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NOTE

Interpretation of relative clauses by young children: another look*

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ABSTRACT

Interpretation of relative clauses sentences was investigated by having sixteen children between the ages of 3;5 and 4;6 act out sentences within four conditions that varied the number of potential referents for each noun within the sentence. No difference in interpretation accuracy was found between felicitous and infelicitous conditions or between biased and neutral conditions. This result raises problems for the view that children of this age know the pragmatic principles for interpreting relative clauses.

INTRODUCTION

Although relative clauses are produced by two- and three-year-old children (McKee, McDaniel & Snedeker, 1995), five-year-old children exhibit difficulty interpreting these sentences (Sheldon, 1974; Tavakolian, 1981). These contradictory findings present an apparent paradox. Researchers have investigated various factors that might contribute to difficulty processing such sentences. The current report continues that line of investigation.

Sentences with a relative clause (RC) differ based on 'embeddedness' (whether the relative clause is embedded within the subject or object noun phrase) and 'focus' (whether the relativized noun is the subject or object of the embedded clause). Table 1 illustrates four RC types based on these two factors. Embeddedness influences the surface order of constituents and presents one source of processing difficulty for RC interpretation. Slobin (1973) proposed the principle that interruption of constituents would increase processing difficulty. This would make sentences with subject-

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TABLE 1. *Relative clause types*

Embeddedness	Focus	
	Subject	Object
Subject	*the cow that hit the pig kissed the sheep* (SS)	*the cow that the pig hit kissed the sheep* (SO)
Object	*the cow hit the pig that kissed the sheep* (OS)	*the cow hit the pig that the sheep kissed* (OO)

embedded relatives – an RC embedded within the subject noun – harder to process because the RC interrupts the main clause and must be interpreted before you can finish interpreting the main clause. In contrast, sentences with object-embedded relatives – an RC modifying the object noun – can be interpreted in order, one clause at a time. Consistent with this principle, children's first productions of relativized sentences are object-embedded relatives (Menyuk, 1969; Limber, 1973) and they imitate object-embedded relatives more accurately than they do subject-embedded relatives (Slobin & Welsh, 1973).

However, studies of children's interpretation of RCs have not shown that children understand object-embedded relatives better than they do all subject-embedded relatives. Rather, SS relatives have consistently been reported to be interpreted by young children as accurately or better than object-embedded relatives (Sheldon, 1974; deVilliers, Flusberg, Hakuta & Cohen, 1979; Tavakolian, 1981). Sheldon (1974) proposed a parallel function hypothesis to account for this. According to this hypothesis, relative clause sentences in which the identical noun phrases have the same grammatical function in their respective clauses would be easier to process. Consistent with this claim, Sheldon found that children aged 3;8 to 5;5 made more correct interpretations on SS and OO relatives than on OS or SO relatives.

In the Sheldon (1974) study, children performed better on OS than on SO relatives. The greater difficulty with the SO relatives appears to be because the order of elements within the initial clause deviates from canonical word order (Slobin, 1973; deVilliers *et al.*, 1979). Whereas the other RC types all begin with an NVN sequence, SO relatives have an initial NNV sequence. deVilliers *et al.* (1979) found that children show accurate interpretations (75% correct) of the initial clause of SS, OS, and OO relatives, but consistently misinterpret the initial clause of SO relatives (only 29% correct). Application of a word order strategy leads to a correct interpretation of the first clause of SS, OS, and OO relatives but cannot be applied to the inverted clause of the SO relatives. However, it should also be noted that the initial NVN sequence is the relative clause of the SS sentence but is the main clause of the object-embedded relatives. Applying a local word order strategy

to the initial clause leads to a correct interpretation of the relative clause in SS sentences but would only apply to the main clause of OS relatives.

To account for the better interpretation of SS than of OS relatives, Tavakolian (1981) suggested that children analyse RC sentences as consisting of two conjoined clauses and then apply a first noun strategy in which the first noun is interpreted as the subject of both clauses. This first noun strategy would result in correct interpretation of SS relatives because the subject of both clauses is the same. However, application of this same strategy would result in a misinterpretation of OS sentences. An alternative strategy proposed by C. Chomsky (1969) is the minimal distance principle in which the closest preceding noun is taken to be the subject of the complement verb. Application of the minimal distance strategy would lead to a correct interpretation of the relative clause for OS relatives while leading to an incorrect interpretation of the second, main clause of SS relatives. These two linguistic strategies thus yield opposite interpretations for OS and SS relatives.

There are semantic factors as well that increase processing difficulty for all types of RCs. Both Sheldon (1974) and Tavakolian (1981) used sentences with three animate nouns. Reducing the number of animate nouns to two has been shown to improve performance (Goodluck & Tavakolian, 1982; Correa, 1995). Goodluck & Tavakolian (1982) included OS sentences with intransitive verbs such as *the dog kicks the horse that hops up and down* and sentences with inanimate objects such as *the dog licks the horse that knocks over the table*, as well as sentences with three animate nouns. Correct interpretations increased from chance levels for the three-animate-noun sentences (49% correct) to 69% for the two-animate-noun sentences and 76% for intransitive sentences. However, Correa (1995) reported that the disruption in interpretation resulting from three animate nouns was limited to object-focused relatives (SO and OO) and did not affect subject-focused relatives (SS or OS).

Pragmatic factors have also been suggested as influencing children's RC interpretations. Hamburger & Crain (1982) first pointed out that the experimental situation for investigating children's interpretations of RCs had violated the felicity conditions for this structure. The felicity conditions for a particular sentence form specify the necessary situational context required for appropriate use of that sentence type. Since RCs serve the function of restricting a referent set, the felicity condition for this sentence type requires that there be a set larger than one. Otherwise, there is nothing to restrict. For a sentence such as *the cow bumped the horse that jumped over the fence*, this means that there must be more than one horse. The usual experimental procedure, however, has been to present children with each of three different objects as possible referents for the relative clause subject. For the sample sentence above, this referent set would include one cow, one horse, and one

other animal. Hamburger & Crain (1982) presented the children with referent sets that included at least two exemplars of the relativized noun, the horse. With this procedural modification, they report more frequently correct interpretations for OS relatives. Comparing their findings to that of Goodluck & Tavakolian (1982), they found 30% fewer interpretation errors by their 4-year-old subjects.

The present investigation sought to replicate and clarify this finding. Hamburger & Crain (1982) concluded that infelicitous contexts can disrupt children's understanding of RCs. However, it is a possibility that their procedural change might actually overestimate what children know about the structure of RCs. Hamburger & Crain (1982) suggested that a pragmatic aspect of the traditional RC experimental task had interfered with the child's ability to apply their linguistic knowledge to interpret the sentences. However, it might also be the case that the children were basing their interpretations solely on their pragmatic knowledge rather than basing their interpretation on the syntax. Such reliance on a contextually based strategy when children do not have the requisite syntactic knowledge has been shown by Strohner & Nelson (1974). For the sentence *the cow bumped the horse that jumped over the fence*, children might eliminate the cow as a possible referent since there was only one and, therefore, no need to restrict the referent set of cows.

The current project addressed this methodological issue by presenting RC sentences under varying pragmatic conditions which varied the number of potential referents for all nouns. To illustrate, for the sentence above, there would be several conditions, one in which there would be two horses but only one cow; one with two cows but only one horse, and another condition with two of each.

It was predicted that children would perform better in felicitous conditions in which there are more than one possible referent for the relativized NP and perform less well in infelicitous conditions in which there is only one member of that referent set. In addition, if children at this age know the felicity condition for RCs but do not know the syntactic principles for interpreting RCs, then they might overgeneralize this pragmatic knowledge and assume that the RC applies to any referent set for which there is more than one. This would be evidence that they had based their interpretation on the situational context rather than on grammatical analysis.

METHOD

Subjects

Subjects were 16 children between the ages of 3;5 and 4;6 with a mean age of 4;0. This included eight three-year-olds and eight four-year-olds. Nine of the children were girls and seven were boys. All of the children were

monolingual English-speaking and were recruited from two preschool programmes, one in suburban New Jersey and one in New York City. All of the children scored within one/half standard deviation of the mean or better on the *Test for Auditory Comprehension of Language* (Carrow-Woolfolk, 1985), a norm-referenced picture identification task. Subject characteristics are listed in Table 2.

TABLE 2. *Subject description* ($N = 16$)

Subject no.	Subject no.	Age	Sex	TACL*
1	15	3;5	F	106
2	1	3;7	F	118
3	4	3;7	F	116
4	5	3;7	M	116
5	14	3;9	M	114
6	16	3;9	F	108
7	2	3;11	M	115
8	8	3;11	M	103
9	10	4;3	F	98
10	3	4;4	M	118
11	9	4;4	M	95
12	12	4;4	M	88
13	13	4;4	M	95
14	6	4;5	F	118
15	11	4;5	F	123
16	7	4;7	F	119

* The mean for this test is 100 with a S.D. of 15.

Procedure

An act-out procedure was used for eliciting comprehension responses. The examiner said a sentence and then the child demonstrated the meaning of that sentence by manipulating toy animals.

Prior to receiving the experimental items, the child was trained to perform the act out task for simple active sentences such as *the sheep touched the pig* and for conjoined sentences. The conjoined sentences provided opportunities for the child to act out two clauses. The training items included sentences such as *the sheep kissed the cow and swam in the pool*, in which the first noun performed both actions and sentences such as *the pig kissed the sheep and the sheep fell off the steps*, in which different nouns performed each action. The training items also included conjoined sentences such as *the cow kissed the pig but first the cow swam in the pool* in which the order of occurrence differed from order of mention. Correct interpretation of the NVN relations within the simple sentences and conjoined clauses was a prerequisite for inclusion in the study.

The experimental sentences included SS type relatives, such as *the cow that kissed the pig jumped over the fence*, and sentences OS type relatives, such as *the cow kissed the pig that jumped over the fence*. It is the OS sentences that were the structure of interest for two reasons. First, this was the RC type studied by Hamburger & Crain (1982). The current study will compare performance on this RC type to that reported by these authors. Secondly, recall that the initial NVN clause of both SS and OS relatives is correctly interpreted so that any interpretation errors occur on the second clause. It, therefore, seemed that violation of the felicity condition for RCs should not disrupt interpretation of the SS sentences, since this second clause is the main clause, but should only disrupt interpretation of the OS sentences, in which the second clause is the relative clause. The SS sentences were, therefore, included as a control. All of the RC sentences included only two animate nouns to reduce processing load (as per Goodluck & Tavakolian, 1982). This was accomplished by having an intransitive verb in the second clause. To further simplify the interpretation task, the referent included only the two animal types mentioned in the sentence, rather than also including a third non-mentioned animal. This eliminated selection of a non-mentioned referent as a possible error so that the investigation could focus on the effect of referent set size.

The different interpretation conditions involved manipulating the set of referents available to the child for acting out the sentences. Pragmatically neutral conditions provide no situational cue as to the referent set that needs to be restricted. For the current investigation, this was operationalized as conditions in which the same number of referents, either one or two, was available for both mentioned nouns. In contrast, a biased condition would provide two possible referents for one of the mentioned nouns but only one possible referent for the other mentioned noun. A biased felicitous condition would provide two referents for the noun that is modified by the relative clause. In contrast, a biased infelicitous condition would provide two referents for the non-relativized noun but only one possible referent for the relativized noun. There were four conditions that varied with respect to these

TABLE 3. *Experimental conditions*

	Relative type	
Referent condition	OS *the cow touched the pig that jumped over the fence*	SS *the cow that touched the pig jumped over the fence*
Neutral felicitous (NF)	2 cows, 2 pigs	2 cows, 2 pigs
Neutral infelicitous (NI)	1 cow, 1 pig, 1 sheep	1 cow, 1 pig, 1 sheep
Biased felicitous (BF)	2 pigs, 1 cow	2 cows, 1 pig
Biased infelicitous (BI)	2 cows, 1 pig	2 pigs, 1 cow

aspects of felicity and neutrality. The conditions and referent sets are shown in Table 3.

There were 32 experimental sentences, 4 each of SS and OS relatives in each of the 4 experimental conditions. Each child heard half of the sentences in each of two sessions. In an initial pilot study, some children changed their pattern of referent selection from one session to the next. For instance, one child showed a first noun selection pattern in session one and a second noun selection pattern in session two. It was therefore decided to present both RC types and all four referent conditions in each of the two sessions. Sentences were grouped into blocks of four, so that all four items for each condition were presented together. Within each session, the order of conditions was randomized, with the exception that the children first received one of the neutral conditions. This was done to avoid introducing a potential response bias. Within each of the conditions, the four sentences were randomized as well.

There were two sets of animals in separate boxes, a farm set including pigs, sheep, and cows, and a wild animal set including lions, bears, and gorillas. To maintain interest, the animal sets were alternated so that the children used one set of animals for four sentences and then switched to the other set of animals for the next four sentences. In order to call the child's attention to the referent set, for each item the child was instructed which animals to take out of the box and then the examiner reviewed the available animals after the child had taken them out of the box. For example, for a biased condition, the examiner would instruct the child 'take out two pigs and one cow'. After the child had taken out the animals, the examiner would say 'now you have only one cow but you have two pigs'.

RESULTS

Scoring

To code the children's responses, each animate noun in the sentence was assigned a number (as described in deVilliers *et al.*, 1979). The first noun main clause subject was coded as 1. The second noun object of the main clause (for OS sentences) or of the relative clause (for SS sentences) was coded as 2. For example, for the sentence *the cow bumped the horse that jumped over the fence*, the cow would be coded as 1 and the horse coded as 2. If the child (correctly) made the cow bump into the horse, that enactment would be coded as 1-2. An incorrect enactment in which the horse bumped into the cow would be coded as 2-1. Since the second clause does not have an animate object, there would only be one number used to code the agent of that clause. If the child (correctly) made the horse do the jumping, the second clause would be coded as 2. If the child made the cow do the jumping, that response would be coded as 1.

TABLE 4. *Within clause interpretations*

Interpretations							
Initial clause							
RC type	1-2	2-1	1,1[a]-2	1-2,2[a]	–[c]	Other	
OS	246 (96%)	7	1	0	0	2	
SS	242 (95%)	9	0	1	2	2	
Second clause							
RC type	1	2	1,1[a]	2,2[a]	2_0[b]	–[c]	Other
OS	107 (42%)	139 (54%)	1	2	2	5	0
SS	138 (54%)	111 (43%)	0	2	0	5	2

[a] Enacted with both members of the referent set.
[b] Enacted with a different member of the referent set than that used in the first clause.
[c] Clause not enacted.

Outcome

The majority of responses (over 90%) involved either a 1-2;1 or a 1-2;2 enactment for both relative clause types. Within clause interpretations of the relative clause sentences are shown in Table 4. The children correctly interpreted the NVN sequence in the initial clause, whether it was the main clause as in the OS sentences (96% correct) or the relative clause in the SS sentences (95% correct). This was somewhat higher than that previously reported by deVilliers *et al.* (1979) for sentences with three animate nouns and contexts with a non-mentioned referent. For both RC types, just over half of the responses involved a correct interpretation of the second clause. The majority of incorrect responses involved selection of the other mentioned animal. There were a few responses that involved use of either both members of a referent set or of a different member of the referent set than that used in the first clause. Examples of such errors for the sentence above would involve making both horses jump over the fence or involve making one horse be bumped by the cow and a different horse jump over the fence. Such errors were rare and no child gave more than one of this error type.

The total number of correct responses was compared across conditions (see Table 5). Pairwise comparisons between conditions using the Wilcoxon *t* test for related samples were made for the number of correct responses. None of the comparisons (shown in Table 6) were significant. For the OS sentences, the total correct for each of the felicitous conditions was 6–8% higher than for either of the infelicitous conditions. For the SS sentences, the total correct for each of the felicitous conditions was 5% lower than the neutral infelicitous condition and 11% higher than the total correct for the biased

TABLE 5. *Number of children who scored the same, higher, and lower in the starred (*) condition*

Hypothesis					
Felicity	Bias	Comparison	Same score	Higher score	Lower score
OS relatives					
+	−	NF* vs NI	8	5	3
+	+	BF* vs NI	8	5	3
+	+	NF* vs BI	7	5	4
+	+	BF* vs BI	8	5	3
−	+	NI* vs BI	7	4	5
−	+	BF* vs NF	8	4	4
SS relatives					
+	−	NF* vs NI	2	6	8
+	+	BF* vs NI	7	4	5
+	+	NF* vs BI	10	4	2
+	+	BF* vs BI	10	4	2
−	+	NI* vs BI	5	8	3
−	+	BF* vs NF	7	5	4

infelicitous condition. This is less than the 17% difference that would be predicted between the biased conditions (with a two thirds probability of selecting the correct referent) and the neutral conditions (with an even probability of selecting the correct referent) given the probability of selecting the correct referent by chance in each condition.

DISCUSSION

Although there were no overall group effects for felicity or bias, it might be the case that individual children were influenced by these factors. The interpretations of OS relatives were compared across conditions to check for possible influences on individual children.

The starting premise, based on Hamburger & Crain's (1982) earlier work, was that violation of the felicity conditions for RC sentences would disrupt the interpretation accuracy for OS relatives. It was therefore, predicted, that children would make more correct interpretations of OS relatives in felicitous conditions and fewer correct interpretations in the infelicitous condition that has been used in most studies (the NI condition). Only one child seemed to demonstrate an interpretation pattern consistent with this prediction. Subject 11 correctly interpreted 75% (3) of the OS relatives in each of the felicitous conditions and showed random responding in the NI condition. However, since this child also showed correct interpretations of the OS relatives in the BI condition, it is not clear that his poorer performance in the NI condition can be attributed to a felicity violation.

TABLE 6. *Number of correct responses*

Subject	Age	BF	NF	NI	BI
OS Relatives					
1	3;5	3	4	3	1
2	3;6	0	1	0	0
3	3;7	4	4	3	2
4	3;7	0	1	1	2
5	3;9	4	4	4	4
6	3;9	1	0	0	1
7	3;11	3	2	2	2
8	3;11	1	0	0	2
9	4;2	4	3	4	3
10	4;2	0	1	0	0
11	4;3	3	3	2	3
12	4;4	3	3	4	1
13	4;4	4	4	4	4
14	4;5	0	0	1	2
15	4;5	2	2	2	2
16	4;7	4	4	4	4
Total		36	36	34	33
SS Relatives					
1	3;5	2	2	1	0
2	3;6	4	3	4	4
3	3;7	3	2	4	3
4	3;7	2	2	3	2
5	3;9	0	0	0	0
6	3;9	2	2	3	2
7	3;11	1	1	0	1
8	3;11	3	4	2	3
9	4;2	0	1	0	0
10	4;2	4	2	4	2
11	4;3	4	4	3	4
12	4;4	1	4	2	2
13	4;4	0	0	0	0
14	4;5	2	3	4	3
15	4;5	4	3	4	3
16	4;7	3	2	3	2
Total		35	35	37	31

A further hypothesis was that the procedural change introduced by Hamburger & Crain (1982) would bias the children's interpretations. It was predicted that children would make more correct interpretations in the biased felicitous (BF) condition than in the neutral felicitous (NF) condition. There were no children who performed in a way that was consistent with this prediction.

A third issue considered that children who had learnt the felicity conditions for relative clauses but had not yet learned the syntax of this form might overgeneralize an RC interpretation based on context. It was predicted that

children might show reduced performance in the BI condition relative to the BF condition. There were two children whose performance was consistent with this prediction. Subjects 1 and 12 each correctly interpreted 3 of the OS sentences in the BF condition but correctly interpreted only 1 OS sentence in the BI condition. However, without also seeing better performance in the BF condition relative to the NF condition, it is not possible to conclude that this worse performance in the BI condition reflected pragmatic knowledge rather than reflecting a contextual bias induced by the larger number of available referents. Support for this latter possibility comes from the one error by Subject 1 in the BF condition. On the sentence *the cow touched the sheep that jumped over the fence*, Subject 1 made one sheep be touched by the cow and made the other sheep do the jumping. This interpretation is not consistent with knowledge of the felicity conditions for RC and suggests that this child was merely showing a response bias related to the larger number of available sheep.

Concluding remarks

The current study found little to no difference in RC interpretation accuracy either for felicitous contexts compared to infelicitous contexts or for biased contexts compared to neutral contexts. This was a surprising finding given the previous report by Hamburger & Crain (1982) that conformance to the felicity conditions for RCs had resulted in increased interpretation accuracy. However, Hamburger & Crain compared the performance of their subjects to the results of other studies. The difference that they found may, thus, have been due to chance variation across groups in different studies. The result of the current study calls into question their conclusions that young children learn the felicity conditions for RCs before acquiring knowledge of their syntax and that interpretations of RC sentences may be adversely affected by violations of these felicity conditions.

Although there were no children whose responding was better in just the BF condition, there were two children whose responding may have been negatively influenced by the contextual bias in the BI condition. Hamburger & Crain (1982) argued against this possibility for two reasons. The four-year-olds in their study acted out the two clauses in conceptual order rather than order of mention. However, in the current study, all of the children acted out the clauses for both SS sentences (correctly) and OS sentences (incorrectly) in the mentioned order. Their second reason was the rare occurrence of interpretations in which a different member of the referent set was chosen to participate in each clause. However, although this response type was rare in the current study as well, it was given by one of the children whose performance was worse in the BI condition. In addition, the response pattern of using the same member of a referent set to act out both clauses was also observed for the conjoined sentences that were used as training items. This

response pattern may, therefore, reflect a general performance preference for using the member of a referent set – what Goodluck (1996) called a 'bird in the hand strategy' – rather than reflecting knowledge specific to relative clauses.

The current study sought to investigate the effect of a contextual bias on children's interpretation of relative clauses. The children in the present study did not demonstrate any such bias nor did they demonstrate a difference in performance relating to felicity conditions. This result raises problems for the view that children of this age know the pragmatic principles for interpreting relative clauses. It should be noted, however, that the children were tested on only four items in each of the conditions. Bearing this in mind, it does seem that children's difficulty in interpreting relative clauses may be due to syntactic limitations.

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