The role of tense and aspect in the acquisition of factivity: children's interpretation of factive complements in English, German and Spanish*

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ABSTRACT

Previous studies on the acquisition of factivity have shown partial understanding of factive complements, as well as problems with their syntactic structure. These studies fail to consider language variation and the possible role of tense and aspect as morphological markers of factivity. An experiment tested comprehension of factive complements in English, German and Spanish (67 children aged 3 to 6 years). A follow-up study (40 English children aged 3 to 6 years) replicated the first study with additional questions to assess story comprehension, and tested the understanding of the presuppositions of factive and non-factive complements in isolation. Our results indicate a general difficulty with understanding factive complements in contexts which contradict the presuppositions, as well as crosslinguistic variation in the understanding of presuppositions in the different syntactic conditions. The identified crosslinguistic differences in acquisition are attributed to language variation with respect to tense and aspect.

INTRODUCTION

Young children exhibit a tendency to over-attribute truth to sentential complements (Abbeduto & Rosenberg 1985). Why, then, are there so many experimental results in the child language literature that show a long delay in acquisition of factive complements (deVilliers & Philip 1992, deVilliers & Roeper 1991, Hopmann & Maratsos 1978, Phinney 1981)? Let us start by first raising the question of what it means to say that children have acquired factivity. Factivity has been traditionally defined as the ability to recognize the presupposition of the truth of the complement clause of a factive predicate. As Kiparsky & Kiparsky (1970) point out, a factive verb presupposes the truth of embedded clause which functions as its complement:

(1)   I know that it is raining.
      I regret that it is raining.   (Kiparsky & Kiparsky 1970)

The factive verb *know* in (1) presupposes the truth of its complement clause 'it is raining', in contrast with non-factive verbs like *think*, *say*, etc., that do not carry a presupposition. Earlier studies have typically considered children's understanding of factivity from a single focus: syntactic, semantic, pragmatic or cognitive (Abbeduto & Rosenberg 1985, Lyon & Flavell 1994, Phinney 1981, Roeper & deVilliers 1992, Scoville & Gordon 1980). The outcomes of these studies do not present a clear picture. Some semantic studies appear to indicate that children around the age of 4 years treat all verbs as factives (Abedutto & Rosenberg 1985), i.e., they assume that all embedded complement clauses are true. Other studies suggest that older children have not learned other aspects of the semantics of factive verbs, such as their entailment properties (deVilliers, Curran, Philip & DeMunn 1997, deVilliers & Philip 1992). With respect to the syntax of factive complementation, children are still not aware that factive verbs are barriers to movement and negation (deVilliers & Roeper 1991, Hopmann & Maratsos 1978, Phinney 1981).

In this study, we attempt to answer the following question: what are the reasons for the apparent asymmetry between the different aspects of the acquisition of factivity? We argue that previous findings on comprehension of mental verbs present only a partial view of the acquisition of factivity, because they only dealt with English and, moreover, did not consider the role of tense in marking factive complementation. In order to make viable generalizations from language development to cognitive development, it is essential to ensure that the acquisition patterns identified are not due to language-specific properties. In other words, our research goal was to separate the operation of general principles of cognitive and linguistic development from the influence of language-specific properties.

We begin the discussion by reviewing the syntax and semantics of factivity, with particular attention to the role of tense and aspect. We then review previous literature on the acquisition of factive verbs and present two new experiments. The first experiment compares the understanding of factive complements in German, English and Spanish. A follow-up experiment tests the understanding of presuppositions independently of the understanding of the complex sentence. Our results place the acquisition difficulties not on the presuppositions themselves but on the grammatical complexity of the factive complement.

THE SYNTAX OF FACTIVE COMPLEMENTS

The role of tense in the structure of factive complements

The literature on factivity typically discusses the semantic and syntactic differences between factive and non-factive verbs, as in (2) and (3):

(2)   Kermit remembered that he bought eggs.

(3)   Kermit thought that he bought eggs.

The factive complement in (2) presupposes that Kermit bought the eggs, but the non-factive complement in (3) lacks this presupposition. Along with this semantic feature, there exist several syntactic differences. Factive verbs can occur along with the noun *the fact*, and they create barriers to *wh*-movement.[1]

(4)   a   Kermit remembered the fact that he bought eggs.
      b   *Kermit thought the fact that he bought eggs.

(5)   a   How did Kermit remember that he bought eggs?
      b   How did Kermit think that he bought eggs?

The question in (5a) is only a matrix question, in contrast with the non-factive counterpart in (5b), which can be a question about either the main or the embedded clause.

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[1] Not all factives complements allow insertion of *the fact*:
    (a)   ?? I know the fact that you did my laundry.
    (b)   ?? The fact that you did my laundry was nice of you.
   Other structures can become factive if *the fact* is inserted:
    (c)   I doubted the fact that there is a deep structure.

A clear but seldom mentioned fact is that to be factive, a factive verb generally requires a tensed complement. Thus, the infinitival complement of a factive verb behaves like that of a non-factive verb:

(6)   a   Kermit forgot that he bought eggs.   (factive)
      b   Kermit forgot to buy eggs.   (non-factive)

Only the sentence in (6a) receives a factive interpretation. In contrast, the infinitival complement in (6b) has the negative implicature that Kermit did not buy the eggs.

The behaviour of the verb *remember*, which has a positive implicature, is consistent with this observation. Infinitive complements of *remember* fail to retain this implicature when the sentence is negated. The preservation of presupposition under sentential negation is one of the standard tests for factivity.

(7)   Kermit remembered to buy the eggs.

(8)   Kermit did not remember to buy the eggs.

The tensed complement of *remember* retains the presupposition under negation. In contrast, while (7) implies that Kermit did buy the eggs, (8) lacks such an implicature. Furthermore, infinitival complements to factive verbs pattern with non-factive verbs in extraction patterns:

(9)   a   At the store, Kermit remembered to buy a boat.
      b   At the store, Kermit remembered that he bought a boat.

The infinitival case in (9a) shows the ambiguities typical of non-factive verbs: it can have the meaning in which Kermit 'remembered' at the store, as well as the meaning in which he 'bought a boat' at the store. For the tensed complement in (9b), *remember* creates a factive island, allowing only the main clause interpretation of the dislocated adjunct *at the store*.

Overall, the association of tense and factivity seems to be fairly general. Factive infinitives are rare, if they exist at all. Let us examine some possible counterexamples to our generalization. First, in many languages, factive infinitives are marked for aspect. For instance, German and Spanish allow perfective markers to be used instead of tense. The examples in (10) are grammatical:

(10) a   *Er hat vergessen, Eier gekauft zu haben.*
          He has forgotten eggs bought to have-PERFECTIVE

      b   *Olvidó haber comprado los huevos.*
          He forgot to have bought the eggs.
          He forgot that he bought the eggs.

It is not the case that any infinitive can be factive: if not marked for tense, the factive complement must be marked for perfective aspect. Example (11a), without aspect marking, is non-factive in the same way as infinitives are in English, in contrast with (11b), which is factive.

(11) a   *Er vergass, ein Boot zu kaufen.*
          He forgot   a boat   to buy.
          He forgot to buy a boat.

      b   *Er vergass, ein Boot gekauft zu haben.*
          He forgot   a boat   bought to have-PERFECTIVE
          He forgot that he bought a boat.

Second, even in English, some factive verbs can have non-finite complements, but these infinitives do not behave like true factives. Consider *know*, for instance:

(12) I know Mary to be a good lawyer.

The infinitive complement of know is not a factive complement: it becomes instead an expression of opinion (Wierzbicka 1988). This explains why the infinitive complement of know can only subcategorize a predicative construction with an evaluative predicate. Complements that truly indicate a fact rather than an opinion are ungrammatical:

(13) ??I know Mary to be Mexican.
       *I know Mary to own a shop.

The third class of examples are the hardest to explain. This is the case of infinitive complements, such as (14):

(14) John hated to win the championship last year. (from Boskovic 1997)

If grammatical, this example presents a serious challenge to our generalization that factive verbs typically require tense or aspect morphology to realize their factivity. Note, however, that most speakers prefer factive *hate* to be followed by a gerund, as in (15):[2]

(15) John hated winning the championship last year.

The choice of tense in the matrix clause has an impact on the

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[2]   The only clear case of factive interpretation of infinitives that we can see are the cases of adjectival complementation. These hold their presupposition under negation:

   I was glad to see you.   (presupposes ——▶ I have seen you)
   I was not glad to see you.   (presupposes ——▶ I have seen you)

interpretation of the complement as factive, as shown by examples in (16). For some speakers, present tense *hate* does not seem to have the factive presupposition with an infinitive, but clearly does so with a gerund:

(16) I hate to win the championships. (no presupposition: If I win, I hate it)

I hate winning the championships. (presupposes ——▶ I sometimes win)

Why should this association between factivity and tense arise? This question can be most clearly answered using some concepts from formal semantics, in particular the notion of event variable.

Event variables, and the semantics of factive complements

Most semanticists assume that every verb has an array of semantic arguments, filling various theta roles. Since Higginbotham (1985), it is also commonly assumed that most verbs contain an additional event argument. This event argument, or event variable, must be bound if the event denoted by the verb is to be interpreted as anchored at a particular time. Tense, certain aspectual markers or adverbs of quantification can bind the temporal argument of a verb (Enç 1987). The thematic grid for a simple verb like *see* is given in (17).

(17) *Thematic grid* (Higginbotham 1985)
Verb *see*: see <1,2,E>
Where E is the event theta-position, corresponding to the state or event described by the sentence.

Hegarty claims that the position of the binder of a sentence event variable determines the semantic interpretation of the sentence. Adopting Heim's file change semantics, binding a variable over individuals or over events involves the same process: the mechanism of discourse-binding, stated in (18).

(18) *Discourse-binding* (δ-binding, Hegarty 1991)
A δ-binder, i.e., a definite determiner or the complementizer that in factive complements discharges an open theta-role by selecting a file card within the discourse frame (cf. Heim's (1982) file change semantics). δ-binding by a definite determiner yields a closed expression that is a definite description of an individual, and δ-binding by the factive complementizer yields a definite description of an event.

In this analysis, factivity is reduced to a presupposition of a definite

description, i.e. to the fact that a particular event occurred. Presuppositions then depend on binding a variable over individuals or events within the discourse frame of the speaker. Consider the discourse in (19):

(19) A: Kermit wanted to buy eggs. In the shop he didn't remember about his plan, and so he didn't buy any eggs.

B: I don't understand. Did Kermit forget that he bought eggs?

A: No! He didn't buy any eggs.

If there is no file card that specifies an event where Kermit bought eggs, the presupposition of the factive verb is not satisfied. This causes a presupposition failure. The notion of presupposition failure can be formulated in terms of the discourse frame:

(20) *Presupposition failure*
Presupposition failure arises if and only if a presupposition S' (e.g., of the complement of a factive verb) conflicts with the discourse frame established so far, i.e., the event described by S' is inconsistent with the events introduced in the file cards.[3]

In Hegarty's (1991) system, the event variable is bound differently in the factive tensed complement in (21a) and in the non-factive infinitival in (22a). These structures are presented along with an analysis of the syntactic structure in (b), and in (c) with their logical form, which explicitly represents the truth conditions of the sentence. The representation in (21) shows how factive verbs select complements with event variable already satisfied. The factive verb selects the factive tensed complementizer *that*, and the complementizer δ-binds the event variable of the complement.

(21) a Kermit forgot that he bought eggs.

b Kermit forgot [CP<> that [IP<e> he [I'<e> I [VP<e> bought eggs]]]]

selects   δ-binds

c regarding δe [buy (Kermit, eggs, e)], Kermit forgot that δe holds.

The representation in (22) illustrates that non-factive verbs select

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[3] Presuppositions can also be used to convey new information; therefore, it is too strong to require presuppositions to be already present in the discourse frame. Heim (1982, 1992) and others discuss possible accommodation mechanisms.

complements with an event variable that is not yet satisfied, and still visible at the CP node.

(22) a Kermit thought that he bought eggs.
     b Kermit thought [CP<e> that [IP<e> he [I'<e> I [VP<e> bought eggs]]]]
     c ∃ε in ME, such that [buy (Kermit, eggs, e)] think (Kermit, e) where ME = the set of events in Kermit's mental model.

Note that, in Hegarty's (1991) analysis of factive structures the complementizer has to be the overt complementizer *that*. This is questionable, given examples such as (23)

(23) John forgot/noticed/denied Mary left.

Instead, we propose that the binding of the event variable is related to the complementizer *position* and that the event variable must be reflected by a particular inflectional morphology.

Consequences for acquisition

The above discussion helps to clarify the nature of the acquisition task, by differentiating the universal and the language-specific components of factivity. Factive complements are clauses whose truth is presupposed by the factive verb. Unlike complements to other mental verbs, in which the content of the embedded clause is opaque, the event denoted by the factive complement must be included in the discourse frame shared by participants in the conversation. This is probably the most demanding task involving complements of mental verbs. Beyond awareness of the content of an individual's mind, i.e., what events are or are not part of an individual's mental model, interpreting factive complements involves evaluating presupposed information.

Thus, to assume that children have acquired factivity one must go beyond a demonstration that children interpret factive complements as true. It must be shown that children reject the use of factive complements in case of presupposition failure. An additional requirement is that children also have to be conservative in their interpretation of sentential complements to factive verbs, so that factive interpretations should not be overextended to non-finite complementation, given the correlation of factivity and inflection.

EARLIER STUDIES ON THE ACQUISITION OF FACTIVITY

One of the central issues in cognitive development is the question of how children understand the concept of mind and of mental

representation. Recent advances in cognitive research show how children's ability to understand false beliefs and to make behavioural predictions accordingly is developed around the age of four (Wimmer & Perner 1983). The acquisition of a theory of mind, as it has been called in the literature, allows children to make sharper distinctions between mentally represented and actual events, in other words, between fact and fiction (Wellman 1990).

One could assume that this skill is a prerequisite for understanding factivity. In fact, many studies find that important developments in the comprehension of mental terms occur at around the age of four. According to Abbeduto & Rosenberg (1985), children before the age of four interpret all verbs (*forget, remember, know, believe* and *think*) as factive, that is they interpret the complement as true, independent of sentential negation and type of verb. This suggests that young children only pay attention to the embedded clause and interpret it as if it was a main clause (Abbeduto & Rosenberg 1985, deVilliers & Roeper 1991, Harris 1974). The older children in the study performed well, but still occasionally treated belief as a factive verb. In contrast, the findings of Johnson & Maratsos (1977) show that older children understood that 'knowing' implies knowing a fact, but that 'thinking' can equally be true or false. Johnson & Wellman (1980) indicated that 4-year-olds, but not 3-year-olds, could distinguish between *think* and *know*. In their study, the older children could tell whether a character 'knew' or 'thought' where a certain object was hidden. Lyon & Flavell (1994) testing the understanding of *remember* and *forget* also found a difference between 3- and 4-year-olds.

Some studies claim that, in the earlier stages of acquisition, factive verbs are not interpreted on the basis of the logical properties of factivity but on the basis of a probability gradient, dependent on context (Harris 1974). In a similar vein, others have proposed that factive verbs are interpreted according to their certainty value or confidence value in contrast with other mental predicates (Falmagne, Gonsalves & Bennett-Lau 1994, Moore & Davidge 1989). It is unclear whether these diverging conclusions are the result of using different methodologies, or because the studies examined different aspects of knowledge of factivity and therefore indicate a gradual mastery of its semantics.

From a syntactic perspective, there are many aspects of factivity which children do not know well after the age of four. Previous studies on factivity indicate that children do not learn the non-bridge properties of factive verbs until a later age. Phinney (1981) found that children up to the age of 9 years treat factive verbs as verbs that allow negation

raising. In other words, children in her study interpreted 'know that not
p' as 'not know that *p*'. Earlier findings of 'overextended negation' by
Hopmann & Maratsos (1978) can also be interpreted in this light.
Similar results have been established for French-speaking children at
ages between 4 and 7 years (Bassano 1985).

Research on *wh*-movement has shown that children between the ages
of 3 and 6 years treat factives as non-factives in that they allow
extracted adjuncts to refer to the embedded clause (deVilliers & Roeper
1991, Phillip & deVilliers, in preparation, Roeper & deVilliers 1992).
A comparison with the early mastery of other barriers indicates that it
is the specific property of being factive that creates problems for the
children (deVilliers & Roeper 1995, deVilliers, Roeper & Vainnikka
1990, Goodluck, Foley & Sedivy 1990). It has also been found that the
ability to recognize invalid inferences is learned late, around the age
of 7 (Phillip & deVilliers, in preparation). Younger children on a series
of studies about semantic entailments treated factive complements as
non-factives, which allow upward entailment inferences.

To summarize, the real extent of the understanding of factivity in the
late preschool and early school years is still unclear. Acquisition of a
theory of mind appears to have an impact on the understanding of
mental events, but not all the syntactic and semantic requisites for
factive complementation are set at that point. Given the discussion
above, consider the following.

If recognition of presupposition failure is the essential step in the
acquisition of factivity, we expect full knowledge of factivity to emerge
late in the acquisition of complex syntax. Other aspects of acquisition
involved, such as developing comprehension of mental terms, acquiring
gradations of certainty, etc., are necessary but not sufficient
requirements for the acquisition of factive representation. If the correct
semantic representation of factive verbs is not in place until a certain
age, the syntactic correlates of factivity are not to be expected until that
point either.

An important limitation of the studies above is the scarcity of
crosslinguistic comparison. This undermines the validity of any general
conclusions about children's cognitive development based on the
behaviour of factive verbs. For instance, Hopmann & Maratsos (1978),
based on the widespread assumption that children follow general
cognitive strategies in the comprehension of complex sentences,
propose that young children exhibit a general tendency to overextend
negation, so that a negative marker in the matrix clause would be
interpreted as negating the lower clause. Clearly, if the acquisition of
factivity depends on language-specific grammatical development, then

differences in acquisition patterns can be expected across different
languages.

We conducted two experiments designed to test children's sensitivity
to the role of tense in the interpretation of factivity, and their ability to
react to cases of presupposition failure. The first study addressed the
effect of tense as a marker of factivity in three languages. The second
study explored further lexical and methodological issues with respect to
complement interpretation.

STUDY 1: CROSSLINGUISTIC ACQUISITION OF FACTIVITY

Rationale

A study was designed to test children's knowledge of the presup-
position encoded in a factive complement. We concentrated on the verb
forget, which selects both infinitives and tensed complements. With a
tensed complement, *forget* works as a factive verb. With an infinitive
complement, it works as a negative implicative, in the sense that stating
'I forgot to *p*' implies 'not *p*'. The purpose of the experiment was to
compare the acquisition patterns in three languages, English, German
and Spanish. English selects only tense as a marker of factivity,
whereas German and Spanish allow both tense and perfective aspect as
binders of the event variable in a factive complement. Compare
the various complement structures in English, German and Spanish
(Table 1).

On the basis of previous studies we predicted that, with respect to
factive complements, the easiest case for children would be accepting
true complements to factive verbs with tensed complements, and that
the hardest case should be rejecting a factive verb with a tensed

TABLE 1. *Complement structures in English, German and Spanish*

Structure	English	German	Spanish
1. *Forgot to* VERB-fin *the eggs*	negative implicative	negative implicative	negative implicative
2. *Forgot that he* VERB+fin *the eggs*	factive	factive	factive
3. *Forgot the* VERB-nominal *of the eggs*	factive?	ambiguous	ambiguous
4. *Forgot* VERB-gerund *the eggs*	factive	negative implicative	*
5. *Forgot to have* VERB-participle *the eggs*	*	factive	factive

* Indicates that the combination is not grammatical in the language.

complement in case of presupposition failure. Given the existence of crosslinguistic variation, we predict the possibility of crosslinguistic difference in acquisition patterns. Focusing on the role of tense and perfective aspect in the sentential complements to forget, we predict that English, because it lacks the structure represented in 5 (Table 1), will be easier to acquire than German and Spanish. In general, the prediction is that languages with simpler marking of factivity (tense as opposed to both tense and perfective aspect) will be easier for children to learn. However, there are further differences with regards to the interpretation of gerunds (cf. 4) and nominalizations (cf. 3) which may lead to differences between German and Spanish.

Subjects

The English group consisted of 20 children (ages 4;1 to 5;7, mean 4;9, median 4;8), recruited at a daycare centre in Massachusetts. The German group was comprised of 28 children (ages 4;3 to 6;1, mean 5;1, median 5;5), recruited at two Montessori kindergardens in Klewe, Germany. The Spanish group was made up of 19 children (ages 3;6 and 6;11, mean 4;10, median 4;5) from a Montessori School in Santo Domingo, Dominican Republic. Participation in the study was voluntary, and parental consent was obtained prior to conducting the study. In our subject selection we aimed at a minimum of social and educational differences among the three language groups. This is an essential methodological component in crosslinguistic research in child language development (Jakubowicz 1996). For that purpose, the schools selected for recruitment served comparable populations: upper middle class families, where one or both parents are college educated. Both the Spanish and the German group were recruited at licensed Montessori schools, and the English group was recruited at a school with a similar curricular emphasis on language arts and personal development, and progressive educational philosophy.

Methods

A controlled comprehension experiment was designed to test children's ability to judge the truth of a sentence based on the presuppositions it had. A warm-up practice session preceded the actual experiment, then children heard 8 short stories telling about an event illustrated by pictures. Half of the stories had non-factive verbs and were included in the protocol as distractors, and will not be discussed further. The stories in the three languages were comparable in content and length. The accompanying pictures were for the most part identical.

The method used for testing comprehension was a variant of the

truth value judgement task (Crain & McKee 1986), in which children were asked to respond to a yes/no question following each story. The response was intended to show their judgement of the test sentence. There were two story types: one in which the event happened (event story), illustrated below in (24), and the other in which the event failed to happen (non-event story), illustrated in (25). Each story was followed by either a question containing an infinitive or a tensed complement to the verb *forget*. The question types were counter-balanced for each story to eliminate a possible story effect.

(24) *Event story*
Kermit went shopping and he was supposed to buy milk and eggs. Look, he bought the eggs, and the milk too. In the evening, he got really hungry, but he said: 'I have nothing to eat in the house.' Look, here are the eggs. He didn't remember about them. What a silly guy!

Tensed question: Did Kermit forget that he bought the eggs?
Infinitival question: Did Kermit forget to buy eggs?

(25) *Non-event story*
Grover called Ernie on the phone, and he said: 'I got a new game of marbles and want to play it with you.' Ernie said: 'Oh, yes, sure, come over.' First they played hide-and-seek, but they didn't play with the marbles because Grover didn't remember about his new game. Then it was time for Grover to go home and he just went home.

Tensed question: Did Grover forget that he played marbles with Ernie?
Infinitival question: Did Grover forget to play marbles with Ernie?

The answer depends on the proper interpretation of the presuppositions of the sentential complements. For the event story, the correct response to the tensed question is 'yes', and the correct answer to the infinitive question is 'no', given that Kermit forgot that he bought the eggs, but he didn't forget to buy them. For the non-event story, the correct answer to the infinitive question is yes, given that Grover forgot to play with the marbles. The correct response to the tensed question in this condition is to reject the sentence, given that Grover never played marbles with Ernie.

A possible order of story effect was controlled by using alternating orders, and no effect of ordering was identified.

Results

Responses to the test questions were coded as correct and incorrect, as described above. A correct response received a score of 1 and an incorrect response received a score of 0. An ANOVA was performed on the number of correct responses. Language was the between-subject factor and Tense and Event were the two within-subject factors. The α level was set at 0.05. The children's responses are summarized in Table 2.

Highly significant main effects were found for the Tense factor ($F(1,64) = 59.075$, $p < 0.0001$), and the Event type factor ($F(1,64) = 34.384$, $p < 0.0001$). As shown in Table 2, subjects did generally better on infinitives than on tensed clauses, and better with events than with non-events. All groups performed below chance on the tense non-event condition, ranging from 0.40 proportion of correct responses for the English group to 0.25 for the German children and 0.16 for the Spanish group. The Language factor was not significant ($F(2,64) = 1.59$, $p = 0.2111$), but there was a significant Language × Tense × Event type interaction ($F(2,64) = 7.424$, $p = 0.0013$).

The statistical analyses of individual language data also revealed several significant effects. As seen in Fig. 1, the English data revealed significant effects of Tense and Event ($F(1,19) = 10.498$, $p = 0.0043$, and $F(1,19) = 16.540$, $p = 0.0007$, respectively). The Tense × Event interaction missed significance at $F(1,19) = 3.1999$, $p = 0.0896$. The English children had performances well above chance for both infinitive conditions, and for the tensed, event condition. Their performance on the tensed, non-event condition was well below chance.

For the German data, the effects of Tense and of Event were highly significant ($F(1,27) = 41.058$, $p = 0.0001$, and $F(1,27) = 12.789$, $p = 0.0013$, respectively), but there was no significant interaction.

As Fig. 2 shows, one of the reasons for the Language × Tense × Event type interaction is that the German children performed much

TABLE 2. *Mean number of correct answers to all four conditions for each language group in Study 1*

Condition	English	German	Spanish	All groups
Infinitive, Event	0.95	0.96	0.63	0.85
Infinitive, Non-event	0.85	0.82	1.00	0.89
Tensed, Event	0.85	0.64	0.95	0.81
Tensed, Non-event	0.40	0.25	0.16	0.27

lower than the other two groups on the tensed event condition (0.64 in contrast to 0.85 and 0.94 for the English and Spanish group, respectively). Although contrary to our basic predictions, the performance in the tensed event condition is still much higher than in the non-event condition.

Additionally, while all groups performed well on the infinitive non-event condition, the Spanish-speaking children gave fewer correct responses to the infinitive event condition than their German- and English-speaking peers (0.63 in contrast to 0.96 and 0.95 for German and English, respectively). The analysis of the Spanish data revealed
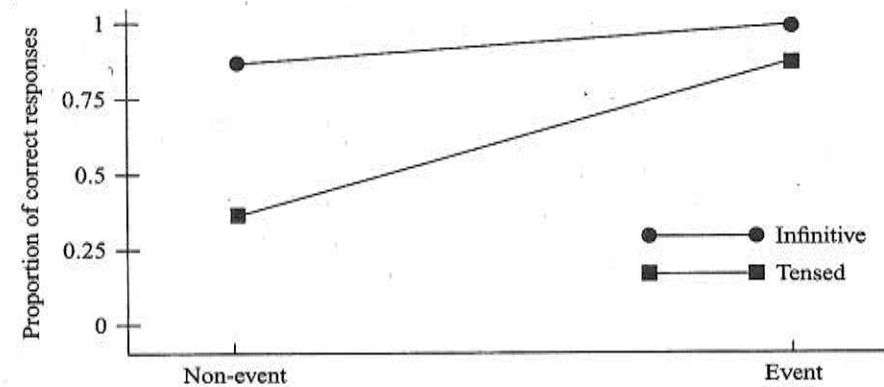

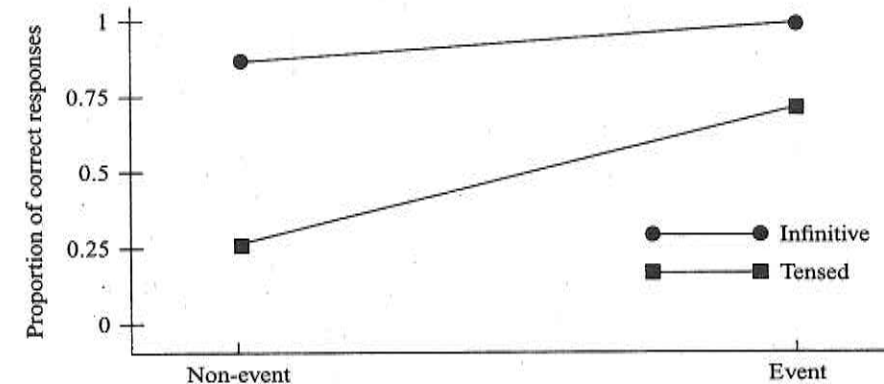Fig. 1 Proportion of correct responses by the English-speaking children

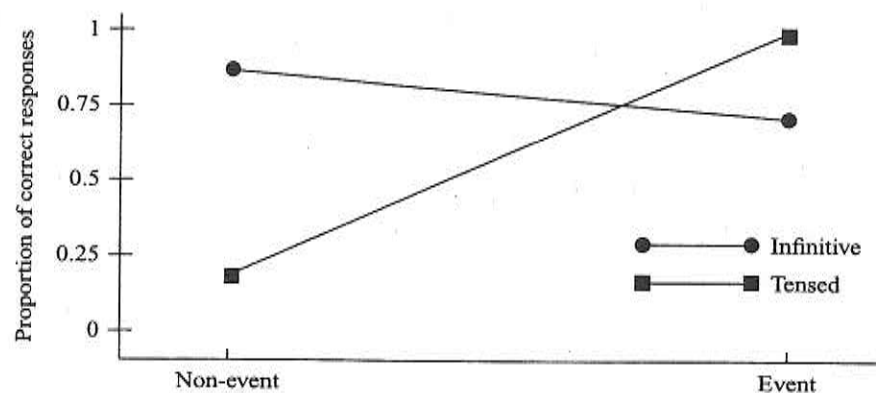Fig. 2 Proportion of correct responses by the German children

Fig. 3 Proportion of correct responses by the Spanish-speaking children

that both main effects of tense and event ($F(1,18) = 20.000$, $p = 0.0003$, and $F(1,18) = 9.143$, $p = 0.0073$, respectively), as well as their interaction ($F(1,18) = 36.605$, $p = 0.0001$, were statistically significant. These data are represented in Fig. 3.

The Spanish group performed well in the infinitive, non-event condition, and in the tense, event condition. Like the German and the English groups, they performed poorly in the tensed, non-event condition. Unlike their German- and English-speaking peers, they performed near chance in the infinitive, non-event condition. This surprising difference could perhaps be attributed to the fact that Spanish infinitives are morphologically ambiguous and can function as non-finite verbs or as nominalizations. Nominalizations have no presuppositions, and are not affected by the negative implicature of the verb *forget*. The children could be interpreting the infinitive as a nominal (i.e., they are confusing *olvido comprar los huevos* (he forgot to buy the eggs) with *olvido el comprar de los huevos* (he forgot the buying of the eggs)). If this is correct, one would expect their performance in this task to reflect the ambiguous nature of a nominal, as was the case.

Discussion

The results show that children, across all three languages, generally understand the meaning of the verb *forget*. They reject *forget* + infinitive when the event happened and accept it when the event did not happen. This indicates awareness that *forget* is a negative implicative verb when followed by a non-finite complement. What is more, the children were very good at accepting factive sentences when the

presupposed event had happened but performed very poorly when they had to reject a factive complement because the presupposed event had failed to happen. The high proportion of correct responses in the infinitival conditions show that the children are willing to respond both yes and no to the target questions. Thus, their failure in the tense non-event condition cannot be attributed to children's unwillingness to give negative responses. The story in this condition presents an event which does not happen. The linguistic presupposition of the question, however, is that the event did happen. This leads to a contradiction between the discourse frame and the sentential interpretation that children cannot resolve.

In addition, there were important crosslinguistic differences. The German children gave fewer correct responses in the tense true event condition than either the Spanish or the English group. This would suggest that tense is a less clear indicator of factivity in German than in the other languages. At first glance, it appears that tense is a sufficient event variable binder in German. Further examination of language use reveals, however, that the present perfect form is preferred over a simple past in spoken German. Thus, the direct translation of (26) is as in (27):

(26) He forgot that he bought the eggs.

(27) *Er hat vergessen, dass er Eier gekauft hat.*
      He has forgotten that he eggs bought has.

This implies that German children hear factive verbs marked by both tense and aspect, but seldom marked by tense alone. On the other hand, in Spanish, factive complements marked by aspect alone are used rather infrequently. This explanation, although *post hoc*, points to differences in the input language which may make tense a clearer marker of factivity in Spanish and English.

The Spanish group performed like the English except that they gave correct responses to infinitives in the event condition only a third of the time. This means that they failed to reject the infinitive when the event had happened. We explained this result by the possible ambiguity between the verbal and the nominal reading of the infinitive in Spanish. We argued that, if children mistook the infinitive for a nominal, both interpretations were plausible. In the case of the *infinitive event condition*, the infinitive analysis would lead to a rejection of the sentence (he didn't forget to buy the eggs: he did buy them). This accounts for two-thirds of the responses, and the nominal analysis would lead to an acceptance, since after he bought the eggs, he did forget about buying the eggs. This accounts for more than a third of the total number of responses in this condition. In

the case of the *infinitive non-event condition*, the children always gave an affirmative response. This is appropriate both under the infinitive or the nominal analysis, because the buying of the eggs had been forgotten.

Analysis of simple main effects showed significant differences for each language. This resulted from overall higher rates of performance with infinitives than tensed clauses, and with true events rather than non-events. Therefore, Study 1 confirmed the prediction that children have special difficulty in recognizing presupposition failure. It did not confirm the primacy of tense as a clear marker for factivity.

The other important finding is that of a significant interaction of the experimental conditions and language. This leads us to conclude that crosslinguistic differences will affect acquisition.

STUDY 2: FACTIVITY AND PRESUPPOSITIONS

Rationale

We conducted a follow-up study with English-speaking children to test whether the incorrect responses to the tense non-event condition were due to an overall lack of understanding of the story, and, furthermore, to investigate the analysis of the complement as factive or non-factive in isolation from other comprehension factors. This second question aimed at exploring children's ability to draw inferences about the truth of the complement solely on the basis of the sentence structure. In this part of the test, besides factive complements (*forget that, find out that*), we included non-factive complements with various verbs (*forget to, think that, ask to*).

Subjects

The group consisted of 40 children (ages 3;3 to 6;11, mean age 5;4) recruited at various daycare centres in Massachusetts. The adult control group consisted of 24 college students. Participation in this study was voluntary as well, and parental consent on behalf of the children was obtained prior to conducting the study.

Methods

The study consisted of two components. In the first part, we replicated the previous experiment, adding a simple comprehension question, to be asked after the children's response to the initial question. This comprehension question aimed at ensuring that the answers were not due to difficulties in comprehending the story. To the protocol in (24) and (25), we added the questions in (28) and (29), respectively:

(28) Did Kermit buy the eggs?

(29) Did Grover play marbles with Ernie?

The second component consisted of a controlled comprehension experiment, designed to test children's ability to recognize the truth value of sentential complements (cf. Abbeduto & Rosenberg 1985). In contrast to the first part, this task contained no explicit reference to the happening or non-happening of an event. The children heard 12 short stories setting up a situation. Each story was illustrated by a picture. The last sentence in the story was a complex sentence consisting of a sentential complement embedded under a factive or non-factive verb. The test prompt was a yes/no question assessing the truth value of the complement. There were 3 story types: one which ended with a factive statement, illustrated in (14), one which ended with a negative implicative statement, as in (15), and a third one ending with a propositional statement, illustrated in (16):

(30) *Factive story*
      This girl got a beautiful teddy for her birthday. One day, she went to the playground with her friend. She forgot that she left the teddy at home.
      Question: Did she leave the teddy at home?

(31) *Negative implicative story*
      It was this girl's mother's birthday. And the girl wanted to give her mother a present. The girl forgot to have a present ready for her.
      Question: Did the girl have a present ready?

(32) *Propositional story*
      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 there was an ant in the bowl.
      Question: Was there an ant in the bowl?

The answer to these questions depends on the proper interpretation of the truth value of the different complement types. The correct response to the question in the factive story is yes, because the truth of the complement of factive verbs is presupposed to be true. The correct response to the question in the negative implicative story is no, since the truth value of the complement of a negative implicative is false. Finally, the correct answer to the question in the propositional story is 'maybe' or 'don't know', given that the proposition expressed in the complement of a non-factive verb could be either true or false.

General comprehension questions were presented after the test

question to ensure that the children truly understood the content of the story. The stories in (30)–(32) were followed up with (33)–(35), respectively:

(33) What happened with the teddy?

(34) What happened to the present?

(35) What did the boy see?

A possible order of story effect was controlled for by using alternating orders, and no effect of ordering was found in the results.

In this part of the experiment, we coded the responses to the test question as correct or incorrect and analysed the number of correct responses. Coding the responses to the propositional condition required a closer look at the children's reactions. While many children responded by saying 'don't know' or 'maybe', some children expressed the uncertainty about the truth of the complement in a different way. These children would answer yes or no to the test question, while expressing in their response to the *wh*-comprehension question that they were unsure about the truth of the proposition expressed in the complement. A typical response is illustrated in (36).

(36) Q: Was there an ant in the bowl?
A: No.
Q: What did the boy see?
A: He thought it was an ant   (child no.11, age 4;3)

Some of the adult responses also followed this pattern; therefore, we grouped this type of response with the explicit expressions of uncertainty as correct responses to the propositional stories.

Results

Table 3 presents the results of the follow-up truth value judgement task for both children and adults.

The results for the children are very similar to the English results of the first study, and show the failure to understand the tense non-event condition even more dramatically. The adults, in contrast, performed well in all conditions. An ANOVA was performed using Age as a between-subject factor and Tense and Event as within-subject factors. The effect of Age was highly significant ($F(1,62) = 51.12$, $p < 0.0001$), as well as the effect of Tense ($F(1,62) = 35.28$, $p < 0.0001$) and Event ($F(1,62) = 23.55$, $p < 0.0001$). All interactions were also highly significant (as a result of the ceiling effect caused by the adults' perfect performance). For the children, a *post-hoc* comparison using a Scheffé

TABLE 3. *Mean number of correct answers to the truth value task for children and adults*

Condition	Children	Adults
Infinitive, Event	0.85	1.00
Infinitive, Non-event	1.00	1.00
Tensed, Event	0.93	1.00
Tensed, Non-event	0.18	0.92

TABLE 4. *Proportion of correct answers by different verb and age group*

Condition	Children	Adults
forget that	0.85	0.98
find out that	0.95	1.00
think that	0.93	1.00
ask to	0.89	1.00
forget to	0.91	0.98

procedure was conducted for all the conditions (with $p < 0.05$). This analysis revealed that the mean of the tense non-event condition was significantly different from the means of all other conditions.

This part of the study confirmed our previous finding that children are unable to resolve the contradiction between the discourse frame and the interpretation of the factive complement. This contrasts with adults, who can easily resolve this contradiction by rejecting the question, i.e., the presupposition failure.

In addition, our results showed that both children and adults performed very well in the comprehension test, responding correctly about 95% of the time. For the subjects who understood the story (comprehension question passers), the correlation between correctness of response to the test question and to the comprehension question was low for both children and adults ($r = 0.14$ for the children and $r = -0.14$ for adults). This eliminates the possibility that children's incorrect answers to the test question reflect a lack of understanding of the story.

The second part of the experiment, testing the inferences about the truth of the complement in undetermined contexts, shows less of a difference between children and adults. Responses of the children and of the adult control group are summarized in Table 4.

Children performed well with all verbs, although their performance was slightly lower than that of the adult control group. An ANOVA was performed on the number of correct responses, with Age as a between-subjects factor and Verb as the within-subjects factor. The analysis yielded no significant main effect of Verb ($F(4,248) = 0.93$, $p = 0.45$), but a significant main effect of Age ($F(1,62) = 9.47$, $p < 0.005$), and there was no significant interaction ($F(4,248) = 0.48$, $p = 0.747$). We did not find any specific differences between factive and non-factive verbs, as measured by weighted analyses of contrast.

There was only an 0.08 proportion of incorrect responses in the *think*-condition and 0.11 in the *ask*-condition, i.e. negating or affirming the truth of the complement, instead of expressing uncertainty. These results for the propositional sentences show that most children did not use simple comprehension strategies like the complement-only strategy (i.e., ignoring the matrix clause, as suggested for younger children by Abbeduto & Rosenberg 1985), or an inference strategy (Harris 1974). The complement-only strategy would predict more incorrect affirmative responses in the propositional condition than we actually find. The inference strategy would predict more affirmative or negative responses (as opposed to uncertain responses) than those actually found in the propositional condition.

Discussion

The results of the first part of the current study confirm the main findings of Study 1, showing additionally that children understood the story well, and that adults had no problems with any of the tasks. Children performed poorly only when it was necessary to reject a factive complement because the presupposed event failed to happen. In the design used in the second part, this situation did not arise.

Furthermore, children in our study recognized the different properties of factive, propositional and negative implicative verbs and are able to assign truth values to the sentential propositions of those verbs, based on their semantic properties. These findings indicate that, at the age we tested, children have mastered the distinction between factive and non-factive verbs with respect to their presuppositional character and do not use simple prelinguistic comprehension strategies like the ones discussed above.

Considering the findings of both experiments in this study reveals a complex picture of the acquisition of factivity. On one hand, children can assign correct presuppositions to the complements of different verb types, and are able to distinguish factives from non-factives. On the other hand, children fail to exclude statements with factive complements

in situations of presupposition failure. Note that the complexity of the two tasks is different. In both cases, children have to generate a semantic analysis of the factive complement. In the latter case, however, they have to compare this analysis with the discourse frame which has been set up by the story. The difference in performance in the two tasks could be explained in terms of the computational complexity involved, or by an inability to modify an already established discourse frame.[4]

CONCLUSIONS

According to a strict definition of the acquisition of factivity, as we have proposed above, some proportion of children have not fully acquired factivity in the early school years. As predicted, mastery of factivity entails knowledge of the semantic, discourse and syntactic properties. Four basic findings have emerged from our discussion:

(a) Children understand the basic meaning of factive complements, and they distinguish between different types of verbs (Study 2).

(b) Children are unable to interpret situations of presupposition failure (Study 1 and 2).

(c) Children miss important aspects of the syntactic properties inherent to factive ·complements (as shown by previous literature).

(d) Children may exhibit different patterns in the acquisition of factivity if the inflectional marking of factive complements is complex (Study 1).

The first and second conclusions exhibit an interesting parallel with the situation described in the theory of mind literature for children before the age of four. Children who fail theory of mind can attribute past behaviour to false beliefs, but fail to predict future behaviour based on an attribution of false belief to subjects (cf. Fodor 1992). Children are also known to substitute mental states according to the current status of affairs; they said somebody 'knew' an answer when he or she only guessed it, if the outcome was correct (Johnson & Maratsos 1977). In these situations, children 'fix' the presumed mental representation of

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[4] Both conclusions are compatible with the interpretation of Inhoff (1985) concerning adult processing of factive complements. In an eye movement study, Inhoff found longer reading times in failed presupposition environments than reading times in other, non-contradictory situations.

events to match circumstances in the actual world. In the case of factive complements, it is possible that they fix the interpretation of the event to accommodate the discrepancy between the sentence and the discourse frame already set (Heim 1982, 1992). Another alternative is to suggest that Heim's accommodation strategy works in opposite directions in children and adults, and that the repair occurs at the lexical level: while children appear to react in cases of presupposition failure by reinterpreting a factive verb as not being factive, but negative implicative, the adult listener fixes up the discourse frame. In a situation in which Grover did not play with the marbles, the correct response to 'Did Grover forget that he played with the marbles?' is 'No, that is not right because he never played with them.' But many children in our studies were satisfied with answering yes even when they knew that the event had never happened.

The last connection to articulate is the link between conclusions (a) and (b), about lexical and pragmatic knowledge, and conclusion (c), about the syntax. A precise understanding of this link is not achieved yet. We suggested earlier that recognition of the grammatical marker of factivity renders the acquisition task more complex for the children. Tense or aspect are the morphological expression of factivity, needed to provide a visible representation of the independent event variable inherent to factive complements. From a syntactic perspective, the presence of an independent event operator binding that variable from the embedded complementizer position could be the reason why factive complements are barriers to movement and negation raising. It is possible that both discourse and syntactic failures depend on children's difficulty in establishing the position and content of this independent event operator.

From a general viewpoint, our results demonstrate the need for an approach to the acquisition of factivity which integrates syntactic, semantic, pragmatic and cognitive development. We conclude that there are universal predispositions in the acquisition of factivity (i.e., failure to comprehend presupposition failure), as well as language-specific difficulties that depend on differences in the structure of the input.

There is a rapidly growing body of research examining children's understanding of the mind. More and more, such research is closely examining the ties between the acquisition of complex syntax and understanding of the mind (Bartsch & Wellman 1995, deVilliers & deVilliers, in press, Tager-Flusberg 1996, Tager-Flusberg 1997). Factive complements are very important within this domain, because many distinctions among the various mental verbs and mental expressions depend on factivity (the difference between *think* and

know, etc.). Our research suggests that factivity is a complex linguistic skill, depending both on lexical learning and on grammatical learning. Interpretation of factivity places substantial demands on children because, beyond direct interpretation of main and embedded clause, it requires the checking of presuppositions against the discourse frame, and the reconciliation of contradictions between these in cases of presupposition failure.

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