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# Against Isomorphism and the Maxim of Charity in child language acquisition: Implications for the validity of the TVJT methodology

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**Abstract:** This paper investigates children’s interpretation of scopally ambiguous sentences containing negation and quantification, such as *Donald didn’t find two guys*, and *Two horses didn’t jump over the fence*. It has been argued, in previous literature, that children interpret such sentences only on their surface scope reading, i. e., on the interpretation ‘It’s not the case that Donald found two guys,’ instead of the adult-preferred inverse scope interpretation ‘There are two guys that Donald didn’t find,’ a phenomenon often called the *Observation of Isomorphism*. The present study shows, however, that this argument, even in its weakest interpretation, does not hold true, and that the apparent Isomorphism effect is an artifact of the experimental procedures used in previous studies. It also shows, based on *Relevance Theory*, and drawing from a series of novel experiments with 5-year-olds, that the reason why children seemed, in previous studies, to favor surface scope interpretations was because they made their decisions based on the set or information that they viewed as most “relevant” in a given context. It is concluded that children differ from adults not in scopal options their grammar allows, but in that they rank “salience” higher as a cue for general “relevance” than the *Maxim of Charity*, though for adults, the Maxim of Charity is at least equally relevant.

**Keywords:** language acquisition, L1 acquisition of semantics, pragmatics, quantification, negation, scope ambiguity, Isomorphism, truth value judgment methodology, child English

## 1 Introduction

In English (and in many other languages), a sentence such as (1) is ambiguous: It has two different interpretations: On one interpretation, it could be paraphrased

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as ‘It is not the case that Donald found two guys’. (e. g., Donald found no guys, one guy, three guys, etc.). On another interpretation, it could be paraphrased as ‘There are two guys that Donald didn’t find’. One way, theoretically, to distinguish these two interpretations is to assign them different syntactic parses, assuming, first, that ‘two guys’ is quantificational and, second, that ‘two guys’ and ‘not’ are scope-bearing elements. On this view, the first meaning is stated to correspond to a “surface scope” interpretation, and the second to an “inverse scope” interpretation, for it is only the first meaning that reflects the surface syntactic position of these two scope-bearing elements (i. e., not > two):

- (1) *Donald didn’t find two guys.*
- a. It is not the case that Donald found two guys. (not > two → surface)
  - b. There are two guys that Donald didn’t find. (two > not → inverse)

When (1) is uttered in a context like the one presented in Figure 1, where *Donald* finds only two of the four guys available (i. e., He finds two, but fails to find the other two.), the interpretation (a) would be false, for it is indeed the case that Donald found exactly two guys. Interpretation (b), on the other hand, would be true, for there are exactly two guys that are not found by Donald:



**Figure 1:** *Donald didn’t find two guys.*

It has been observed, in child language acquisition research, that, unlike adults, children judge these sentences false in truth-value judgment tasks, signaling that they choose the interpretation that makes the sentence false (i. e., (1a)).

Children do this despite the *Maxim of Charity* (Grice 1975), the assumption that a sentence will be judged true when at least one reading is true.

It has been claimed in the literature that this is because children can reach only surface scope interpretations, and that they can *not* reach inverse scope interpretations (the interpretation that makes the sentence true), and thus, that they take such sentences to be unambiguous (i. e., false). This was called the *Observation of Isomorphism* by Musolino (1998), and has later been shown to hold true by several researchers (e. g., Lidz and Musolino 2002; Musolino et al. 2000; Lidz and Musolino 2005, 2006). In its original form, the Observation of Isomorphism states, “when syntactic scope and semantic scope do not coincide, children’s interpretations correlate with the interpretations determined by syntactic scope” (Musolino 1998: 145). As one reviewer has indicated, Musolino originally presented the Observation of Isomorphism simply as a descriptive observation, i. e., the observation that children prefer isomorphic interpretations, and crucially, this observation was “not a theory, not a principle and not an account,” as the same reviewer points out. As is demonstrated by much later research (e. g., Musolino and Lidz 2006; Viau et al. 2010), however, there have been “different accounts of Isomorphism,” attributing the observation to various underlying causes (Viau et al. 2010: 27).

The Observation of Isomorphism, though, is not without its problems, and findings of previous research are rather conflicting: Children acquiring Dutch, for instance, consistently interpret similar sentences with inverse scope (not surface, i. e., non-isomorphic), although adult speakers can access both interpretations (Krämer 2000). Furthermore, English children can also reach inverse scope interpretations under appropriate conditions (Gualmini 2003, 2004, 2008; Hulseley et al. 2004).

This paper presents a unified account of these facts based on the *Relevance Theory* (Sperber and Wilson [1986] 1995). I argue that children do not differ from adults in grammar (i. e., The child grammar, like the adult grammar, can assign two parses), and that the apparent Isomorphism effect is an artifact of the experimental conditions in prior studies, caused by children’s over-reliance on “salience” as a cue for “relevance”. In previous studies, a child judging sentences like (1) false, in contexts like the one presented in Figure 1 below, was understood to have only the surface scope reading available, under the assumption that a sentence will be judged true when at least one reading is true (*Maxim of Charity*). The current study shows, however, that children judge (1) false, because, in the absence of certain expectations created by context (e. g., that *Donald* was supposed to find *all* guys), they make judgments based only on the more salient set of “found guys” out of a set of (a) “found” and (b) “unfound” guys (and (c) the universal set of *all* guys): After all, based only on the set of

found guys, it would indeed be false to utter (1) (on both surface and inverse scope readings).

This proposal makes a number of testable predictions: There are, for example, certain cases where children are predicted to be able to access inverse scope interpretations of sentences like (1), i. e., when the set of unfound guys is made more salient or when an expectation that involves *all* four elements in context is presented, which both serve to make the set of unfound guys more relevant. There are also certain cases where it should be more difficult for children to reach surface scope interpretations, i. e., when the numerally quantified NP is in the subject position as in *Two horses didn't jump over the fence*, where focusing on the more salient set of “jumping horses” out of a set of (a) “jumping” vs. (b) “not jumping” horses would, unlike the object NP cases, lead to an inverse scope interpretation, rather than surface.

To test these predictions, we conducted a series of experiments, and the results, as will later be elaborated on in detail, confirm the current proposal, and are inexplicable under any other previous proposal, including the Observation of Isomorphism or any other syntactic account.

The remainder of this paper is organized in the following way: First, in Section 2, a brief overview of the findings of previous research on children's scope assignment is provided. Second, in Section 3, previous accounts of these facts are presented, together with an overview of their problems. The current account is then detailed in Section 4. This section also presents the empirical predictions of this account, and is followed by Section 5, where the results are presented regarding a series of experiments conducted in order to test these predictions. Finally, Section 6 provides a general discussion and Section 7 concludes the paper.

## 2 Acquisition facts and theoretical background

It has been argued, in child language acquisition literature, that young children at ages 4 and 5 interpret sentences such as (2), (3) and (4) on their surface scope readings (i. e., (a) readings) rather than inverse scope (i. e., (b) readings) (e. g., Musolino 1998; Musolino et al. 2000; Lidz and Musolino 2002). This proposal was based on the finding that even when (b) readings are true (i. e., in contexts like the one in Figure 1, for sentences like (2) and (3)), and thus, these sentences are expected to be judged true on such readings – as a result of a strategy that helps judge a sentence true when at least one reading is true (Maxim of Charity [Grice 1975]) – children resort to the interpretations in (a), and judge these sentences false:

- (2) *The detective didn't find two guys.*  
 a. It is not the case that the detective found two guys.  
 b. There are two guys that the detective didn't find.
- (3) *The detective didn't find some guys.*  
 a. It is not the case that the detective found some guys. (=The detective found no guys.)  
 b. There are some guys that the detective didn't find.
- (4) *Every horse didn't jump over the fence.*  
 a. No horse jumped over the fence.  
 b. Not every horse jumped over the fence.

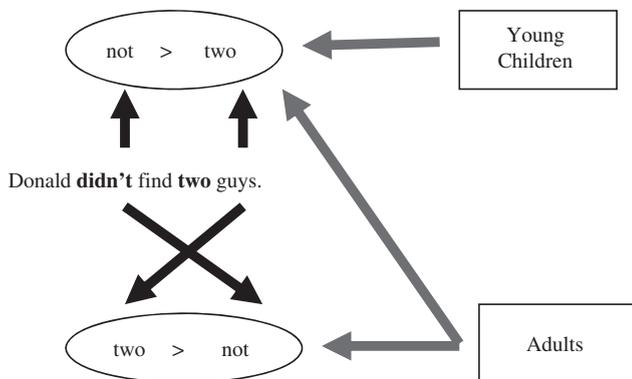
Musolino (1998) called this the *Observation of Isomorphism*, arguing that these findings indicate that children choose the interpretation where the c-command relations holding between the two quantificational elements (i. e., quantified NP and negation) in the surface syntax map directly to the c-command relations between these two elements in the semantics. Musolino et al. (2000) explained this as a grammatical problem, proposing that children are learning a grammar that does not allow inverse scope, as with children acquiring languages that only permit surface scope. Lidz and Musolino (2002) later offered support for the structural account of these facts, from Kannada, arguing that Isomorphism should be described in structural, rather than linear terms (i. e., through c-command relations between the two scope-bearing elements, rather than through their surface order, see Section 3 below).

The behavior of children viz a viz adults can, then, be summarized visually as follows:

This means that a scope-bearing element that c-commands another scope-bearing element in the surface will also have to take scope over it. With respect to Figure 2, then, *not*, which c-commands *two* in the surface syntax, will also be interpreted, by children, as having scope over *two* in the semantic representation (i. e., “narrow” scope interpretation of the quantified NP). In other words, representation (5a) below will be the one employed by children, though adults could reach (5b), too, where the quantified NP takes “wide” scope over negation:

- (5) a.  $\neg \exists_2 x [\text{guy}(x) \wedge \text{find}(\text{Donald}, x)] \rightarrow \text{surface}$  (= narrow here)  
 b.  $\exists_2 x [\text{guy}(x) \wedge \text{find} \neg (\text{Donald}, x)] \rightarrow \text{inverse}$  (= wide here)

Previous research reached these results by means of truth value judgment tasks (TVJT) (Crain and McKee 1985), which requires subjects to make a



**Figure 2:** Graphic illustration of the apparent behavior of children vs. adults.

judgment about whether or not a statement accurately describes a situation alluded to in a story. In a typical TVJT with young children, a puppet listens to the story along with the child, and utters, at the end, a statement as to what he or she thinks has happened in the story. The child is, then, instructed to indicate whether he or she agrees with the statement of the puppet. More often than not, the child is asked to accompany his or her statement with a reward (usually a candy) or punishment for the puppet (usually a piece of garbage), the former being an indication of a correct answer on the part of the puppet, and the latter being an indication of a false answer.

### 3 Previous accounts

#### 3.1 The Observation of Isomorphism

Children, in Musolino's experiments ( $n = 20$ ), judged sentences like (3) and (4) true only 50% of the time whereas adults judged them true around 90% of the time, indicating, according to Musolino, that children were interpreting these sentences on their surface scope (Isomorphic) reading whereas adults were adhering to the Principle of Charity, thereby interpreting the same sentences on their inverse scope (non-Isomorphic) reading, the reading that makes the statement true. Furthermore, when individual children were considered, an interesting pattern appeared: Half of the children judged the sentences true around 90% of the time whereas the other half judged them false, again, around 90% of the time, showing that there were two populations of children: those

who are adult-like who choose the true, inverse scope interpretation and those who are child-like who choose the surface scope interpretation even though this is the interpretation that makes the sentence false (i. e., violates the Maxim of Charity). According to Musolino (1998) and Musolino et al. (2000), these results meant that children *cannot* access inverse scope interpretations!

Later, these results and arguments were supported by further research: Lidz and Musolino (2002), for instance, tested children and adult speakers of English and Kannada<sup>1</sup> on their interpretation of scopally ambiguous sentences involving numerally quantified noun phrases and negation such as (1) *Donald didn't find two guys*, where either negation can take scope over *two guys*, giving rise to a narrow scope interpretation of the quantified NP, or *two guys* can take scope over negation, giving rise to a wide scope interpretation. They found that, when presented with contexts in which either interpretation (but not “both”) was true,<sup>2</sup> adults from both languages easily judged the sentences true whereas 4-year-old children (n = 12) were reluctant to do so when the wide scope reading was true. In fact, children in this study judged these sentences true only 33 % of the time in such conditions. Lidz and Musolino concluded that these results indicate a strong preference, on the part of children, for the narrow scope reading, which corresponds to the surface syntactic structure of the sentence (and thus to the Isomorphic Interpretation). More importantly, they concluded, based on similar results from the speakers of Kannada – a language where linear order and c-command relations are *not* confounded (as opposed to English in which negation both precedes and c-commands the object) – that children compute scope relations based on surface c-command relations between negation and the object, not based on linear order. Therefore, Lidz and Musolino claim to have reconfirmed not only the argument that children differ from adults in that their semantic scope corresponds to syntactic (surface) scope (i. e., the Observation of Isomorphism), but also that children and adults are alike in that

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<sup>1</sup> Kannada is a language in which, unlike English, linear order and c-command relations are not confounded. Therefore, a scope bearing element, in this language, could c-command another scope-bearing element even if it does not precede it.

<sup>2</sup> They managed this by having two conditions: In condition 1, Donald finds only two of the four guys available in context, which makes only the inverse scope interpretation true, for there are indeed two guys that Donald didn't find but it is not true that it is not the case that two guys were found. In Condition 2, on the other hand, there are two guys available in context, and Donald finds only one of these and fails to find the other. In such a context, the surface scope interpretation is the only reading that makes the sentence true since it is true that it is not the case that Donald found two guys, because he found only one guy. The inverse scope interpretation, however, makes the sentence false since it is not true that there are two guys Donald didn't find, for there is only one guy Donald didn't find.

both populations represent sentences as hierarchical constructs and not just as a linear string of words.

These and similar early findings were taken quite seriously, such that many researchers argued that they offer extra evidence for the popular assumption that indefinites, such as *two guys*, are quantificational (Diesing 1992), although some early research suggests that they might not be (Heim 1982; Kamp 1981) (i. e., They might be getting their quantificational force from other elements in the sentence.). Several other researchers used these findings as evidence for explaining some other phenomena. For example, just as Lidz and Musolino concluded that these were an indication of children's representation of sentences as hierarchical (rather than linear) constructs, researchers like Musolino et al. (2000) interpreted them as evidence for a learnability issue such as the subset principle. In particular, they claimed that, for a sentence like (1), all languages allow the surface scope reading, as in (a), whereas only some languages (such as English) allow the inverse scope reading, as in (b). Given also that (1a) is true only in a subset of the circumstances associated with (1b) (i. e., (1a) entails (1b)), they claimed that (1a) is children's initial assumption, because they could then add (1b) on the basis of positive evidence. On this account, the Observation of Isomorphism in English is caused by the fact that no matter what the target language is, all children universally consider a surface scope/isomorphic interpretation first, and inverse scope interpretations are (universally) added later, on the basis of positive evidence, once learners receive sufficient input from the target language demonstrating that it does allow the additional inverse scope interpretation, as with English.

The study of children's scope assignment for sentences like (1) was not limited to the generative studies mentioned above. Researchers from other frameworks also attempted to account for the so-called Observation of Isomorphism. Gennari and MacDonald (2005/2006), for instance, aimed to account for this observation by referring to the distributional patterns in the input that children receive. To this end, they argued, based on patterns from four experiments (production and rating studies with adults and corpus studies of children and adults' speech), that children's interpretation preferences are activated as a reflection of their prior "frequency in the input", and not because of the properties of Universal Grammar (UG) or lack of certain grammatical or pragmatic principles. In other words, claiming that children almost never hear negative sentences in contexts that promote the inverse scope reading, the authors argued that it is quite normal for them to have difficulty with inverse scope interpretations.

Isomorphism effects have been reported by several other studies, for various languages, and there have been numerous accounts attempting to explain what

the source of the Observation of Isomorphism is (see e.g., Musolino and Gualmini 2004; Lidz and Musolino 2005, 2006; Musolino and Lidz 2006; Noveck et al. 2007; Han et al. 2007, Viau et al. 2010; see also Lidz 2016, for a review).

### 3.2 Conflicting findings and the Weak Isomorphism account

Findings of research on children's scope assignment were not always in line with the Observation of Isomorphism, even for English-acquiring children. Gualmini (2003, 2004, 2008), for instance, showed that when presented with an appropriate "expectation" such as (6), English children can reach inverse scope interpretations of sentences such as (7):

(6) *The Troll is supposed to deliver all four pizzas.*

(7) *The Troll didn't deliver some pizzas.*

In particular, Gualmini revealed, with 15 children (ages 4:1 to 5:6, with mean age 4:10), that children judged sentences like (7), which include negation and *some* in object position, true 90 % of the time when presented with an expectation like (6). When, however, a different group of 15 children (ages 4:2 to 5:8 – mean: 4:11) were presented with (7) without an expectation like (6), they judged them true only 50 % of the time, as in Musolino's experiments.

According to Gualmini, this is because contexts that do not make an expectation such as (6) explicit enough are infelicitous. He suggests that negative sentences are felicitous only when they point out a discrepancy between what is expected to happen and what actually happens (i. e., when they are presented in a context where an expectation goes unfulfilled).

Though this means that the Observation of Isomorphism on its strictest interpretation cannot be correct, for children do indeed reach inverse scope interpretations under certain circumstances, the question of why children cannot reach inverse scope interpretations in the default setting (i. e., in the infelicitous condition on Gualmini's approach), where no expectations are presented, still remains. In other words, the research question that remains to be answered is now not why children *cannot* reach inverse scope interpretations but rather why they *favor* surface scope interpretations more often than inverse scope interpretations.

It is perhaps to answer this new research question that a less stringent (weak) version of the Isomorphism account was first suggested as a possibility

in Musolino and Lidz (2003) and was later adopted by Lidz and Musolino (2005, 2006) and Musolino and Lidz (2006), and was then offered further support by Conroy (2008), Conroy et al. (2008), and Viau et al. (2010). According to this new version, Isomorphism emerges as default in infelicitous contexts (i. e., contexts without an expectation that goes unfulfilled), because in such contexts, the processing demand is so high that an initial parse cannot be inversed, the initial parse being the surface scope interpretation, a parse that involves identity between LF and the syntactic structure (i. e., the “Isomorphic” parse on their account). This proposal also seems to be supported by the finding that the Isomorphism effect can be induced in adults, too, under certain circumstances that require high processing demands (Musolino and Lidz 2003). After all, it is a well-known fact that children have difficulty revising parsing decisions and undergo “garden-path” effects more often than adults (Trueswell et al. 1999).<sup>3</sup>

The weak Isomorphism account would then predict Isomorphism to arise in contexts that do not involve a situation where an expectation goes unfulfilled (Gualmini’s infelicitous contexts). Although this could account for the English facts better than a strong Isomorphism account, it is still unable to capture the crosslinguistic facts; children learning Dutch, for example, behave completely differently: As mentioned above, Krämer (2000) found that Dutch children favor inverse scope interpretations in those default contexts rather than surface scope interpretations, even when the latter is what Dutch adults prefer. In particular, he presented Dutch children with sentences such as (8) in a context where a boy had caught two of the three fish available, and children judged these sentences false 84 % of the time whereas adults always judged them true:

- (8) *De jongen heft een vis niet gevangen.*  
 The boy has a fish not caught  
 ‘There is a fish the boy hasn’t caught.’

This seems to suggest, then, that Dutch children prefer inverse scope (non-Isomorphic) interpretations over their surface scope (Isomorphic) counterparts, once again presenting evidence against Isomorphism-based accounts, accounts that attribute a default status to surface scope (isomorphic) interpretations.

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<sup>3</sup> The garden-path effect can be defined as “processing difficulty that is caused by reanalysis of a certain parse assigned as a result of local interpretive decisions.” A sentence like *The dog walked along the river is Fred’s*, for example, could first be interpreted/parsed as ‘The dog did the walking along the river’. Once the listener hears the word *is*, however, the sentence would be reanalyzed as ‘the dog that was walked along the river’. And this reanalysis is difficult since the listener is already led down the “garden path” (by the first parse).

Crosslinguistic facts such as this are, however, not the only complications for Isomorphism-based accounts, whether it is the strong or the weak version. Another complication comes from English itself, the very language that was claimed to present evidence for Isomorphism-based accounts: When sentences such as (9) and (10) are passivized, as in (11) and (12), children still give the same answers (i. e., same percentage of “yes” and “no”) (Hulsey et al. 2004), as opposed to what would be predicted by an Isomorphism account. An Isomorphism-based account would expect the percentage of “yes” and “no” answers to change in this condition, for the scopal relations between the quantified NP and negation are reversed in passive constructions, as indicated below in parentheses:

- (9) *The Troll didn't deliver some pizzas.*  
 a. It is not the case that the troll delivered some pizzas. (not > some → surface)  
 b. There are some pizzas that the troll didn't deliver. (some > not → inverse)
- (10) *The Troll didn't lose some pizzas.*  
 a. It is not the case that the troll lost some pizzas. (not > some → surface)  
 b. There are some pizzas that the troll didn't lose. (some > not → inverse)
- (11) *Some pizzas were not delivered.*  
 a. It is not the case that some pizzas were delivered. (not > some → inverse)  
 b. There are some pizzas that were not delivered. (some > not → surface)
- (12) *Some pizzas were not lost.*  
 a. It is not the case that some pizzas were lost. (not > some → inverse.)  
 b. There are some pizzas that were not lost. (some > not → surface)

All of the above sentences were presented in a context following an expectation like (6), which meant that (9) and (11) were equally felicitous and (10) and (12) were equally infelicitous. Sentences (9) and (10) had been tested before by Gualmini (2003), and children gave a “yes” answer 90% of the time and 50% of the time respectively. Hulsey et al. tested (11) and (12) with two groups of children (n = 12 and n = 15 respectively), and they found that children said “yes” for (11) 94% of the time whereas they said “yes” for (12) only 50% of the time. This means that children give an equal number of “yes” answers for (9) and (11) (around 90% of the time) and an equal number of “yes” answers for (10) and

(12) (around 50 % of the time) although this is not what would be expected by an Isomorphism-by-default account, which predicts that the surface scope interpretations should be easier.

It should be noted at this point that these results could also be attributed to other reasons, reasons that do not necessarily pose problems for accounts that place a default status to Isomorphism. For example, it could be that passives behave differently for other reasons (Musolino and Lidz 2004) or that double (semantic) negation in sentences like (10) and (12) places extra processing demand on children, thereby confounding the results (e. g., giving an effect as if children cannot reach surface scope interpretations in (12)).

Nevertheless, it seems that even a relaxed version of Isomorphism-by-default is unable to explain certain data. It seems also that an explanatorily adequate account should be able to (i) be not completely based on syntax (for, otherwise, Dutch facts and passivization facts would be left without an explanation), and (ii) capture the fact that children will judge a sentence like (12) false possibly for the same reason that they judge (10) false.

Below, I present such an account, an account, which not only seems to capture the above-mentioned facts and the apparent Isomorphism effect, thereby accounting for the conflicting findings of previous research, but also presents new data from 5-year-old English-speaking children, which are inexplicable under existing theories of children's scope assignment. The proposal I will be making is based on the Relevance Theory (Sperber and Wilson 1995 [1986]), and is detailed below before data are presented on the novel experiments.

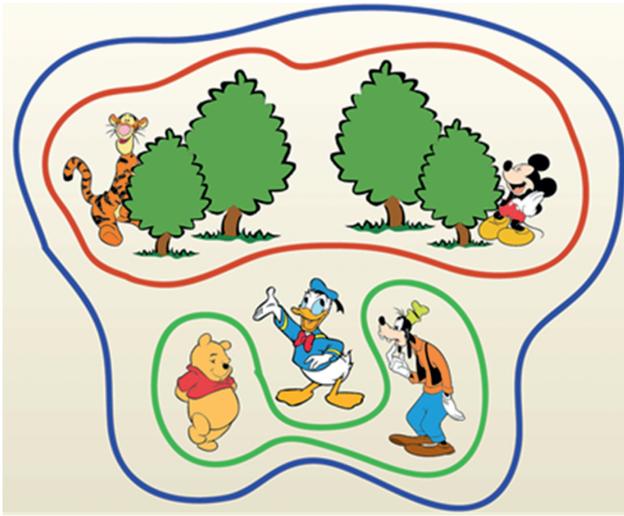
## 4 The current account: children and relevance

Below, I first provide an overview, in Section 4.1, of the intuitive idea behind the current proposal, and then in Section 4.2, I present a brief introduction to Relevance Theory. Later, in Section 4.3, I delve more into the proposal made in Section 4.1, and show its relevance to Relevance Theory, as outlined in Section 4.2. This section also presents several empirical predictions that the current account makes. Finally, in Section 4.4, I present information regarding a number of experiments conducted to test these predictions, along with their results.

### 4.1 Main proposal

I argue that the apparent Isomorphism effect is an artifact of the experimental conditions in prior studies, caused mainly by children's over-reliance on salience

as a cue for relevance. In previous studies, a child judging sentences like (1) false was understood to have only the surface scope reading available, under the assumption that a sentence will be judged true when at least one reading is true (Maxim of Charity). The current study shows, however, that children judge (1) false, because, in the absence of certain expectations created by context (e. g., that *Donald* was supposed to find *all* guys), they make judgments based only on the more salient set of “found guys” out of a set of (i) “found” (shown in green in Figure 3 below) and (ii) “unfound” guys (shown in red):



**Figure 3:** Sets involved in context for the sentence *Donald didn't find two guys*.

After all, based only on set (i) (“found” guys), it would indeed be false to utter (1) (on both surface and inverse scope readings). That is, based only on this set, Donald did indeed find two guys! In fact, when children’s justifications as to why they judge a sentence like (1) false in a context like the one presented in Figure 3 is taken into account, this idea becomes even more clear: When children judge (1) false, they often point to the green circle, saying, *Donald did indeed find two guys*, *Donald found these two guys*, etc. (see e. g., Lidz and Musolino 2002).

So if the detective (or Donald) found some (or “two”) guys out of a larger set of guys, then some guys will be on the “found” side of the detective while some others will be on the “not found” side. Again, if the Troll (in Examples (9) and (11)) delivered some pizzas, some pizzas will be on the “delivered” or “(something is) *happening*” side of the picture, whereas some other pizzas will be on

the “not delivered” or “not happening” side. Similarly, if the Troll lost some pizzas, as in (10) or (12), some pizzas will, this time, be on the “lost” side of the picture while some will be on the “not lost” side.

The argument in this paper is that in each case children will be focusing on the what is “happening” side of the picture rather than what is “not happening”. And it is exactly for this reason that they seem to be choosing the Isomorphic interpretations, because it is these interpretations which focusing on the happening set leads to. To put it another way, it might be that the reason why children tend to reject the sentences with inverse scope reading is because they rank contextual relevance (which, so far, means “salience” for us) higher as a cue for general relevance than the Maxim of Charity. It is, then, a way of thinking like “If the only relevant thing is that Donald found two guys, why would I say he didn’t find two guys?”

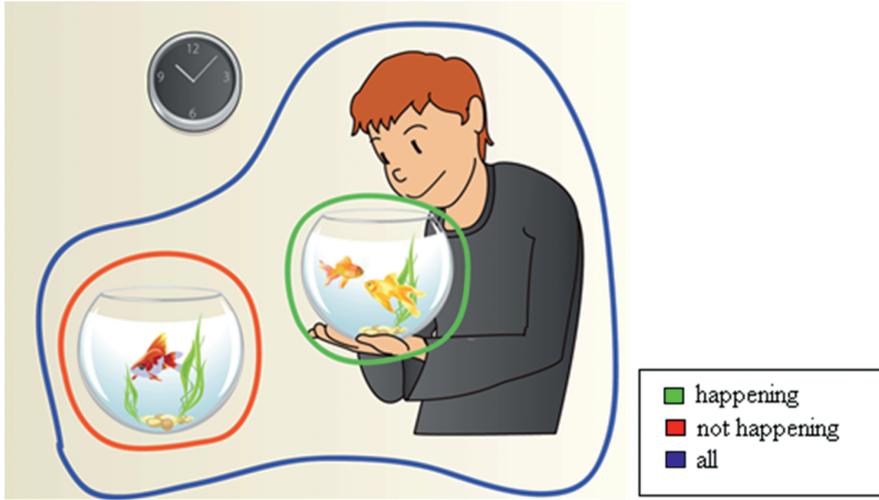
If, however, the set of unfound guys is somehow made more relevant, children would then be able to take this set, too, into consideration and would be able to reach inverse scope interpretations. Remember that Gualmini (2003, 2004) presented children with expectations like (6) *The Troll is supposed to deliver all four pizzas* before letting the puppet utter sentences like (7) *The Troll didn’t deliver two pizzas* (see above), in contexts like the one presented in Figure 4 below. And children, in that experiment, were able to reach inverse scope interpretations. On the present account, these results find a principled explanation; the reason why such an expectation helped children reach inverse scope interpretations is because the word “all” makes *all* of the elements involved in the universal set relevant, including the “red” set of “not delivered” pizzas (see Figure 4). This is, then, a way of thinking like “If the Troll was



Figure 4: *The Troll didn’t deliver two pizzas.*

supposed to deliver all four pizzas, but in the end he managed to deliver only 2, then the fact that he didn't deliver the other two is important/relevant, for it means that the original purpose has not been achieved."

Notice that this proposal also accounts for the Dutch facts of Krämer (2000) which are inexplicable under any syntactic account such as those that attribute a default status to isomorphic interpretations. To see this, examine Figure 5, which schematizes the context where (8) was presented to Dutch children:



**Figure 5:** Context for sentence (8): *There is a fish the boy hasn't caught.*

Again, as in Figure 4, here, children focus on the green circle (fish that was actually caught), and given what is happening there, they reject the argument that the boy did not catch a fish since, then, it would not be true (because the boy has indeed caught two fish given what is going on in the green circle).

Note finally that passive constructions do not pose a problem for this account, for it is not syntax-based. If, after an expectation like (6), uttered in a context like the one presented in Figure 4, children say "yes" 50% of the time for the active sentence (9), they should give a "yes" answer around the same percentage of time, for the passive sentence (11), too, as the meaning stays the same, although the surface syntax (along with scopal relations) changes. In fact, Hulsey et al.'s (2004) findings show that this is exactly the case. As their findings indicate, both for (9) and (11), children said "yes" around 50% of the time. This, again, supports the current account.

In sum, then, the current account does not only capture the apparent Isomorphism effect documented in the literature, but it also offers a unified

explanation for the conflicting findings presented in previous literature, including those on Dutch where inverse scope interpretations are favored by children rather than surface. It also provides an explanation for cases where an “expectation” helps children reach inverse scope interpretations (as the expectation makes the universal set relevant, thereby making the set of “unfound guys”, “undelivered pizzas”, etc. also relevant).

The following two sections explain how this proposal finds a principled explanation under Relevance Theory (Sperber and Wilson 1995 [1986]), as well as detailing the empirical predictions of such a relevance theoretic account. A brief overview of Relevance Theory is first presented.

## 4.2 Relevance theory

What kind of things could be relevant? In Relevance Theory (Sperber and Wilson 1995 [1986]), any external stimulus or internal representation that provides an input to cognitive processes could be relevant to an individual at a certain time. On this view, utterances raise expectations of relevance not because speakers are expected to obey a Cooperative principle like that of Grice (1989), but the search for relevance is a basic property of human cognition.

When could an input be relevant? Intuitively, an input (a sight, an utterance, a memory, etc.) is relevant to an individual when it is related to background information the individual has, and when it helps him or her to make conclusions that matter to him, by means of, for example, answering a question he or she has in mind, setting a doubt, confirming a suspicion, etc. In relevance theoretic terms, an input is relevant to an individual when its processing yields a positive cognitive effect.

In a natural environment, there is an abundant number of inputs that could be relevant to us (i. e., that could yield a positive cognitive effect), but we cannot attend to all of them. So, on Relevance Theory, what makes an input worth attending is not just that it is relevant but that it is *more* relevant than any other input available at the time. Intuitively, other things being equal, the more worthwhile conclusions achieved by processing an input are, the more relevant the input is. In relevance theoretic terms, other things being equal, the bigger the positive cognitive effects achieved by processing an input, the more relevant it is. So, for example, other things being equal, if one is waiting for the bus, the fact that the bus is late is more relevant to him or her than the train being late.

What makes an input worth attending from among the mass of competing stimuli, according to Relevance Theory, is not just the cognitive effect it achieves. In different contexts, the same stimulus may be more or less salient,

more or less accessible, etc. Intuitively, the greater the effort of perception, memory and inference required to process an input, the less deserving it will be of our attention. In Relevance Theoretic terms, other things being equal, the greater the processing effort required, the less relevant an input is. To exemplify, other things being equal (one is not waiting for the train or the bus), the fact that the train arrives at the station is going to be more relevant to one than the arrival of a bus, for the train is more salient as an object than the bus.

That is, relevance, according to Relevance Theory, is assessed in terms of two factors: (a) effect factor and (b) effort factor. In general, other things being equal, the more (cognitive) effect processing an input achieves, the more relevant it will be. And the less effort processing an input requires, the more relevant it will be. These two components of Relevance Theory are summarized below in (13):

- (13) a. Other things being equal, the greater the positive cognitive effects achieved by processing an input, the greater the relevance of the input to the individual at that time. (Effect factor)  
 b. Other things being equal, the greater the processing effort expended, the lower the relevance of the input to the individual at that time. (Effort factor)  
 (Sperber and Wilson 1995 [1986])

### 4.3 Relevance theoretic account and predictions

How does Relevance Theory, as presented in Section 4.2, account for the proposal laid out in Section 4.1 above? It was argued in Section 4.1 that in the absence of an expectation involving all members of the universal set, for a sentence like (1), children make their decisions based only on the more salient set of “found guys”. That is, in Relevance Theoretic terms, in the absence of any expectations of the type mentioned above – or everything else being equal – children make their decisions based on the set whose processing requires less effort (see (13b)).

The idea is, then, that certain information becomes salient. One way for information to be salient is, as in the default case above, for it to be the information that is part of the update, and the more recent the update is, the more salient it is. So, if, at the end of the story, Donald found two guys, this information will be taken as relevant, and the target sentence will be construed in the way that is most relevant to the most recent update of information. Therefore, children’s decisions will also be based on what they think the most relevant information is, i. e., that Donald finds two guys. Given this, they will

reject the puppet's statement, which they take as the falsification of this information (not the falsification of the less relevant information that there are two guys Donald didn't find).

Another way for certain information to become salient is for there to be certain "expectations." Given these expectations, one construes the target sentence in a way that is maximally relevant to the expectation. So if children are presented with the expectation that Donald is supposed to find *all* four guys in context (as opposed to "some guys," "two guys," etc.), but in the end manages to find only two, as in Gualmini's experiments, then, processing the set of unfound guys becomes worthwhile, for it determines the difference between whether Donald achieved his original goal or not. In other words, in Relevance Theoretic terms, taking into account the set of unfound guys, in this case, has greater positive cognitive effects (see (13a)), than the default case where no such expectations are given. It is, thus, worthwhile to attend the set of unfound guys or to the information that there are two guys that Donald didn't find.

This proposal makes a number of very specific testable predictions, which are detailed below, first for cases where the quantified NP is in object position and then for cases where it is in subject position. The latter will be the focus of the experiments presented in this paper, as this condition better helps determine the underlying reasons for the apparent Isomorphism effect found in previous literature (see below).

We start with object NPs. For scopally ambiguous sentences that contain negation and an NP with *two* or *some* in object position, as in (1) or other examples we mentioned above (see (9) through (12) for example), a Relevance Theoretic account would have the following predictions, out of which, we've already covered the first and the last one:

(14) Predictions for object NPs:

- a. **Prediction 1:** If children limit their focus to the more salient set of "found guys" (or the most recent information update) out of a set of found vs. unfound guys, then, they should be able to prefer only surface scope interpretations in the absence of any expectations.
  - High effort factor in processing the set of unfound guys
  - Supported by Musolino (1998); Musolino et al. (2000); Lidz and Musolino (2002), etc., studies where no clear expectations were provided.
- b. **Prediction 2:** If children limit their focus to salient characters (or to the information which is part of the update), making the "unfound guys" salient should, this time, lead them to an inverse scope interpretation, and to judge (1) true.
  - Decreases the effort factor in Relevance Theoretic terms

- c. **Prediction 3:** Providing an “expectation” which makes the set of unfound guys relevant should similarly help them reach inverse scope interpretations.
- Increases the effect factor in Relevance Theoretic terms
  - And, to *some* extent, decreases the effort factor, too, by making the set of unfound guys more salient (After all, the set of *all* guys includes the unfound guys.)
  - Supported by Gualmini’s (2003, 2004) and Hulsey et al.’s (2004) findings, where children were presented an expectation that involves “all” four elements in context (outer circle in Figure 4): 50% vs. 90%

In other words, for object NP cases, both making the set of unfound guys more salient (Prediction 2) and providing children with the expectation that Donald is supposed to find all four guys (Prediction 3) should have the same effect: Both should help children reach inverse scope readings.

Gualmini’s and Hulsey et al.’s findings present partial evidence for this proposal. However, an alternative account is still possible, at least for English facts (if not Dutch): It could be argued that Isomorphism arises as default when the context does not make the set of unfound guys salient enough, or when the context itself is not felicitous, such that no unfulfilling of expectations is present. That is, neither the current account nor a revised version of the Weak Isomorphism account (one revised to accommodate the saliency issue) would be the absolute winner when only English facts are considered (though Dutch facts clearly support the current account).

If, however, the quantified NP was to be presented in subject position, as in (15) below, and in the context presented in Figure 6, then, it is the inverse scope interpretation that corresponds to focusing on the set of “happening” things (or to taking the most recent information update (i. e., that two horses jump) as relevant). That is, if the current proposal is in the correct path, in the absence of any expectations, or in the absence of a more salient “not happening” set, children should be able to reach only inverse scope interpretations, rather than surface. If, however, the Weak Isomorphism account (or a revised version that takes saliency, too, into account) is right, Isomorphism should arise as default in these cases; that is, no matter what, children should interpret (15) on its surface scope reading:

- (15) *Two horses didn’t jump over the fence.* (two > not)
- a. There are two horses that didn’t jump over the fence. (two > not → surface: true)
  - b. It is not the case that two horses jumped over the fence. (not > two → inverse: false)

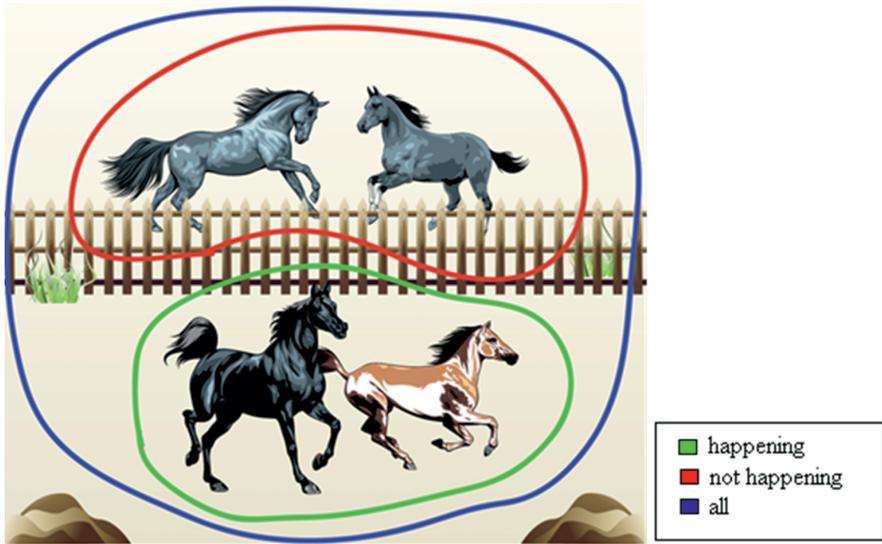


Figure 6: Two horses didn't jump over the fence.

Further, on the current account, presenting children with an expectation that involves *all* the elements in the universal set or making the “not happening” side more salient would, this time, help them reach surface scope interpretations, instead of inverse, for it is now the surface scope interpretation which makes the target sentence true in the default case. In other words, all the predictions in (14) are now reversed. These predictions are all summarized in (16) for sentences like (15):

- (16) Predictions for Subject NPs (Compare with (14)):
- a. **Prediction 1:** If the quantified NP is in the subject position, as in (15), children should, this time, favor “inverse” scope interpretations, not surface, for it is now the inverse scope interpretation which corresponds to focusing on the set of “happening things” (or the most recent information update).
  - b. **Prediction 2:** Making the set of “not jumping horses” salient would, this time, help children reach “surface” scope interpretations.
  - c. **Prediction 3:** Presenting children an “expectation” that involves “all” four elements in the context would, likewise, help them reach “surface” scope.

In contrast, a revised version of the Weak Isomorphism account would expect children to prefer surface scope in *all* three cases in (16), for, according to this

account, the first parse children come up with is always the Isomorphic one. Moreover, since the Isomorphic interpretation (15b) is “true” here, the bias to access the interpretation that makes the sentence true (Maxim of Charity) also favors the Isomorphic interpretation. That is, there is no competition between the Maxim of Charity and Isomorphism, a perfect situation to choose the surface scope interpretations.

In order to test these predictions, we conducted a series of experiments, which is the subject of the next section.

## 5 Experiments

In order to test the predictions laid out in (16), children were tested in 3 different conditions. Condition 1 tested Prediction 1; Condition 2 tested Prediction 2; and Condition 3 tested Prediction 3. In each case, children were tested by using the same method and similar materials as the ones used in previous research on children’s interpretation of scopally ambiguous sentences.

### 5.1 Methodology

#### 5.1.1 Subjects

We tested 15 monolingual English-speaking children between the ages of 5;0–5;7 (mean: 5;1). 10 children were exactly 5;0, and the median age was also 5;0. 5-year-olds were chosen, because previous studies such as Musolino (1998), Musolino et al. (2000) found that children in this age range have a strong preference for the Isomorphic interpretations. All the children were selected from the same daycare.

#### 5.1.2 Procedures

As in previous studies, the subjects were tested individually and using the Truth Value Judgment Task (TVJT) methodology. First, an experimenter, a monolingual native speaker of English, acted out short stories in front of each subject using small toys and props. In the meanwhile, a puppet (a girl) watched the stories along with the subjects. At the end of each story, the puppet (played by the same experimenter) made a statement as to what she thought had happened in the story. The child’s role was to determine whether the puppet was right or

wrong. If the puppet was right, the child was instructed to reward her with a candy. If the puppet was wrong, they were instructed to punish her with garbage. Finally, the subjects were asked to justify their answers by explaining why they decided to give the puppet candy or garbage.

Each subject got two pre-test stories, and if the subject could answer them both, they were presented with eight more stories, four of them being test stories and four control, presented in a pseudo-random order.

### 5.1.3 Materials

Participants were placed in an experimental situation where both surface and inverse scope readings of sentences like (15) were possible. Only the surface scope readings (wide scope readings of the quantified NP) were, however, true. An answer of “no” was, therefore, taken as a measure of participants’ ability to access only the inverse scope interpretations.

In each of Condition 1, 2 and 3, children were tested on their interpretation of sentences like (15). The actual sentence uttered by the puppet was the same in each condition. Truth conditions in each story were also the same. What made each condition in each story different was the degree to which the set of “not jumping” horses was made relevant in the story.

In Condition 1, which mirrored Musolino’s (1998) and Musolino et al.’s (2000) experiments (though theirs were concerned with object NPs), no special attention was attracted to the set of “not jumping” horses. The story did indeed start, however, by pointing out that it was about “4 horses.” These four horses are hanging out in the forest, playing games. One day, one horse notices a fence and suggests jumping over it. And he jumps. Another horse also follows. That is, two horses jump over the fence, and two don’t. (The phrase *two horses* is not uttered anywhere in the story.) At this point, the experimenter says “the end” signaling the end of the story. At the end of the story, the puppet utters what she thinks has happened, saying (15), see Figure 6. The exact phrase that the puppet uses is given below:

(17) *I know what happened: Two horses didn’t jump over the fence. Am I right?*

Note that (17), or rather (15), is false on its inverse scope interpretation, for it is indeed the case that two horses jumped over the fence. Therefore, if children access inverse scope (non-Isomorphic) interpretations, we would expect them to judge (15) false. If, however, they access surface scope (Isomorphic) interpretations, we would then expect them to judge this sentence true, for there are indeed two horses that didn’t jump over the fence.

In Condition 2, children were presented with the same sentences as those used in Condition 1, but this time, the context made the set of “not jumping” horses more salient in order to test Prediction 2, see (16b). This was achieved as follows: As in Condition 1, the story begins with a statement that it is about four horses and that these horses are hanging out in the forest. Again, as in Condition 1, they notice a fence, and two horses jump over the fence after the suggestion of one horse. As different from Condition 1, however, one of the not jumping horses says – after two horses have already jumped – that he has a broken leg (one of his legs was indeed covered in bandage), and therefore, that he doesn’t want to jump. After hearing this, the last horse says that it is a good idea, and that he will also stay there with him in order not to leave him alone.

As for Condition 3, whose purpose was to test Prediction 3, the stories here mirrored Gualmini’s (2003; 2004) tasks – though his involved object NPs, not subject. Children were, thus, presented with an expectation that *all* four horses decide to jump over the fence, but in the end, this expectation goes unfulfilled. The story, again, starts as it does in Condition 1 and 2. This time, however, before the two horses jump, all four horses decide to jump over the fence. The word “all” here is emphasized in the story by making one of the horses say “Let’s all jump over the fence,” followed by the rest of the horses’ confirmation: “Yeah, let’s all jump over the fence.” In the end though, as in Condition 1 and 2, only 2 horses jump over the fence, and children are presented with the same sentence in (15): *Two horses didn’t jump over the fence*. Again, if they are using inverse scope interpretations, they should judge this sentence false. Alternatively, if they are using surface scope interpretations, they should judge this sentence true, and give the puppet a candy.

The complete set of experimental sentences used in Condition 1, 2, and 3 is given in Table 1 below. Four target sentences were used as in most previous research on this subject. The verbs and nouns used were, again, similar to those used in previous research:

**Table 1:** Puppet’s statements at the end of each *test* story.

- 
1. *Two horses didn’t jump over the fence.*
  2. *Two dogs didn’t eat grapes.*
  3. *Two elephants didn’t drink milk.*
  4. *Two lions didn’t buy a cookie.*
- 

The experimenter playing the role of the puppet was instructed to say these sentences in a way that is most naturally compatible with the stress and intonation patterns of the target interpretation in case there are prosodic cues associated with

each reading (though see McMahon et al. (2004) who argue that adult speakers do not use prosody to distinguish between the two scopal readings of these sentences).

In addition to the test sentences given in Table 1, each child was also presented with four control sentences. The control sentences, unlike the test sentences, were not ambiguous. The purpose of these was to see if children knew several linguistic structures involved in the test statements, such as negation and quantified NPs. Furthermore, these also ensured that the number of *yes* and *no* answers was balanced. This was done, as in previous research, by means of having two different statements for each control story, one true and one false. So if the child answered *yes* to the previous item, the puppet uttered the control statement corresponding to a *no* answer. If, on the other hand, the child answered *no* to a particular test item, then the following control statement was the one corresponding to a *yes* answer. Finally, different control sentences were used (they were slightly modified with new toys and props and new verbs) for each condition. This was done in order to further prevent any possible contamination effects since it gave children the impression that each experiment/condition was completely different from the previous one(s). The four control statements used in Condition 1 are given in Table 2:

**Table 2:** Puppet's statements at the end of each *control* story.

- 
1. a. *Two butterflies went to the city.* → True  
b. *Four butterflies went to the city.* → False
  2. a. *The bears didn't sleep.* → True  
b. *Two bears slept.* → False
  3. a. *Two frogs danced with bugs.* → True  
b. *The frogs didn't dance.* → False
  4. a. *The hedgehogs didn't play hide and seek.* → True  
b. *Two hedgehogs played hide and seek.* → False
- 

Finally, each condition was tested with each of 15 subjects. Also, in order to see if there were any contamination effects, the three conditions were not administered in a fixed order. In other words, the order of conditions was different for each child. For example, some kids took Condition 1 first, followed by Condition 2 and 3 whereas some others started with Condition 2 followed by Condition 1 and 3. Others started with Condition 3, followed by Condition 2 and 1, and so on. In order to further prevent any possible contamination effects, there was a 1-week period between each condition for each child.<sup>4</sup> Each condition took around 20 to 30 minutes in length.

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<sup>4</sup> Two children took Condition 3 four weeks later, instead of one week, as they were not initially available.

## 5.2 Results

As with previous research, the proportion of children's *yes* responses to the puppet's statements was used as the dependent variable. As was predicted, it was found that the subjects judged the puppet's statements true much more often in Conditions 2 and 3 than in Condition 1. The proportion of *yes* answers for Condition 1 was much less than 50%: It was 36.66% if only *yes* answers are considered, and 43.33%, if both *yes* and *yes & no* answers are collapsed as *yes*. Children judged the puppet's statements true around the same percent of the time in Conditions 2 and 3: 60% and 56.66% respectively if only *yes* answers are considered, and 75% and 73.34% respectively if both *yes* and *yes & no* answers are collapsed together as *yes*. In addition, in Condition 1, 7 children never gave a *yes* answer for any of the 4 target statements. In contrast, in Condition 2, only 1 child never gave a *yes* answer, and, in Condition 3, only 2 children never gave a *yes* answer to the puppet's statements. These results are summarized in Table 3 below for each condition:

**Table 3:** Results.

	No	Yes	Yes & No
Condition 1	56.66 %	36.66 %	6.66 % Total/collapsed: 43.32 %
Condition 2	25 %	60 %	15 % Total/collapsed: 75 %
Condition 3	26.66 %	56.66 %	16.66 % Total/collapsed: 73.32 %

The *yes* and *yes & no* answers were collapsed and entered into an analysis of variance (ANOVA). The results confirm that the difference across the three conditions was statistically significant,  $F(2, 42) = 4.122$ ,  $p < 0.05$ . In addition, a Tukey's HSD test revealed that the results of both Condition 2 and Condition 3 differed significantly from those of Condition 1,  $p < 0.05$ . On the other hand, there were no significant differences between Condition 2 and 3,  $p = 0.991$ .

On control items, children did not have any difficulties; they gave *yes* answers 96.66%, 98%, and 96.6% of the time for Experiment 1, 2, and 3 respectively.

Finally, in terms of justifications, when children were asked about why they gave the puppet garbage, the most typical responses were: "because two horses did jump over the fence," "because they (two horses) did [jump over the fence]," because she (the puppet) said "two horses didn't jump over the fence," but they

did,” “because they did jump over the fence,” and so on. When they were asked about why they gave the puppet a candy, their responses took the form of “because these two horses didn’t jump over the fence,” “because of these two horses,” “because these two did, but these two didn’t.” Finally, when they were asked why they gave the puppet both candy and garbage, they almost always said: “because these two did; these two didn’t.”

### 5.3 Discussion

These results confirm the proposal made in this paper: In the absence of any expectations involving *all* four horses in discourse (i. e., Condition 3), or in the absence of increasing the salience of the set of “not jumping” horses (i. e., in Condition 2), children make judgments based only on the more salient set of “jumping horses”, and judge a sentence like (15) false. Our participants judged (15) true only 43.3% of the time in Condition 1 even when *yes* and *yes & no* answers are combined. In Relevance Theoretic terms, this is because of the high effort factor associated with attending the non-salient set of “not jumping” horses. And as is mentioned in (13b), on Relevance Theory, the higher the effort in perceiving an input, the less deserving it will be of our attention.

Note that these facts are inexplicable under any version of an Isomorphism account, for, on such an account, children are expected to favor the Isomorphic, surface scope interpretation (15a) since, on such an account, that is the first parse children come up with. Moreover, since the Maxim of Charity also favors the Isomorphic interpretation here, there is no competition between the two biases, and therefore, it should be even easier for them to say *yes*. Since this is not what we found, we conclude that an account that attributes a default status to isomorphic interpretations is not possible.

Notice also that when an expectation that involves *all* members in the discourse was presented (Condition 3), or when the set of “not jumping” horses was made more salient (Condition 2), children were able to reach surface scope much more often than otherwise. In particular, they said *yes* 75% of the time in Condition 2 and 73.34% of the time in Condition 3 (when *yes* and *yes & no* answers are collapsed together). An increase from 43% to 75% or 73.34% is quite noticeable (and statistically significant). This, again, supports the current account, which predicts expectations or saliency to help children see the relevancy of the “not happening” set (e. g., “unfound guys,” “not jumping horses,” etc.), and this, in turn, helps children reach inverse scope in the case of object NPs, and surface scope in the case of subject NPs, which is what we found to be the case in this study.

Finally, note that children's justifications of their answers are also quite informative. Statements that indicate that the child is aware of the relevance of the two sets (jumping and not jumping horses) are made only when they give a *yes* or *yes & no* answer. When they give a *no* answer, they only point out that "they did jump" or that "two horses did jump." In particular, they do not justify *no* answers with statements like "because of these two horses." When, however, they give a *yes* answer, they almost always point to the set of "not jumping" horses, making statements such as "because of these two," "because these two horses didn't jump," "because these two horses jumped; these two horses didn't jump." Notice also that, when justifying their answers, most children refer to the two relevant objects with a "definite" form of reference. All these seem to support the current account; when children give a *no* answer, it is because they do not view the "not happening" set relevant.

Note finally that the last type of justification mentioned above for a *yes* answer, "because these two horses jumped; these two horses didn't jump," is also used to justify a *yes & no* answer. This shows us that, in addition to those children who abide by the Maxim of Charity, there are some children who do not. In other words, when they are aware of the fact that both of the interpretations are possible, they do not always give the benefit of the doubt to the speaker and judge the sentence true. That is, it is perhaps too generous to believe the common assumption that children, too, favor the interpretation that makes a statement true (Crain and Thornton 1998), a rather unexpected result of the current experiments.

## 6 General discussion

The current study was concerned with children's interpretation of scopally ambiguous sentences that contain negation and a numerally quantified NP either in object or in subject position, as in (1) and (15), repeated here as (18) and (19):

- (18) *Donald didn't find two guys.* (not > two)  
 a. It is not the case that Donald found two guys. (not > two → surface: false)  
 b. There are two guys that Donald didn't find. (two > not → inverse: true)
- (19) *Two horses didn't jump over the fence.* (two > not)  
 a. There are two horses that didn't jump over the fence. (two > not → surface: true)  
 b. It is not the case that two horses jumped over the fence. (not > two → inverse: false)

Previous research found, for sentences like (18), that children favor the surface scope interpretation provided in (a), as indicated by the fact that they judge these sentences false in TVJTs, and the interpretation (a) is the one that makes the statement false. The most popular account of these facts, the Observation of Isomorphism, claims, on its strongest interpretation, that children cannot reach inverse scope interpretations (Musolino 1998; Musolino et al. 2000; Lidz and Musolino 2002). The weaker version, on the other hand, argues that surface scope arises as default in contexts that are not felicitous (i. e., that do not present a situation where an expectation goes unfulfilled) since such contexts put extra demand on the processor and since it is easier to process a sentence which has identity between the LF and the syntactic structure (Musolino and Lidz 2006; Viau et al. 2010). Both versions have some problems, as detailed above. Further, neither can account for certain crosslinguistic facts, such as those from Dutch, child learners of which favor inverse scope for the Dutch counterparts of these sentences, rather than surface scope, even when adults prefer surface scope interpretations.

In order to circumvent problems such as these, and in order to account for the conflicting findings of previous research, a new account was proposed in this paper based on Relevance Theory. In particular, I argued that the so-called isomorphism effect is an artifact of previous studies, and that the reason why children favor surface scope interpretations of sentences like (18) is because, in the absence of any expectations, they make judgments based on the more salient set of found guys. In other words, it is not because their grammar differs from the adult grammar, but because they over rely on contextual relevance, such that they rank contextual relevance above the Maxim of Charity.

This argument captures not only the conflicting findings of previous research with English children – e. g., the effect of expectations (Gualmini 2003, 2004), passive constructions (Hulsey et al. 2004), etc. – see Section 3.2 – but it also accounts for the Dutch facts (Krämer 2000), which are, otherwise, inexplicable under any Isomorphism-based account.

Further, this account makes several testable predictions. One prediction was that, for sentences with numerally quantified NPs in *subject* position, as in (19), this time, inverse scope interpretations should be easier to access – in the default case – than surface scope interpretations even though it is the surface scope interpretations that make these sentences true. Notice that this is a case where the predictions of an Isomorphism-based account and those of the current account completely diverge since, for an Isomorphism-based account, this is an ideal context for children to favor surface scope interpretations. As the results of our experiments (specifically in Condition 1) demonstrate, we found, contra the predictions of such an account, that children favored inverse scope interpretations

much more often than surface scope interpretations, providing further evidence for the current account.

In addition, we found, in line with the predictions of the current account, that children can interpret these sentences on their surface scope reading (the reading that makes the statement true) when they are given an expectation that involves *all* four horses in context, or when the set of “not jumping horses” are made more salient, as both serve to make the set of “not jumping horses” more relevant. That is, the mirror image of the situation with object NPs appears in the case of subject NPs, across all conditions.

Children, then, do not favor surface scope interpretations. Rather, they favor interpretations that correspond to the set that they take as contextually more relevant, and they rank these contextual relevancy-related considerations (e. g., saliency, effect, etc.) higher as cues for general relevancy than the Maxim of Charity. This, then, is the only difference between children and adults!

This point seems to be supported also by the justifications children presented when they gave a *yes* & *no* answer: In justifying these answers, they make, almost all the time, a statement like “because these two horses jumped; these two horses didn’t.” Statements such as this seem to show that some children rank the Maxim of Charity very low, such that even when they are aware of the interpretation that makes the sentence true, they do not simply judge that sentence true, but rather point out that the sentence is (or could be) both true and false (depending on which set one chooses to focus on).

These findings present a number of implications: First, previous research seems to have overestimated the bias to choose the interpretation that makes a sentence true when two interpretations (true and false) are available. In other words, when children give the answer *no* to a scopally ambiguous sentence, for which both *yes* and *no* answers are available, one should not perhaps jump to the conclusion that children’s grammar does not have the interpretation that makes the sentence true (e. g., the inverse scope interpretation in the case of Musolino (1998); Musolino et al. (2000); Musolino and Lidz (2002), etc. or the surface scope interpretation in the current study for cases with subject NPs). This means that even when children perform differently from adults in TVJTs, that does *not* necessarily imply differences in grammar (or processing) between the two groups.

One formal interpretation of these results, then, is that children have the knowledge of the covert movement operation leading to the non-Isomorphic interpretation, despite the fact that this is (nearly) impossible to learn based on input, suggesting that it is provided by the UG.

Another interpretation is that these NPs are not in fact quantificational to begin with. After all, in the default case, both for quantified NPs in object and subject position, children favor the interpretation where the quantified NP takes

narrow scope over negation (corresponding to surface scope in the case of object NPs like (1) and inverse scope in the case of subject NPs like (15)). That is, it could be that these NPs are free variables (instead of being quantificational), and for free variables, the existential has to be below negation, possibly because existential closure has to be at the VP-level (nuclear scope), resulting in the requirement that they cannot take wide scope over negation (since VP is below negation). This possibility was never taken seriously by previous child language acquisition research, perhaps because no studies have so far found that the narrow scope interpretation is favored even when these NPs are in subject position (although even the fact that object NP cases are interpreted with narrow scope, by itself, makes this as much of a possibility as an Isomorphism-based account). So far, only Lidz and Musolino (2005, 2006) looked at subject NP cases like (15) and (19), and argued that children interpret these, too, with surface scope. However, they presented their participants an “expectation” that involves all members in context (although they had not presented expectations in the case of *object* NPs in their previous research, based on which the Observation of Isomorphism was proposed). Therefore, the current study is the only one that tests children’s interpretation of subject NP cases, such as (15), in the default case, i. e., Condition 1 (in addition to comparing it with other cases). This condition is crucial since this is the condition that mirrors the experimental setting of those studies that found the Isomorphism effect with object NP cases.

Thus, with the current study, a comparison between object and subject NP cases is now possible on fair grounds. And the results of such a comparison is in line with the predictions of the current account, which are outlined in (14) and (16) for object and subject NP cases respectively: Children favor surface scope in the default case with object NPs, but inverse scope with subject NPs (Predictions 1). However, when they are given an expectation of the type mentioned above (Predictions 3) or a more salient set of “not happening” items (Predictions 2), they reach inverse scope with object NPs and surface scope with subject NPs. In other words, if one takes Lidz and Musolino’s (2005, 2006) findings as representative of the whole subject NP cases, and compares this with object NP cases in previous research – as has often been done – an incomplete picture will emerge, where children favor surface scope interpretations across the board. This paper presented ample evidence that this is not the case.

Formally, the fact that this is not the case raises the above-mentioned question of whether these NPs (or indefinite NPs in general) are quantificational or not, a question asked originally by Kamp (1981) and Heim (1982) in formal syntactic literature, but recently rejected for several reasons, one of them being the apparent Isomorphism effect: After all, if children’s representation of indefinite NPs were always Isomorphic, including the subject NP cases, then, it

would follow that the quantified NP sometimes has to take wide scope over negation, suggesting that it is quantificational at least in child language. If, in turn, it is quantificational in child language, then, there is no reason why it would not be that way in adult language. Otherwise, there would have to be a mechanism to lose this knowledge, which does not seem to be possible given current accounts of learnability and the Subset Principle, according to which, language acquirers do not unlearn things/additional possibilities (see e.g., Berwick 1985, Pinker 1989, Crain 1991).

If, however, these NPs are not quantificational in child grammars, then, the possibility that they are not quantificational in adult languages, either, becomes stronger. The fact that context plays a very important role in their interpretation, and that the default seems to be the narrow scope interpretation in each case, rather than surface scope, as shown in this paper, seems to suggest that this possibility is a strong one, and thus that, instead of being quantificational, these NPs might instead be free variables that have specific vs. non-specific interpretations depending on context. In either case, the current account, which is based on Relevance Theory (instead of being based purely on syntax or semantics), can capture the relevant facts. However, more formal research is needed to see if NPs with numerals are truly quantificational or not.

## 7 Conclusion

The current study presented a unified account, based on Relevance Theory, of the conflicting findings of previous research into children's resolution of scopally ambiguous sentences such as (1) and (15), as well as presenting some novel data. It was found that the Observation of Isomorphism, which was previously supported by much research (e.g., Lidz and Musolino 2002; Musolino et al. 2000; Lidz and Musolino 2005/2006), does not hold even in its weakest interpretation. That is, children can reach both surface and inverse scope interpretations of scopally ambiguous sentences; surface scope is neither preferred nor does it emerge as default.

In addition, and perhaps more importantly for the field, the findings of the current study also present some formal and empirical implications that go beyond the debate on the Observation of Isomorphism: Formally, the quantificational status of quantified NPs such as *two guys* and *two horses* has been questioned; they may rather be free variables, instead of being truly quantificational. Empirically, the study raises questions regarding the validity, in child language acquisition research, of the bias to choose the interpretation that

makes a sentence true (Maxim of Charity) and, thus, the reliability of the TVJT methodology.

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