

Relative Clause Acquisition in Hebrew: Towards a Processing-Oriented Account

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1. Introduction

Relative clauses have been extensively studied in language acquisition due to their complex structure and the apparent difficulty children have with them. Their study has been made more intriguing by the well-documented asymmetry between subject and object relatives. It has long been noted that children comprehend subject relatives better than they do object relatives (Correa, 1995; Friedmann & Novogrodsky, 2004; de Villiers, 1979). Previous accounts have attributed this difficulty to the use of non-adult processing strategies (The Parallel Function Hypothesis – Sheldon, 1974; The Conjoined Clause Hypothesis – Tavakolian, 1981) or to under-developed syntactic abilities and specifically to an inability to process structures involving movement. Both types of account share the assumption that the difficulty children experience with object relatives is purely developmental. In this paper I would like to argue that although children's difficulty is in part developmental (i.e. reflects under-developed syntactic abilities) it stems in part from the extra processing load imposed by object relatives on both children and adults. In other words, part of their difficulty is not unique to children but rather is a magnified version of the difficulty that adults experience with object relatives. I report the results of two experiments that challenge the validity of movement-based accounts and then draw on memory-based models of adult relative clause processing (Gibson, 1998) to suggest an alternative processing-oriented account.

The movement-based account has been offered as an explanation for the performance of normal children (Friedmann & Novogrodsky, 2004), children with SLI (van Der Lely, 1994) and aphasic patients (Grodzinsky, 2000). This account claims that children do not yet possess the ability to process movement that is necessary to create the link between the clausal head and its role in the clause. As a result, children 'lose' the thematic role of the clausal head and assign it a default Agent role. In the case of subject relatives (*the granny that kisses the girl*) this strategy results in intact performance because the head accidentally receives the correct thematic role, but for object relatives (*the granny that the girl kisses*) the strategy results in chance performance because both the clausal head (*the granny*) and the subject of the clause (*the girl*) now have an Agent role. The existence of two competing Agents leads the child to randomly choose between the correct interpretation and the incorrect one. The

movement-based account thus predicts the documented asymmetry between subject and object relatives. It also leads to several additional empirical predictions. First, children should exhibit chance performance on object relatives. Second, when children err, they should display only errors of thematic reversal. Third, if difficulty is due to movement, children should not have difficulty with object relatives that do not involve movement. Results from a recent study in Hebrew (Friedmann & Novogrodsky, 2004) were consistent with the first two predictions. However, there are several reasons for questioning the movement-based accounts. First, children comprehend WH-questions at an age when they do not yet comprehend object relative clauses (Seidl, Hollich & Jusczyk 2003) suggesting that there is not an across-the-board difficulty with all structures that are analyzed as involving movement. Second, reports of adult difficulty with object relatives (Traxler, Morris & Seely 2002) undermine the claim that the difficulty is only a developmental stage. Finally, a closer look at previous support for the movement-based account reveals some potentially crucial methodological flaws.

Friedmann & Novogrodsky (2004) tested the comprehension of subject and object relative clauses by young Hebrew speakers (mean age 4;7) using a picture selection task and reported chance performance on object relatives and only errors of thematic reversal. Children heard a relative clause and were asked to choose the matching picture from a pair of pictures showing the two possible thematic assignments (e.g., granny kissing girl and girl kissing granny, respectively). Asking children to choose a picture rather than a referent might have hindered detection of the full performance range for the following reason: when a child points to the correct picture, we do not know whether he or she is indeed pointing to the correct or the incorrect referent. For example, after hearing the object relative *'Show me the granny that the girl is kissing'* the child might point to the correct picture showing a granny being kissed yet we cannot know if he or she is pointing to the correct answer (*the granny*) and displaying intact comprehension or to the agent of the clause (*the girl*) and displaying poor comprehension. The possible existence of previously undetected errors is crucial for the predictions of the movement-based account not only because it implies that difficulty in comprehension is not due solely to difficulty with movement, but also because this would affect the numerical value of chance. If children are considering not the two pictures but rather the four referents then chance level is not 50% and children may be performing above chance, contra the suggested strategy. Both potential pitfalls can be overcome by asking children to choose a referent rather than a picture.

Taken together, the evidence of adult difficulty with object relatives, the lack of child difficulty with WH-questions, and possible methodological shortcomings in prior studies call for a critical investigation of children's difficulty. This paper reports the results of two experiments designed to re-evaluate the predictions of the movement-based account among young Hebrew-speakers by a) assessing the full performance range and b) testing the comprehension of resumptive relatives, which are not analyzed as involving

movement in Hebrew (Borer, 1984). First, identification of a wider error range would serve to undermine both the validity of the picture selection task in its previous usage and the validity of an account that only predicts errors of thematic confusion. Second, if children perform poorly also on resumptive relative clauses this will imply the existence of additional non-movement related difficulties with object relative clauses. Experiment 1 assessed production and comprehension of non-resumptive subject and object relatives. Experiment 2 then tested comprehension of resumptive relatives.

2. Experiment 1: What kinds of errors do children really make?

2.1 Method

Participants. A total of 14 monolingual native Hebrew speakers (7 boys and 7 girls) participated in the experiment. The mean age was 4; 7 (range 4; 5 - 5; 2). All were normally developing children with no language impairments, hearing deficits or neurological difficulties.

Materials. The comprehension of subject and object relative clauses was tested with a modified version of the picture selection task used by Friedmann & Novogrodsky (2004). Children heard subject relatives (1), object relatives (2) or combinations of NP + PP serving as fillers (3) preceded by the request 'put a sticker on'. Importantly, asking children to choose a referent rather than a picture enables the detection of the full range of possible answers.

- (1) tasimi madbeka al ha-safta she menasheket et ha-yalda.
Put sticker on the-granny that kisses the-girlACC
'Put a sticker on the granny that kisses the girl'
- (2) tasimi madbeka al ha-safta she ha-yalda menasheket.
Put sticker on the-granny that the-girl kisses
'Put a sticker on the granny that the girl kisses'
- (3) tasimi madbeka al ha-safta im ha-xultza ha-aduma.
Put sticker on the-granny with the-shirt the-red
'Put a sticker on the granny with the red shirt'

After each item, children were presented with two pictures featuring the relevant NP's in both thematic assignments. For example, for 'Show me the granny that the girl is kissing' one picture depicted a granny kissing a girl and the other depicted a girl kissing a granny. Children were asked to put the sticker on the referent described by the sentence. This procedure enabled four possible answers: Correct answer – the kissed granny, Reversal error – the kissing granny, Agent error - the kissing girl and Other - the kissed girl.

Each picture set was presented twice preceded once by a subject relative and once by an object relative. Separate picture sets, also involving two NP's in both thematic assignments, were used for the filler items. The presentation of the picture pair, in which there are two instances of the clausal head (two grannies)

fulfils the felicity conditions defined by Hamburger & Crain (1982) and makes the use of a restrictive relative clause pragmatically adequate.

All verbs were used in the present tense. All were transitive verbs taking a direct object as a complement. In all sentences both NP's were of the same number and gender as to avoid inflectional clues provided in Hebrew by the agreement of gender and number on the verb. All sentences were semantically reversible, enabling logical assignment of either thematic role to both NP's in the sentence (grannies and girls can kiss or be kissed).

The experiment consisted of 40 items, 15 subject relatives, 15 object relatives and 10 fillers. Items were presented in pseudo-random order, enabling controlled variation between sentence types. All participants were given the test items in the same order. Answers were coded according to the position of the sticker. A pre-test was run before the actual test to ensure that children identified the objects and understood the instructions.

Production of subject and object relative clauses was evaluated using an elicitation task involving two experimenters and four puppets, two identical elephants and two identical mice. Experimenter A acted out a situation using two puppets, one of each type (all four were present to provide an adequate pragmatic context). In each situation, a scene where one puppet performed an action on the second puppet (kicked, hugged, etc.) was performed and narrated by experimenter A (e.g. "this mouse is naughty today, and he comes and bites this elephant on the leg"). After viewing the scene with the child, Experimenter B covered his eyes with a blindfold. The child then had to describe one of the puppets that participated in the scene so that Experimenter B could pick it up when the blindfold was removed. Seeing that there were two identical tokens of each animal, using a relative clause was the simplest way to guarantee correct identification. Production of both subject and object relatives was induced by pointing to either the Agent or the Patient in the acted-out scene.

The experiment elicited 10 subject relatives and 10 object relatives. Five additional intransitive situations (sleeping, crying) were included as fillers. All verbs were presented in the present tense. All actions were daily, familiar actions and were not continuous (e.g., bite, push). Each test item was continued until the child produced the required response or got fed up. When children produced inappropriate responses the experimenters helped with questions or comments that did not include relative clauses¹. Sessions were recorded and answers were coded by the author. The utterance used for coding was the child's first full appropriate one, whether or not it included a relative clause².

¹ A session might look like this: Exp. A – tell him to pick up this elephant. Child - pick up this elephant. Exp. B – but I can't see, which elephant? Child - the elephant that the mouse bit. Exp B - oh, I understand (takes off blindfold and picks up the correct puppet).

² Only answers that respected both the limitation of the second experimenter (cannot see) and the limitations of identifying the object (two identical puppets of each kind) were considered appropriate. Full answers were defined as answers

Procedure. All tasks were administrated individually to each child, in a separate room in the kindergarten. Each child chose when he or she wanted to do the tasks. Prior to administration, the experimenter spent two days getting to know the children. In all, the experimenter spent 14 full days in the kindergarten. Comprehension was tested in two separate sessions about a week apart. Production was tested between 15 and 18 days after the comprehension task in one session lasting 30 minutes. Sessions were recorded and later transcribed.

2.2 Results and Discussion

First of all, the results replicated the previously documented asymmetry in comprehension for subject and object relative clauses. Thus, as shown in Table 1, subject relatives were comprehended significantly better than object relatives $t(13) = 6.26, p < .001$. This asymmetry was not found in production because children did equally well in producing subject and object relatives. This shows an intriguing effect whereby production of object relative clauses preceded comprehension (discussed further in section 5). Seeing that the main focus of the study was on object relatives and that performance on subject relatives was at ceiling, only the results for object relatives will be addressed further.

Table 1: Correct production and comprehension (in percentage) of subject and object relatives

	Subject relatives	Object relatives
Comprehension	95	51
Production	88	93

The most important result has to do with the types of errors children made. As predicted, children did not make only errors of thematic reversal. Rather, the data presented in Figure 1 confirm that the novel Agent error, by which children chose the Agent of the relative clause, was found in 22% of the cases and this error was made about as often as the previously documented Reversal error. In other words, children often made the error of choosing the Agent of the relative clause instead of the clausal head.

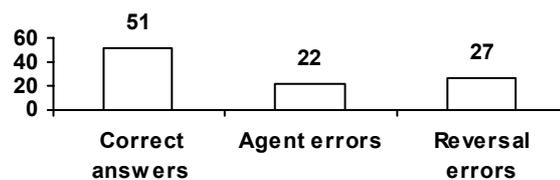


Figure 1: Performance (in percentage) on object relatives

that had at least a subject, a verb, and a complementizer. Answers that met these criteria but did not include relative clauses were coded.

The existence of the novel Agent error is revealing from several perspectives. First, it demonstrates an error range that is wider than predicted by movement-based accounts suggesting additional difficulty. Second, it undermines previous reports of chance performance on object relatives using a picture-selection task. The existence of the Agent error demonstrates that children are considering at least three if not all four referents in the picture set. Thus, chance level is not 50%, as would be the case if children were only considering the two tokens of the clausal head, but 33% or more likely 25% if they are considering all 4 possible referents. The change in the value of chance level means that the 51% correct performance exhibited by children in this study is not at chance level but rather is significantly above chance, $t(13) = 2.99, p < .01$. The Agent error further implies that previous use of the picture-selection task (Friedmann & Novogrodsky, 2004) did not detect the full error range.

Third, the novel Agent error suggests an additional difficulty having to do with mastering the modifying nature of the relative clause. The Reversal error seems to be associated with confusion with regard to the thematic role of the clausal head: children understand that the clause modifies one of the grannies, but they are not sure which one. The Agent error seems to tap a more basic misunderstanding with regard to the modifying nature of the clause: children do not grasp that the relative clause adds information about the clausal head. The existence of both errors suggests that there are two points of difficulty with object relative clauses: mastering the modifying nature of the clause and assigning the thematic roles correctly. Thus, children exhibited a wider error range than previously detected and displayed difficulties that seem to be associated not only with the thematic assignment to the clausal head (Reversal errors) but also with the modifying nature of the relative clause (Agent errors).

The picture of relative clause acquisition is further complicated when one considers differences in individual patterns. Interestingly, the percentage of correct responses differed greatly for the children, ranging from 0%-87%. Division of children into three groups according to their performance level (low: under 33% correct, mid: 33-66% correct and high: over 66% correct) revealed 3 distinct sub-groups that differed also in their error and production patterns. Regarding the latter, although all children produced a very high proportion of grammatical object relative clauses, they differed on whether these included a resumptive pronoun (*pick up the elephant that the mouse kissed him*). Resumptive pronouns in direct object position are optional in Hebrew (Givón, 1975) so both options were coded as fully grammatical. Table 2 shows the performance patterns of the three different groups.

Table 2: Sub-groups performance (in percent) on object relatives

	Correct	Reversal errors	Agent errors	Percent with resumptives
Comprehender Group (n=4)	82	8	10	20
Reversal Group (n=5)	43	41	16	20
Agent Group (n=5)	15	33	46	80

The first "Comprehender" group showed high comprehension rates, displayed a similar distribution of Reversal and Agent errors and produced object relative clauses almost exclusively without resumptive pronouns. The second "Reversal" group showed quite low comprehension rates, made far more Reversal than Agent errors, and produced object relatives without resumptive pronouns. The third "Agent" group showed very poor comprehension, made more Agent than Reversal errors, and was the only group to produce almost exclusively object relatives with resumptive pronouns. The groups differed significantly in the distribution of errors, Reversal: $\chi^2(2) = 9.37, p < .05$, Agent: $\chi^2(2) = 9.02, p < .05$. Grouping participants according to their level of correct performance thus revealed a pattern that would otherwise have been overlooked: the full picture of children's performance on object relative clauses is made up not only of their correct performance but also of their error and production patterns. It also implies a connection between comprehension patterns and use of resumptive pronouns in production: the more likely children were to make Agent errors, the more likely they were to use resumptive pronouns in production, $r = .57, p < .05$.

One way to conceptualize the difference between the groups is to view them as reflecting three consecutive stages in the acquisition of object relative clauses. The Agent group represents an earlier stage in which neither the modifying nature of the clause, nor the thematic assignment to the clausal head are properly mastered. The Reversal group reflects a later stage in which the main difficulty is with the thematic assignment to the clausal head while the Comprehender group reflects full mastery. Another possibility is that the three sub-groups reflect not different stages but different paths toward the mastery of relative clauses. In other words, children in the agent and reversal groups were adopting different strategies to cope with their difficulty. Further research is necessary to examine and distinguish among these possibilities.

To summarize, the results of Experiment 1 did not support the two main predictions of the movement-based account: chance performance on object relatives and limitation of errors to thematic reversal. Children exhibited a wider error range. They did not make only errors of thematic reversal but also made the novel Agent error: choosing the agent of the relative clause instead of the clausal head. Furthermore, detection of this novel error necessitated revision of the chance level and application of the revised level indicated that children actually performed better than chance. The results highlighted shortcomings of the picture-selection task as used in previous studies because asking children to point to a picture instead of a referent prevented detection of the Agent error. The results also suggest an additional source of difficulty related to mastering the modifying role of the relative clause. Finally, they indicated that evaluation of correct performance, error patterns and production patterns is important to providing a comprehensive picture of acquisition.

3. Experiment 2: Are non-movement object relatives still difficult?

Under the assumption that children's difficulty is caused by their inability to process movement, relative clauses that do not involve movement should not pose any difficulty. Conversely, if the difficulty is not related only to movement, non-movement relatives might still be difficult. Hebrew allows resumptive pronouns in object relative clauses. These resumptive relatives are commonly analyzed as not involving movement (Borer, 1984) but rather as involving co-indexation between the clausal head and the resumptive pronoun. As a result, children's performance on resumptive relatives can serve as a further test of the movement-based account: if resumptive object relatives are also difficult, movement cannot be the only source of difficulty.

3.1 Method

Participants. Seven children from the two non-comprehender groups (Reversal and Agent) participated in the second experiment.

Materials. The same picture selection task described in Experiment 1 was used to assess the comprehension of resumptive relative clauses; the only difference was that resumptive pronouns were added to the object relatives (4).

- (4) tasimi madbeka al ha-safta she ha-yalda menasheket ota.
Put sticker on the-granny that the-girl kisses
'Put a sticker on the granny that the girl kisses her'

Children were presented with the same picture sets as in Experiment 1. Items consisted of 9 object relatives, 7 subject relatives and 4 fillers. All other properties were as described for Experiment 1.

Procedure. The procedure was identical to that described in Experiment 1. The task was administered a month after completion of Experiment 1.

3.2 Results and Discussion

As predicted, and contrary to the movement-based account, the children also found resumptive object relatives difficult and performed correctly on only 42% of the items. Figure 2 shows the performance of the same children on object relatives without resumptive pronouns (Experiment 1) and with resumptive pronouns (Experiment 2).

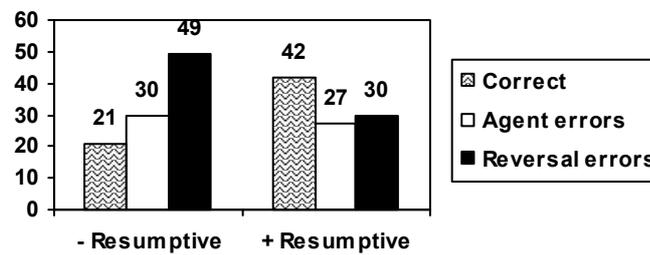


Figure 2: Comprehension of object relatives with and without resumptives

Although children's performance was significantly better on resumptive than on non-resumptive object relatives $t(6) = 2.77, p < .05$, comprehension was still poor. Interestingly, the improvement in performance was due to a significant drop in Reversal errors, $t(6) = 2.41, p < .05$, but not in Agent errors, $t(6) = .53, p = .30$. In other words, the addition of the resumptive pronoun helped reduce errors of thematic confusion (Reversal errors) but did not help clarify the modifying nature of the relative clause. This finding suggests an intriguing connection between the addition of a resumptive pronoun and simplification of thematic assignment and suggests further that addition of the resumptive pronoun did not facilitate comprehension of the modifying nature of the clause³.

To summarize, the results of the second experiment demonstrated that resumptive relatives were still difficult, despite the fact that they do not involve movement. This further undermines the movement-based account and strengthens the need to look for additional explanatory factors.

4. An Alternative Processing-oriented Account

Taken together, the results undermine the ability of the movement-based account to explain the full range of data on relative clause acquisition in Hebrew. The results of the first experiment did not match the predictions of the movement-based account on regular relative clauses. The second experiment showed further that resumptive object relatives were still difficult for some children even though they do not involve movement. Taken together, the results suggest that factors other than movement create the difficulty associated with object relative clauses. Both experiments, however, replicated the well-documented difficulty with object relatives and yielded Reversal errors that reflect thematic confusion. What could be causing this thematic confusion?

³ Interestingly, a different pattern seemed to emerge for the two sub-groups with the Reversal group replicating the general trend and the Agent group not showing improvement on resumptive structures. This might support the existence of two consecutive stages but the very small number of participants doesn't allow any strong conclusions.

One explanation is that object relative clauses are difficult not because they involve movement but rather because the interfering NP makes thematic assignment to the clausal head harder. One clear difference between subject (5) and object (6) relatives is that in the latter, an additional NP (*the girl*) needs to be processed before the clausal head can be assigned its thematic role.

- (5) Show me the granny that is kissing the girl
- (6) Show me the granny that **the girl** is kissing

That the interfering NP might be a source of difficulty has been offered for adult processing of object relatives. (Gibson, 1998; Gordon, Hendrick & Johnson, 2001). This view has received strong support from a series of studies that demonstrated that manipulating the referential properties of the interfering NP reduced the difficulty associated with object relatives (Warren & Gibson, 2002; Gordon, Hendrick & Johnson, 2002). For example, Warren & Gibson (2002) showed reduced difficulty for object relatives with more accessible interfering NP's (pronouns). Additional studies have demonstrated that manipulating the animacy of the NP's reduced the difficulty associated with object relatives (Mak, Vonk & Schriefers, 2002; Traxler, Morris & Seely, 2001). Could children's difficulty be governed by similar principles?

The answer seems to be partially affirmative. Specifically, one can venture that Agent errors represent a developmental stage unique to children when they have not yet mastered the modifying nature of the clause. In order to understand the structural relations between the head and the clause the child has to know that the complementizer opens a new sentence, subordinated to the matrix clause. Lack of this knowledge may lead to assigning a 'flat' structure in which the complementizer opens a new sentence altogether such that the relative clause '*Show me the granny that the girl is kissing*' will be understood as '*Show me the granny, the girl is kissing*' inviting the possibility of Agent errors⁴. Although this idea receives some support from production data indicating that in Hebrew children use the complementizer to open main sentences (Berman, 1997), it needs to be examined in further research of production patterns. The Reversal error, on the other hand, does not reflect a developmental stage but rather a magnified version of the difficulty adults experience with object relatives. Although in adults the interfering NP only slows down performance, in children it can lead to complete disruption of the thematic assignment, manifested in Reversal errors. Attributing Reversal errors to the interfering NP serves an additional purpose of embedding the study of relative clause acquisition within a more general framework of language processing. To take this notion a step further, it might be the case that much of the difficulty children experience with complex syntactic structures such as relative clauses or passives can be attributed to non-syntactic

⁴ Importantly, this does not predict difficulty on subject relatives where the flat structure can still converge on one referent (*show me the granny, is kissing the girl* points to the kissing granny).

factors which still play a role in adult processing rather than to underdeveloped syntactic abilities.

One obvious direction for further research is to investigate whether children exhibit the same sensitivity as adults do to NP-type manipulations. Should this occur, it would support the claim that there is a common source underlying the difficulty that both adults and children experience with object relatives.

It is important to note that this study tested an especially difficult type of relative clauses (semantically reversible with two full NP's) that is not common in child speech (Diessel & Tomasello, 2000). The claim is not that children necessarily do not comprehend other, simpler types of relative clauses but rather that when there are no additional semantic or pragmatic cues to assist in comprehension, object relative clauses create difficulty. This difficulty is of interest because it results in errors that are not apparent in adult speech. In other words, somewhere along the way, children learn how to process even these de-contextualized, 'heavy' object relatives. The pitfalls and advances of this process are of great importance in understanding language acquisition.

5. Open question: On the relation between production and comprehension

In both experiments production of object relatives seemed to precede comprehension. The direction of this lag is intriguing since it is usually assumed that comprehension precedes production in acquisition. However, the relation has been suggested to be less linear and depending on the interaction between the child's linguistic and cognitive abilities (Bloom, 1974). This kind of view might imply a different relation between production and comprehension for more complex syntactic structures. For starters, the main source of difficulty in comprehension was correctly deciphering the thematic assignment, a task that is completely annihilated in production where the thematic assignment is clear to the speaker. As a result, more resources might be needed for the comprehension of complex structures (presented with no contextual cues) than for their production. It would be interesting to investigate whether production of other complex structure, such as passives or clefts, also precedes their comprehension.

6. Conclusions

The results have several important implications both for the methods used in the study of relative clause acquisition and for the explanations that have been offered to account for the findings. The studies undermine the validity of movement as an explanatory factor for the difficulty children experience with object relatives and shed light on previous methodological shortcomings hindering detection of the novel Agent error. Alternatively, this paper suggests that children's difficulty with object relatives stems in part from problems with the modifying nature of the clause and in part from the increased load brought on by the interfering NP. The results further imply that embedding the study of relative clause acquisition within a broader context of child and adult processing might be fruitful.

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