CHILDREN'S UNDERSTANDING OF SENTENCES WITH ACTIONAL AND NONACTIONAL VERBS

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ABSTRACT

Previous work has shown that sentences with actional verbs (e.g., <u>to hit</u>) are better understood by children than sentences with nonactional verbs (e.g., <u>to see</u>). This effect is accounted for in contrasted ways in the literature. These explanations are analyzed and found wanting both theoretically and empirically. An alternative suggestion is made. It is based on new data as well as on a reanalysis of previously published ones. Accordingly, actional verbs favor the construction of mental images that serve as supports for the operations involved in processing sentences.

Passives are usually more difficult to understand than actives (Beilin & Sack, 1975), and they are mastered later during development than corresponding actives (Baldie, 1976). By passive sentences, we mean full syntactic passives, i.e. those passives with the verb at the passive voice and the underlying grammatical subject introduced by the preposition "by", e.g. the pot was broken by the boy. The full syntactic passive is equivalent to an active sentence in its underlying relations although a reversal of surface grammatical subject and object is implied. The noun phrase that serves as the underlying grammatical subject remains invariant whether in sentence-first position as in the active or in sentence-last position as in the passive.

An increasing capacity for the comprehension of passive sentences by children has been linked to a number of cognitive factors; e.g., an ability to focus attention on the underlying grammatical subject and to give it an emphatic position at the beginning of the sentence (Tannenbaum & Williams, 1968; Turner & Rommetveit, 1967). Other factors such as reversibility also contribute to the difficulty of passives (Sinclair & Ferreiro, 1970; Beilin & Sack, 1975). Typically, children have more difficulty to understand reversible passives such as The girl is pushed by the boy than nonreversible ones such as The bottle is broken by the boy (see Rondal, Thibaut, & Cession, 1990). Young children tend to decode reversible passives as if they were corresponding actives. In reversible passives, the surface grammatical subject and object can be interchanged while maintaining a semantically plausible construction (e.g. the sentences The girl was pushed by the boy and The boy was pushed by the girl are two semantically acceptable sentences). Because of semantic expectations, children have fewer difficulties in understanding nonreversible passives (Baldie, 1976). In our world, this is always the case that patients are treated by doctors, bottles broken by people and not the reverse. Henceforth, nonreversible sentences like The patient was treated by the doctor or The book was read by the teacher are easier to understand than reversible sentences. It is interesting to note that semantic factors such as reversibility can influence the processing of other syntactical forms.

Other cognitive determinants than those suggested above may also influence the processing of declarative sentences, especially the passives. Recent works have shown that passive sentences constructed around actional verbs (e.g., kick, spill) are better understood by

children than passive sentences constructed around nonactional verbs (e.g., know, hear, like) (Maratsos, Kuczaj, Fox, & Chalkley, 1979; Maratsos, Fox, Becker, & Chalkley, 1985; Sudhalter & Braine, 1985; Gordon & Chafetz, 1990; Rondal, Thibaut, & Cession, 1990; Thibaut, Rondal, & Kaens, 1995). However, Maratsos et al. (1979, 1985), Sudhalter and Braine (1985), and Gordon and Chafetz (1990) restrict the actionality effect[1] to the passives. In contrast, Rondal et al. (1990) and Thibaut (1993) present data showing that, under appropriate methodological conditions, the actionality effect can also be demonstrated with actives. It can be suggested therefore that the actionality effect is of a more general nature than previously thought and that it may constitute an example of a basic semantic influence in sentence processing.

Gordon and Chafetz (1990) distinguished between two possible explanatory categories for the actionality effect, that they label class-based and verb-based respectively. Class-based accounts are those focusing on the semantic properties of the actional and nonactional verbs as two different classes. In opposition, in verb-based accounts, acquisition is considered to be first based on a learning item-by-item. It is argued that children are restricted in their knowledge of passives by frequency differences in their language input. The verbs that they hear in the passive voice are more often actional than nonactional ones.

Rondal et al. (1990), Thibaut (1993), and Thibaut et al. (1995) have suggested a procedural explanation, therefore going beyond the class/verb-based distinction of Gordon and Chafetz (1990). Accordingly, the actional verbs are supposed to favor a different cognitive treatment as compared to nonactionals. It is suggested that, when children are confronted with an actional sentence, they tend to form a mental image and use it as a mental support for further computations (e.g., when they are requested to answer questions bearing on the sentences). Correlatively, it is posited that the processing of nonactional sentences is not accompagnied by the construction of a mental image.

In what follows, we first discuss the distinction between the class-based and verb-based explanations of the actionality effect and question the validity of their empirical basis. We turn then to our own theoretical proposal and supply what we consider to be relevant supportive empirical data from our experimental work. We suggest that early

accounts of the actionality effect cannot handle some of the data that we have obtained, especially the data revealing an actionality effect for active sentences.

Class-based approaches

Sudhalter and Braine (1985) report the results of two comprehension tasks with children aged 3 to 9 years. They take their data to suggest that the acquisition of the passivization rule is a gradual process of "rule strenghening". Sudhalter and Braine (1985) argue that the actionality effect stems from the children's interpretation of preposition by in the passives as a cue to agent. In nonactional sentences, by cannot be interpreted as introducing an agent. As a consequence, young children tend to interpret the nonactional passives as the corresponding actives. Consistent with Sudhalter and Braine's indications, Maratsos and Abramovich (1975), Rondal, Thibaut, Cession, Brédart, and Kaens (1988) (the latter using French sentences with native French-speaking subjects) have shown that the presence of by is a sufficient condition for the subjects to interpret sequences of the structural type Noun phrase-be+past participle-BY-Noun phrase as passives. When the preposition by is removed from the sentence (e.g., *The girl is hit the boy), the probability for the remaining sequence of words to be understood as an active greatly increases. However, Gordon and Chafetz (1990) have observed an actionality effect with truncated passives (i.e., passives with no "by phrase", for example, the girl is hit) which effect cannot be explained in terms of the presence of the cue "by".

Maratsos et al. (1985) have reported results from two experiments with children aged 4 to 11 years that are congruent with those of Sudhalter and Braine (1985). Two experimental methodologies were applied, either answering a question bearing on the sentence presented, or pointing to a picture correctly representing the sentence proposed. Across variations in method, children consistently understood actional passives more accurately than nonactional ones. Maratsos et al. (1985) suggested an explanation of the actionality effect in terms of semantic transitivity. Semantic transitivity (see Hopper & Thompson, 1980, for a theoretical analysis) entails the transfer of a property from a grammatical subject (GS) to a grammatical object (GO) through the mediation of a verb. Verbs with a higher level in semantic transitivity

involve properties such as kinesis, change of state, reference to a punctuate event, intentional meaning, and other properties. Highly transitive subjects are animate, intentional, physically active, singular, and definite, while grammatical objects high on transitivity are affected or changed by the event, definite, inanimate, and nonintentional (among other properties). For example, a sentence such as <u>John chops the wood</u> may be considered to be high in transitivity. <u>John sees the girl</u>, in contrast, is lower on the same scale. The actionality of the verb plays a major role in the expression of transitivity as it may be considered to serve as a "vehicle" for the expression of other transitivity characteristics such as animacy and intentionality (see Rondal & Thibaut, 1992, for a discussion of the various transitivity features and their possible relationships). Maratsos et al. (1985) observed that the sentences which were best understood in their experiments were highly transitive. For these authors, it is this semantic-structural core of high transitivity from which children eventually spread their analysis to the productive range of passives. Children probably induce this semantic core from an analysis of the passives to which they are exposed. This may be so but, as Maratsos et al. (1985) recognize , "we have no evidence about why the passive extends its semantic range after the period of initial restriction" (p. 189). No explanation is supplied by these authors of the generalization mechanism that is needed in order to explain the move from a sub-class of verbs (the actionals) to all the verbs that can be passivized. Maratsos et al. (1979, 1985) explicitly reject any verb-based explanation, as suggested by Gordon and Chafetz (1990), and more generally any explanation based on a differential processing for the two types of verbs and the sentences in which these verbs are incorporated.

A verb-based approach

In opposition to the semantic class-based suggestion of Maratsos et al. (1985), and following suggestions in Pinker (1984) and Pinker, Lebeaux, and Frost (1987), Gordon and Chafetz (1990) have proposed that the actionality effect can be explained by a verb-based mechanism. They mean that "the passive is acquired and represented on individual verbs within the lexicon" (p. 230). If it turned out to be the case that actional passives were more numerous in the children's input, then passive lexical entries derived from the input would be

more common for actional verbs than for nonactional ones; hence actional passives would be better understood than nonactionals. As a first step in their empirical search, Gordon and Chafetz (1990) checked the language input to the Harvard children (Brown, 1973) for various types of passives. They report that passives represent only 3.6% of all input utterances. Among passives, nonactionals corresponding to verbal passives (e.g., <u>You got your back sunburned</u>) are rare but this is not the case with adjectival passives (e.g., <u>The toy is broken</u>). The latter amount to 41% of the passive input. As a verb-based account of the actionality effect relies heavily on differential input for actional and nonactional verbs, the higher frequency of nonactional adjectival passives found in the input is troublesome for such a theory. Gordon and Chafetz (1990)'s input analysis identified only four full passives. This observation is in contradiction with a verb-based theory. How could children come to understand full passives without having heard actional or nonactional sentences produced in this voice ? Again some sort of generalization mechanism is needed. The problem is that such a mechanism is excluded by definition from any verb-based explanation.

In a second study, Gordon and Chafetz (1990) presented actional and nonactional actives as well as full and truncated actional and nonactional passives, to children aged 3 to 5;6 years. A retest followed one week later. According to the authors, a purely class-based account predicts that children will have problems with nonactionals as a class. Errors on nonactional passives should be essentially at random. In contrast, a verb-based account focuses on children's knowledge of passives for individual verbs. Hence, a question about a passivized verb that a child answers correctly on the first test should also be answered correctly on the retest. Comparing consistency in the children's interpretive responses from test to retest should supply an interesting indication for validating either a class-based or a verb-based explanation of the actionality effect. A child was scored as consistent for a given verb if he or she was either correct or incorrect on both test and retest for that verb. The consistency scores were compared against chance level, i.e., 50%. Results significantly differed from this level. It can be argued, however, that confronting a verb-based account to a theoretical consistency of 50% does not constitute a correct test of the hypothesis. A strong verb-based hypothesis predicts the absence of inconsistent responses. Children's consistency

scores, therefore, should not deviate from a level of 100%. Indeed, if the subjects know (don't know) one verb in the test, they ought to know (not know) it in the retest as well, demonstrating 100% consistency or close to. In Gordon and Chafetz's data, inconsistent responses represented 24% of the total scores for actional passives and 34% for nonactional ones. The authors are aware of this problem. They try to minimize it insisting that inconsistent scores are at least partially the consequence of an improvement in the children's interpretive performance from test to retest. Accordingly, test-retest consistency could have been underestimated. They correctly point out that an increase in correct performance contradicts a strong verb-based hypothesis as it calls for some generalization taking place between test and retest. Observations made by Maratsos et al. (1985) show that some degree of generalization may take place in the course of the experimental task and can partially explain children's overall performance. For example, the order in which actional and nonactional verbs are presented during the task significantly affects performance. When the experiment begins with the presentation of actional sentences and goes on with sentences constructed around nonactional verbs, nonactional passives are better understood (63% of success) than in the converse situation (34% of success). The knowledge acquired in interpreting actional passives seems to transfer to nonactionals. Such a generalization, however, is alien to a strong verb-based account.

Additionally, if a verb-based account were correct, variations in verb frequencies in the language input to the children should markedly influence comprehension of the passives, i.e., the most frequent verbs should be better understood than the less frequent ones. In contradiction, Sudhalter and Braine (1985) observed that the actionality effect demonstrated in children's comprehension of passives was not a function of individual characteristics of verbs such as frequency in the language or regular/irregular morphology. The product-moment correlation between percentages of correct responses and frequency-data proved nonsignificant and there was no significant difference between the number of correct responses to regular and irregular verbs, actional or nonactional.

Moreover, in our opinion, Gordon and Chafetz's second experiment does not allow for a valid empirical test of verb-based and class-based accounts. It is not clear, in the case of a

class-based account, why errors on nonactional passives should represent random responses. Nothing in a class-based account prevents response consistency, as it may be assumed that children's treatment of verbal characteristics should not basically change over a one-week interval. The semantic characteristics that render comprehension easier or more difficult are the same in the test and in the retest situations. Furthermore, one may suggest that improvement in children's performance from the first to the second experimental session results at least partially from a generalization process. Actually, a class-based account seems to be more compatible with Gordon and Chafetz's data.

A procedural viewpoint

The experiments reported by Gordon and Chafetz (1990), Maratsos et al. (1979, 1985), Sudhalter and Braine (1985) have yielded results which were interpreted by these authors as restricting the actionality effect to passives. However, Rondal et al. (1990) (see also Thibaut, 1993, 1995) have reported actionality effects in active sentences as well. Children were given active and passive sentences, plausible (The man hits the table; The table is hit by the man) as well as implausible ones (The table hits the man; The man is hit by the table) in comprehension tasks. The questions asked in order to evaluate comprehension were formulated in the same voice as the test-sentences or conversely. Rondal et al. (1990) suggest that the failure to find a significant difference between the processing of actional and nonactional actives in preceding studies is due to a ceiling effect. In Maratsos et al. (1985) (experiment 2), a ceiling effect is likely as soon as 4 years. Sudhalter and Braine (1985) obtained scores higher than 90% on the nonactional actives with children aged 4 to 5 years. In contrast, Rondal et al. (1990) reported an average performance in the condition "active sentence-active question" that was lower (68% of correct responses) than the one observed by other authors in corresponding conditions. This is probably because Rondal et al. proposed implausible sentences in equal proportion with plausible ones whereas other authors only used sets of plausible sentences. In processing implausible sentences like The man is hit by the table, children cannot use their general knowledge in order to compensate for possible procedural difficulties.

Note that Maratsos et al. (1979) explicitly reject the possibility of a ceiling effect on actives in their experiment which could have masked the presence of an actionality effect. To discard this possibility, they analysed the results of those of their subjects who made at least one error in the six questions asked in the experiment. No actionality effect appeared in the resulting data. This reasoning, however, is not convincing. If the actionality effect is linked to specific characteristics of the interpretive task, removing the best performing subjects does not modify these characteristics. A lesser efficiency with the task in some subjects may have to do with possible confounding variables such as low motivation, worse concentration on the task, intellectual ability, etc.

Thibaut (1995) also observed an interaction between sentence complexity and actionality that runs against linking the actionality effect to characteristics of the passives. If one increases the difficulty of the passive sentence, for example, by adding an adverbial phrase, one should expect a global reduction of the performance or, at best, a performance equivalent to the one obtained without the adverbial phrase. In Thibaut (1995), the difference in the comprehension scores were found actually to decrease for the sentences containing the adverbial phrase.

The above works were concerned with the passive voice. Thibaut (1993) has reported the results of two additional experiments purporting to test the generalization of the actionality effect to active sentences. As to prevent any possible processing bias determined by the exposure to passives, the experimental sentences only contained complex actives sentences with relatives. Results revealed significant actionality effects and significant interactions between verb actionality and such variables as (a) embedding, i.e., embedded relatives versus relatives derived on the right, (b) semantic reversibility of the main clause, (c) semantic reversibility of the relative clause. A significantly larger actionality effect was observed in relative clauses derived on the right (The man is looking at the girl who welcomes his brother) compared to embedded relative clauses (The man who is looking at the girl welcomes his brother) with both main and relative clauses being reversible (Robert who is looking at his brother kicked John) compared to nonreversible clauses (John kicks the dog that is near the window). Such data suggest that each structural type of clause and sentence has specific

characteristics likely determining a particular processing. For example, adding a temporal adjunct to the relative clause significantly modifies the interaction between the variables Embedding and Actionality. The actional-nonactional difference increases for nonembedded relatives in comparison with embedded ones for relatives without temporal adjunct, whereas the reverse situation is observed for relatives with temporal adjuncts.

Rondal et al. (1990) and Thibaut et al. (1995) have proposed a procedural explanation of the actionality effect, retaining the notion of semantic transitivity but linking it to mental imagery. While Maratsos et al. (1985) tie the actionality effect to a prototypical semantic role, Thibaut et al. (1995) suggest that the semantic characteristics of the actional verbs (and probably other characteristics defining semantic transitivity as well) render these verbs, and therefore the sentences constructed around them, simpler to understand. During sentence presentation or immediately following it, subjects build a mental representation which may sustain the storing of the sentence in working memory and/or the immediate reprocessing of the sentence in order to answer a question about it (for example, in experimental comprehension tasks). Along this theoretical line, actives as well as passives built around actional verbs should be better understood than sentences constructed around nonactional verbs. High transitivity verbs may be regarded as having a more concrete reference, therefore favoring analogical representations in mind. Such mental representations provide a "material" conveniently supporting some of the computational operations involved in sentence processing.

Thibaut et al. (1995) empirically analyzed possible links between imagery capacity and difference in sentence processing between actionals and nonactionals, with children aged 5 to 7 years. Each child was classified in one of four categories on the basis of his or her performance in two mental imagery tasks (a mental rotation task and a mental reconstruction of pictures presented in separate parts). Results revealed an interaction between Actionality and Imagery demonstrating that comprehension of actional sentences is better in those subjects with higher scores in mental imagery tasks. As for nonactionals, performance decreased in high imagery subjects compared with low imagery ones. The higher imagery subjects exhibited a greater tendency to use mental imagery and seemed to draw maximum profit from

it in sentence interpretation whenever the sentences proposed were concrete enough to be represented mentally in image forms, i.e. for the actional sentences. High imagery subjects cannot use this strategy with nonactional sentences. Consequently, their performance decreased with these verbs compared to low imagery subjects who do not use the imagery strategies spontaneously or use it much less.

Other authors such as Glass, Millen, Beck, and Eddy (1985) suggested that mental imagery may play a significant role following the comprehension process when subjects are to realize cognitive and/or linguistic activities bearing on the sentence (for example, verifying its truth value) (see Denis, 1989, for a review). But it is also plausible that subjects use mental imagery in the course of the comprehension process as imageable referents can better contribute to the mapping of the thematic relations involving the entities refered to in the sentences.

Data reported by Lempert and Kinsbourne (1981) are compatible with our theoretical proposal. These authors compared the memory retention of verbal stimuli in three experimental conditions : (a) actional SVO sentences; (b) nonactional SVO sentences; (c) a neutral condition in which subjects were presented pairs of lexical terms composed of the subjects and objects involved in the actional and nonactional sentences used in (a) and (b). Memory learning for pairs of lexical terms was significantly lower than for actional sentences, and approximately equal to the one for nonactional sentences. According to our hypothesis, it may be suggested that subjects used actional verbs as linking elements for the construction of mental images, but could not use this possibility (or much less) with nonactional verbs and pairs of lexical terms. It has been shown that the use of mental imagery enhances subjects' memory performance. Bower (1972), for example, has shown that subjects memorize pairs of words better when they are suggested to construct a mental image associating the representation of the referents of the two words in one representation. In the Thibaut et al. 's experiment (1995), the observed interaction between the variables Imagery and Actionality (see above) indicates that the difference observed between actionals and nonactionals is tied to a better performance by "higher-mental-imagery" subjects who spontaneously tend to use an image-construction strategy.

The significant interaction observed between Reversibility and Actionality in Thibaut's experiment (1993), reveals that the actionality effect takes place in reversible sentences but not in nonreversible ones. The latter sentences can more easily be interpreted by the subjects given their sole semantic-pragmatic properties whereas the interpretation of reversible sentences demands an analysis of the syntactic roles (e.g. Amy, 1983). For reversible sentences, young children have to correctly map nominal action agent and patient roles on the sole basis of grammatical properties. For these sentences, a mental image could help them to anchor the result of the mapping of the syntactic roles in a representation in order to answer a question asked about the sentence. The larger difference observed between actionals and nonactionals in the case of non-embedded than in the case of embedded sentences, can be explained in the same way. With embedded clauses, the verbs of the relative and the main clauses modify the same noun and require integration of the two information within the same mental image (e.g., The man who kicks the chair looks through the window), whereas in the case of the clauses embedded to the right, the verb of the main clause modifies a noun different from the one modified by the relative clause (e.g., The man kicks the girl who looks through the window).

In summary, the above discussion and data review clearly show that the actionality effect is in no way restricted to passive sentences. The general explanation that we are proposing is based on the notion of mental imagery and its role in sentence processing. Actional sentences favor the construction of a mental image during sentence processing or just following it, which facilitates the retention in memory of its meaning and the reprocessing of the sentence whenever a question is asked about it or a further analysis is needed. Such a procedural strategy is characteristic of high-imagery people ("mental visualizers"). It seems to be much less used by low-imagery subjects. Of importance, is the observed fact that the difference between actionals and nonactionals does not manifest itself to the same degree depending on the semantic-syntactic structure dealt with.

The kind of explanation that we advocated in the present paper for explaining the actionality effect, is congruent with models derived from studies of complex syntactical forms. In many cases, when diverging comprehension scores are obtained for two syntactical forms (e.g., embedded versus relative clauses derived on the right), the explanation is based on

variables such as differences in knowledge about the world, or cognitive mechanisms that are not restricted to the grammatical form under study. As a last example, let's take the case of temporal clauses. It has been shown that sentences such as "<u>John left the house after he had finished his work</u>" are more difficult to understand than sentences such as "<u>After he had finished his work, John left the house</u>". In the first sentence, the order of statement of the actions violates their order in the reality (John first finished his work, then, he left the house). It is obvious that this kind of explanation based on "plausibility in the real world" could be used for other grammatical devices in which this plausibility would be violated in the same way. Following this logic we have shown that the actionality effect is not restricted to the passives and, consequently, should be explained in terms that are not specific to the passive forms.

NOTE

1. Following Gordon and Chafetz (1990) we use the expressions actional and nonactional verbs and we generalize them to sentences labeled actional and nonactional. We have coined the expression actionality effect to refer to the performance differences in the comprehension of actional and nonactional sentences.

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