When is children’s scope interpretation non-isomorphic, and why?

1. Claims. As reported by Musolino (1998), preschoolers tend to interpret sentences containing a universal quantifier and negation (see (1)), or an indefinite noun phrase and negation (2) isomorphically; they cannot access the inverse scope readings. We demonstrate that Hungarian preschoolers assign to doubly quantified sentences distributive readings that do not show the isomorphism of the scope order and the linear order observed by Musolino (1998).

Children’s Observed Isomorphism is attributed to immature grammar by Musolino (1998), and to the interaction of pragmatic constraints by Gualmini (2004; 2008; Gualmini et al. 2008). According to Musolino & Lidz (2003; 2006), scopally ambiguous sentences represent a garden-path situation, which is known to be hard for children (Trueswell et al.1999). The default reading of such sentences is the statistically more common and cognitively less demanding isomorphic reading. If it proves to be untenable, children have difficulties with revising their original commitment. We argue on the basis of four experiments that the lack of isomorphism attested in the interpretation of Hungarian doubly quantified sentences provides evidence for the ‘garden-path’ explanation of Observed Isomorphism.

2. Experiments 1-2. In experiment 1, we tested whether Hungarian preschoolers can access the distributive readings of doubly quantified sentences such as (3). 46 children (aged 6;5, SD 4 months) were shown sentence–picture pairs, where the sentence was SOV or SVO, and the picture showed either its direct distributive (i.e., isomorphic) reading (Picture A) or its inverse distributive reading (Picture B). The children were asked for truth value judgements. Their answers displayed a mild bias towards isomorphism, but they were much less isomorphic than the adult control group, who rejected the inverse readings nearly unanimously (at the rate of 89% in the case of SOV sentences, and at the rate of 99% in the case of OSV sentences) – see Figure 1.

In Experiment 2, 41 preschoolers (aged 6;5, SD 4 months) listened to doubly quantified sentences such as (3) associated with pairs of pictures such as Pictures (A-B). They had to decide which of the two pictures the sentence was about. They opted for the isomorphic representation only in about the half of the cases, as opposed to the adult control group, who gave isomorphic answers in about 90% of the cases (Figure 2).

3. Interim discussion. The finding that Hungarian children’s scope interpretation is less isomorphic than that of Hungarian adults appears to contradict the isomorphism attested in English children’s interpretation of sentences involving quantification and negation. However, it is parallel with the results of former experiments testing the interpretation of doubly quantified sentences in English (Musolino 2009) and Chinese (Lee 2003). This suggests that Observed Isomorphism is limited to the interaction of quantification and negation, and does not extend to doubly quantified sentences.

We explain this difference in the framework of the ‘garden-path’ theory of scope ambiguity. According to Musolino & Lidz (2003, 2006), the default reading of ambiguous sentences of type (1)-(2), to which children are committed until the context or the situation forces them to revise it, is the isomorphic reading. We hypothesized that this is not so in the case of doubly quantified sentences; their default reading is the collective reading (also in the presence of the distributive particle is ‘each’). We tested this hypothesis by Experiment 3. If a distributive reading represents the revision of the collective reading computed online, it has an increased reaction time. This assumption was tested in Experiment 4.

4. Experiments 3-4. In Experiment 3, testing 48 subjects (mean age 6;5), children had to act out doubly quantified sentences such as (4-5). In 72.5% of all the test cases, they acted out the collective reading. They chose a distributive interpretation only when the collective reading was pragmatically very implausible. We concluded that the default reading of doubly quantified sentences for preschoolers is the collective reading. Accessing a distributive reading requires ‘turning back on the garden-path’ of interpretation, and making a second attempt. They do this only when forced by pragmatics. As the distributive interpretation is dissociated from the linear flow of speech, scope order can also be determined by strategies other than the linear order of the quantifiers, e.g., on the basis of their thematic hierarchy, the structure of the visual input, etc.

We confirmed our garden-path hypothesis by Experiment 4, measuring the reaction times of the collective and distributive interpretations. 23 children (mean age 5;11) had to judge the truth values of sentence–picture pairs. Test sentences of type (3)-(5) were presented together with three different types of pictures, showing their collective, direct distributive, and inverse distributive readings. We measured the average reaction times of the children’s answers. The average reaction time in the case of collective readings (1065 ms) was significantly shorter than the average reaction times in the case of direct distributive readings (1629 ms) and inverse distributive readings (2149 ms).
(1) Every horse didn’t jump over the fence.
(2) Donald didn’t find two guys.

(3) Két tornyot is három fiú épít.
Two towers - ACC DIST three boy builds
'Two towers each are being built by three boys.'

Figure 1: Acceptance of direct/inverse scope in Exp.1
\((*p>0.001)\)

Figure 2: Direct scope choices in Exp.2
\((*p>0.001)\)

(4) Három maci is két autóval játszik.
Three bears - ACC DIST two car-with plays
'Three bears each are playing with two cars.'
Collective reading (3 bears, 2 cars): 100%

(5) Három maci is két cukorkát kapott.
Three bears - ACC DIST two candies got
'Three bears each got two candies.'
Collective reading (3 bears, 2 candies): 65%

(6) Mean reaction times by readings (ms)

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<th>Children:</th>
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<tr>
<td>P1: Collective:</td>
<td>1065</td>
<td>1290</td>
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<td>P2: Isomorphic distributive:</td>
<td>1629</td>
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<td>P3: Non-isomorphic dist.:</td>
<td>2149</td>
<td>1558</td>
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References