment was conducted with 40 monolingual English-speaking children between the ages of 4 and 6 (*MEAN* = 5;4; *SD* = 10.6 months) The children were drawn from three day care centers in Massachusetts. The children were tested in the daycare centers and the sessions were recorded for later transcription. 24 monolingual English-speaking university students served as an adult control group. All subjects spoke English as their first language and none had any handicapping conditions.

5.2. Method

A version of the Truth-Value Judgment Task (cf. Crain & McKee, 1986) was used. Each subject heard 10 brief stories, each story illustrated by a picture to facilitate the child's attention. The last sentence was always a complex sentence containing different types of matrix predicates and complement clauses. The test prompt then consisted of a yes/no question assessing the truth-value of the complement clause. The following structures were used: *forget that* and *find out that* (FACTIVE), *think that* and *ask to* (INDETERMINATE), and *forget to* (NEGATIVE-IMPLICATIVE). The answers to the test prompt depended on the proper interpretation of the truth-value of the complement of the different structures: *yes* for the factives, *no* for the negative-implicatives, and *maybe* or *don't know* for the indeterminates. A general text-comprehension question was added after the test question in order to assess children's general understanding of the story. The stories were narrated by the experimenter, and the questions were asked by a hand puppet. The children were told that the puppet needed

3. For the relationship between Theory of Mind and the acquisition of factivity, cf. Schulz (1999).

their assistance in understanding the stories and would ask a lot of questions that could be answered with *yes*, *no* or *don't know/maybe*.

Possible effects of order of story were controlled for, and no ordering effects were found.

5.3. Stimuli

The following example illustrates a factive item. The experimenter presented the child with the story in (13a), accompanied by a picture of an anxious boy in a house and a dog running towards the house. Then, the puppet proceeded to ask the child the test question (13b) and the text-comprehension question (13c):

(13) a. This boy was looking out of the window. He was a bit scared because there was a strange dog running towards the front door. The boy forgot that he locked the door.
b. Did the boy lock the door?
c. What did the boy do with the door?

An indeterminate item together with the questions is given in (14):

(14) a. One morning, this boy and his mother made a beautiful cake for after dinner. The boy looked in the bowl and saw a dark spot. The boy thought that there was an ant in the bowl.
b. Test question: Was there an ant in the bowl?
c. Text-comprehension question: What did the boy see?

5.4. Predictions

In their answers to the test questions children were expected to take into account the type of matrix predicate and type of complement clause and thus to correctly interpret the truth-value of factive, indeterminate and negative-implicative structures as true, indeterminate, and false, respectively.

5.5. Results

Table 1 below shows the mean percentages of correct responses for children and adults for all five verb structures.[4] An ANOVA was performed on the number of correct responses, with age as the between subjects factor and verb as the within subject factor (α level .05). The analysis yielded no significant main effect of verb, $F(4,248) = .93$, $p = .45$, but a significant main effect of age, $F(1,62) = 9.47$, $p < .005$, indicating an overall advance in performance with age.

4. The evaluation of the indeterminate responses is discussed in detail in Schulz (1999).

Table 1. Mean percentages of correct responses (and standard deviation) by verb type and age group

Verb	Children	Adults
forget to	91.5 (25)	98 (10)
ask to	89 (33)	100 (0)
think that	92.5 (18)	100 (0)
find out that	95 (22)	100 (0)
forget that	85 (26)	98 (10)

Weighted analyses of contrast for the child data showed no significant difference for the contrast *to* - *that* (t = .95), for the contrast factive – indeterminate - negative-implicative (t = .149), and for the contrast *forget to* - *forget that* (t = .149).

5.6. Discussion

The results of experiment 1 suggest that four- to six-year-olds differentiate correctly between verbs like *forget/find out* and *think* by assigning a factive and an indeterminate interpretation to the tensed complement, respectively. Moreover, children at that age correctly distinguish tensed from infinitival complements - an aspect that had gone unnoticed. *Forget* with a *to*-complement was interpreted as negative-implicative, and *forget* with a *that*-complement as factive. Thus, preschool children are sensitive to the factors 'type of matrix predicate' and 'type of complement clause'.

6. Experiment 2

The second experiment tested whether preschool children assign truth-values to complement clauses based on discourse-semantic properties rather than according to pragmatic measures such as the perceived level of probability. This prediction cannot be evaluated in an experimental design that is based on accommodation scenarios. Therefore, I developed an experiment that required processing the complex sentences in relation to different discourse backgrounds (cf. Pérez-Leroux & Schulz, 1999; Schulz, 1997, 1999, 2000). The subjects were the same as in experiment 1.

6.1. Method

A controlled comprehension study again using a variant of the Truth-Value Judgment Task was designed. The subjects heard eight stories, each story illustrated by three pictures. Half of the stories told of an event that happened (s-event) and half of them told of an event that failed to happen (non-s-event). Each story was followed by a yes/no question. These questions varied in verb type (*forget, tell*) and in complement type (*to, that*). Questions were

counterbalanced for the type of complement to eliminate a possible story effect (test version A and B). The correct response was *yes* or *no*, depending on the combination of the three variables: s-event, verb and complement. Verb type *forget* and complement type *that* yielded the factive condition. A text-comprehension question assessed general understanding of the story.

Possible effects of order of study, order of story, and version of story were controlled for, and no ordering effects were found.

6.2. Stimuli

The example below illustrates a factive item. The experimenter presented the child with the story in (15a). Then, the puppet proceeded to ask the child the test question (15b) and the text-comprehension question (15c):

(15) a. Kermit went shopping and he was supposed to buy eggs. He bought the eggs in the store. Then, in the evening, he got really hungry, but he said: "I have nothing to eat in the house." He didn't remember the eggs. What a silly guy!

b. Did Kermit forget that he bought eggs?

c. Did Kermit buy eggs?

6.3. Predictions

Children should correctly interpret the *to*- and *that*-complements of the matrix verbs as true or false, depending on the type of discourse background provided.

6.4. Results

Both children and adults performed well in the text-comprehension question (95% correct responses for the child group and 96% correct responses for the adult group). Table 2 below shows the mean percentages of correct responses for children and adults to the test question by verb type, complement type and s-event type.

An ANOVA was performed with verb, complement and event as the within subject factors and age as the between subjects factor (α level .05). There were significant main effects of verb, complement and event as well as of age, $F(1,62)=51.12$, $p = .00005$, indicating improvement in performance with age.

Concentrating on the children data, a second ANOVA was performed, using the same within subject factors. There was a significant three-way interaction of verb, complement, and event, $F(1,32) = 10.12$, $p < .005$, due to the low performance on the factive item *forget that* in the non-s-event condition, i.e. in case of a failed presupposition.

Table 2. Mean percentages of correct responses (and standard deviation) by verb, complement, s-event, and age group

Verb	Complement	S-event[a]	Children	Adults
forget	*that*			
		+e	93 (27)	100 (0)
		-e	18 (39)	92 (28)
tell	*that*			
		+e	98 (22)	100 (0)
		-e	73 (45)	100 (0)
forget	*to*			
		+e	85 (36)	100 (0)
		-e	100 (0)	100 (0)
tell	*to*			
		+e	85 (36)	100 (0)
		-e	98 (16)	100 (0)

[a] +e = s-event condition; -e = non-s-event condition

6.5. Discussion

The predictions were borne out. Already four-year-old children are sensitive to variations in the discourse background and correctly interpret factive and non-factive complements as true or false, depending on the type of discourse background provided. In case of presupposition failure they also acknowledge the discourse information, but, unable to reject a failed presupposition, misinterpret the factive complement as negative-implicative (cf. Schulz, 2001, for a detailed account of this interpretation pattern).

7. Conclusion

The results from the analysis of two longitudinal corpora and of previous as well as two new comprehension experiments demonstrate that the proposed compositional approach to factivity is mirrored in the acquisition process. Four main findings arise from linking the theoretical claims regarding factivity to the acquisition studies.

First, the concept of factivity was claimed to be multidimensional. This is supported by the observation that children acquire the concept of factivity stepwise, producing tensed complements as well as potentially factive matrix predicates long before tensed factive complements occur in their speech. Second, I proposed a semantic-syntactic account of factivity, according to which only potentially factive predicates and tensed and/or aspect marked complements yield a factive interpretation. This account is corroborated by the finding that already four-year-olds are sensitive to these factors. Third, I argued that factive complements should be analyzed within a discourse-semantic

framework as anaphoric expressions that are bound to a previously established event. This assumption can be confirmed as well, as children were shown to take the discourse background into account at age 4. Fourth, I hypothesized that the presence of the δ-binder fComp at LF induces a barrier, blocking long adverbial *wh*-movement and Neg-raising out of factive complements. This hypothesis is substantiated by earlier experimental findings indicating that children recognize the barrierhood of fComp around age 7. Put differently, children are sensitive to the syntactic restrictions of factive complements only after they have established Comp as an event binder in factive complements. I suggest that this delay results from the fact that cross-modular evidence is needed to represent the relevant Comp features at the level of LF (cf. Schulz, 1999, for details).

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