RESOLVING WH-/QUANTIFIER AMBIGUITIES:

INTEGRATING THEORETICAL AND EXPERIMENTAL PERSPECTIVES

by

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ABSTRACT OF THE DISSERTATION

Resolving *wh*-/quantifier ambiguities:

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Universal quantifiers, such as *every* and *each*, and *wh*-words interact in complex ways, creating ambiguity. Questions, such as *Which toy did every boy pick?* may be understood as asking about a single toy, that everybody picked - a single answer, or for pairings of boys and toys of their choice - a pair-list answer. The factors affecting the availability of pair-list answers have played a prominent role in motivating various linguistic theories of questions in syntax and semantics. However, most of the data on the availability of pair-list answers comes from intuitive acceptability judgments, and several kinds of examples are a subject of disagreement in the literature. This dissertation presents experimental results revealing that that the interaction of *wh*-words and quantifiers is more complex, than originally thought. The analysis developed in the thesis confirms that the acceptability of pair-list answers is affected by the syntactic positions (subject vs. object) and the lexical type of the quantifier phrases. However, contrary to theoretical predictions, the plurality of a *wh*-phrase does not have a strong effect on the judgments. Furthermore, although pair-list answers to questions with certain object quantifiers are predicted to be unavailable, adults, both naïve speakers and professional linguists, find them acceptable in some cases. Children also access pair-list readings of questions with object-quantifiers. They sometimes understand questions, such as *Who picked every toy?* as asking about pairing of toys and children such as *John picked the car, and Jane picked the truck*. Given that in other domains, at the age of four and five, children's grammatical representations are abstract and elaborate, I maintain that non-adult like patterns of responses in the area of *wh*-/quantifier interactions are the result of a developing lexicon and discourse parsing, rather than immature grammar, as previously suggested in the developmental literature. I propose that the information structure status of the quantifier phrase (topic vs. focus), rather than its structural position (subject vs. object), affects the availability of pair-list answers. Such answers are available if a quantifier phrase can be understood as a topic. I recast the subject-object asymmetry in *wh*-/quantifier interactions in terms of information structure. The proposed analysis also accounts for the observed variability among speakers and incorporates the semantic factors affecting the possible readings of questions with quantifiers.

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INTRODUCTION

This dissertation focuses on the semantics of questions with quantifiers from a psycholinguistic perspective. Since the meaning of questions is understood through their answer space (Hamblin, 1973; Karttunen, 1977), looking at the *types* of available answers becomes a way to study the semantics of questions. Quantifiers, words, such as *every* and *each*, participate in complex interactions, and may give rise to sentential ambiguities – cases when the same surface sequence of words give rise to several different interpretations. In questions, this ambiguity can be seen through a range of answers that a question admits.

Wh-questions containing a universal quantifier, such as (1), are ambiguous and may have three types of answers: a single answer (1a), a pair-list answer (1b) and a functional answer (1c). A single answer picks a woman, such that every man loves that woman. A pair-list answer (PLA) provides pairings of men and women, where in each pair a man loves a woman. A functional answer does not pick one woman loved by every man; instead it is a function that maps individuals to individuals. In (1c) that function could be characterized as *being a mother of*. When applied to *x*, such that *x* is a man, the function returns *y*, such that *y* is a mother of that man.

(1) Which woman does every man love?

a.	Mary.	Single answer
b.	John loves Mary, and Peter loves Sue.	Pair-list answer (PLA)
c.	His mother.	Functional answer

Not all questions containing a quantifier are ambiguous in the same way. The structural position of the quantifier, i.e. whether it occurs in subject or object position, has been observed to affect the range of possible interpretations of a question. In (1) the quantifier is the subject of the sentence, and the question may have all three types of answers (1a-c). However, if instead, the quantifier is in object position, as in (2), many have observed that the pair-list answer is very hard or even impossible to obtain (Liu, 1977; May, 1985; Aoun & Li, 1993; Chierchia, 1993; Beghelli, 1997; among others).

(2) Which man loves every woman?

a. John.

b. *John loves Mary, and Peter loves Sue.

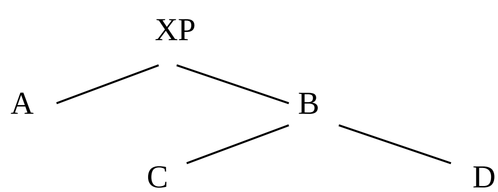
c. *Her father.

In this dissertation, I make an attempt to bring experimental evidence on the availability of different types of answers to questions with quantifiers. More specifically, I am concerned with the circumstances that make PLAs possible. This work shows how the semantics of questions is shaped, in part, by the interacting terms: their semantic and pragmatic properties, as well as syntactic behavior. While PLAs are possible for questions with subject quantifiers, questions with object quantifiers may lack this reading. This phenomenon is referred to in the literature as a subject-object asymmetry in the availability of PLAs. Not only the analyses of the precise mechanisms giving rise to the lack of PLAs differ, judgments on the availability of PLAs appear to be controversial as well. The goal of this work is to provide experimental data on the availability of different types of answers, which could potentially confirm/challenge the existing theoretical analyses of the *wh*-/quantifier interactions. I am going to show that PLAs are, in fact, at least sometimes possible for questions with object quantifiers. I argue that this conclusion involves rethinking the subject-object asymmetry as a phenomenon that creates a categorical distinction of subject-quantifier PLAs being acceptable and object-quantifier PLAs being unacceptable. Instead, I propose that PLAs fall on a continuum of acceptability, and the exact placement on this continuum is determined by a complex interaction of semantic, pragmatic, and structural factors proposed in the literature.

Availability of PLAs bears on the asymmetry between subjects and objects, and thus, is one of the ways how the hierarchical structure of language reveals itself. The subject-object asymmetry is a phenomenon not limited to the interaction of NPs with quantifiers or *wh*-words. Studies on the psychological validity of the subject-object asymmetry show that there is indeed a hierarchy of syntactic positions with implications for language comprehension. In a study of relative clause formation, Keenan & Comrie (1977) establish a hierarchy of relativization cites – positions where relative clauses can be formed. The authors argue that subjects are more accessible to relativization than direct objects, and direct objects are in turn higher in accessibility than indirect objects. Keenan & Comrie propose that the hierarchy arises as a reflection of "psychological ease of comprehension" (1977, p. 88). It is easier to understand relative clauses formed on higher positions, such as subject, than lower positions, such as objects. The authors cite a number of studies that support the psychological ease hypothesis. Legum (1975) & Brown (1981) show that children understand relative clauses built on subjects better than clauses built on objects. Hawkins & Keenan (1974/1987), using a repetition task, found that subject relative clauses are easier to process than object clauses. These studies confirm the psychological validity of an asymmetrical hierarchical relationship between subjects and objects.

In formal terms, an asymmetrical structural relationship between subjects and objects can be represented in terms of c-command: subjects are said to *c-command* the objects but the reverse does not hold. C-command [constituent command] is defined as a relation between the constituents of a phrase/sentence. According to Reinhart's (1976, 1983a) definition, node A c-commands node B iff the branching node most immediately dominating A also dominates B. In (3) nodes A and B c-command each other. Node D (possible place for direct objects) does not c-command A (place for subjects), while A still c-commands D.

(3)



An asymmetry between subjects and objects in their c-command relationships has direct consequences for quantifier scope. Liu (1997) defines two possible interpretations of quantifier phrases: scope-dependent and scope-independent ones. Liu relates the ability of quantifiers to have scope-dependent and scope-independent readings to the syntactic position they occupy. From the semantic point of view, scope-independence implies that the interpretation of a quantifier phrase (QP) does not depend on the denotation of any other QP in the same sentence. For example, under the scope-independent reading of *some woman* in (4), the QP *some woman* is understood as referring to one particular woman, who all the men love.

(4) Every man loves some woman. (from Liu, 1997, p. 118)

Liu (1997) maintains that the ability of a quantifier to have scope-dependent or scope-independent interpretations is mediated by the position of the quantifier in a sentence. He compares the pair of sentences in (5) and (6).

(5) <u>Most of the students</u> read two of the books.

(6) Every teacher has met <u>most of the students</u>.

(from Liu, 1997, p. 121)

In (5) the subject QP *most of the students* c-commands the QP *two of the books.* In other words, *most* takes scope over *two*. The object QP *two of the books* is unable to take scope over the subject QP *most of the students*, since objects do not c-command subjects. In sum, the sentence in (5) can only have one reading, where *most* takes scope over *two*, there is only one group of students that read the books (either specific books or a different pair of books for each student). The sentence cannot be understood as involving two separate groups of students for each of the books. The quantifier phrase headed by *two* cannot take scope over *most*. Liu calls the use of *most* in (5) scope-independent. On the other hand, the interpretation of *most* in (6) is scope-dependent: each teacher can meet a different set of students, and then *most* is interpreted in the scope of *every*.

The notion of scope-(in)dependence can also be generalized to the interpretation of question words and thus it is applicable in questions. When a *wh*-phrase (e.g. *which book*, *who*) is interpreted as a scope-independent element, its denotation is set disregard the values of other quantifiers in a question. In (2) *who* is scope-independent: there is a unique man that loves every woman: the interpretation of *who* is equivalent to the one it has in a question like *Who left?*, where there are no other quantifiers in the sentence.

Phrases headed by quantifier words (e.g. in (5)-(6)), show a semantic behavior similar to *wh*-phrases. For both kinds of phrases the scopal readings available in an object position are limited, while a phrase in the subject position has a wider array of available readings (the subject-object asymmetry). I show in Chapters I-III of this dissertation that the exact extent of subject-object asymmetry has been debated, especially in the domain of scopal interactions between quantifiers and *wh*-words. In this study, the nature and the pervasiveness of the subject-object asymmetry is assessed with experimental tools, and the results have direct bearing on linguistic theory. I examine the subject-object asymmetry in *wh*-/quantifier interactions in three aspects: theoretical, methodological and developmental. The experimental findings converge on the idea that the structural constraints described above may not be as rigid as originally thought, and that they might be better understood as constraints on information structure.

In Chapter I I first review the linguistic analyses of the possible readings for sentences with *wh*-/quantifier interactions. I then present experimental data to assess the factors which are reported to affect the availability of particular readings for questions with quantifiers. Chapter II is devoted to an investigation of the method, addressing the issue of whether linguistic expertise could help the subject in giving more robust judgments. I compare several populations of speakers that differ in expertise, and determine whether their responses are in line with each other. Testing different groups of speakers has implications for experimental research in linguistics, since the robustness of naïve speaker judgement has been questioned in other domains. In Chapter III, I focus on the role of quantifiers in PLA availability, and discuss whether some lexical effects can cancel out the structural constraints on quantifier interpretation. Chapter IV is devoted to the acquisition of *wh*-/quantifier interactions. Although the existing developmental studies argue that children display non-adult like patterns of responses to questions with quantifiers, a striking similarity emerges in the present experiments. I consider a range of factors that might explain both the similarity and the difference between children and adults.

The theoretical, experimental and developmental components are brought together in Chapter V, where I propose a discourse-structure based account of *wh*-/quantifier interactions. I show how the three approaches to the study of language benefit and enrich each other, giving us a new understanding of the subject-object asymmetries.

CHAPTER I

PAIR-LIST ANSWERS AND THE SUBJECT-OBJECT ASYMMETRY

1.1 Ambiguity in questions with quantifiers

May (1985, 1988) observed that while subject-quantifier questions, such as (7), are ambiguous and allow for both a single and a pair-list answer, questions, such as (8), where the quantifier originates in object position, lack a pair-list reading.

(7) Which woman does <u>every man</u> love?

a.	Mary.	Single answer
b.	John loves Mary, and Peter loves Sue.	PLA

(8) Which man loves <u>every woman</u>?

a.	John.	Single answer
b.	*John loves Mary, and Peter loves Sue.	PLA

Since May (1977, 1985) new factors affecting the availability of PLAs have been identified. The structural constraint opposing subjects and objects have been restricted to a much narrower set of quantifiers and question types. Moreover, judgments reported in the literature have been shown to diverge (Achimova, Déprez, Musolino, 2013). The goal of Chapter I is to systematically review the factors that have been claimed to affect the interaction of questions with quantifiers and the subject-object asymmetry. I begin the discussion by an overview of the semantics of questions in Section 1.2. Section 1.3

summarizes the factors that possibly affect the availability of PLAs. Experiments testing the subject-object asymmetry in particular cases are discussed in Section 1.4, followed by a general discussion in Section 1.5, and a brief summary in Section 1.6.

1.2 Semantic approaches to pair-list answers

1.2.1 Quantifier Raising account

My goal in this section is to establish a semantic background that will allow me to consider ambiguities in questions with quantifiers. Modeling the semantics of questions requires a different approach than declarative sentences. In formal Fregean semantics models, the meaning of a declarative sentence is described through its truth conditions[1]. Knowing what a declarative sentence means requires knowing what the state of the world needs to be for that sentence to be true. The same approach, however, does not straightforwardly exptend to questions. Questions do not have a truth value, as there are no state of the world that would make them true or false; consequently, it is impossible to define the meaning of a question through its truth conditions. To resolve this problem within a formal semantics approach, Hamblin (1973) proposed to understand a question as setting up a choice in the a set of propositions that constitute possible answers to it. Following up this idea, Karttunen (1977) contended that the meaning of a question should be restricted to possible true answers to it, ignoring false ones, that could be infinitely many. Restricting the relevant set to only true answers allowed developing an analysis for various types of questions including direct and indirect questions.

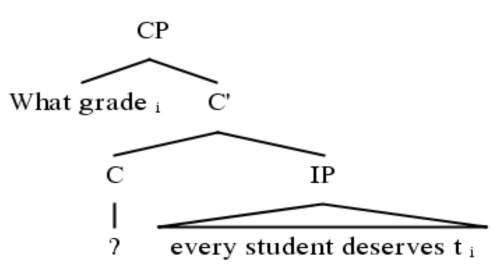
[1] The idea that the meaning of a sentence can be understood through its truth conditions is attributed to Frege. However, philosophers debate exactly which idea Frege expressed when he talked about sense and meaning. For a discussion see Dummett (1976), Wiggins (1997), Maunu (2002), among others.

Following Hull (1974), Karttunen (1977) noted that questions, such (9), allow several types of answers, including single answers and PLAs and are therefore ambiguous.

(9) What grade does every student deserve?

Karttunen sought to derive the ambiguity of *wh*-questions with quantifiers from a scopal interaction of the question term and the quantifier phrase, treating the question terms as scope-bearing elements. The scopal analysis of quantifier ambiguities was first developed in Montague (1974) for declarative sentences. Karttunen’s analysis straightforwardly predicts how single answers are derived in the system: the *wh*-phrase combines with a proto-question as a last step in the derivation. As a result, the *wh*-phrase scopes over the quantifier and the individual interpretation of a question (an interpretation leading to a single answer) becomes available. To illustrate this point Karttunen (1977) uses an indirect question[2] that contains a *wh*-phrase and a universal quantifier (10).

(10) What grade does every student deserve?



[2] Karttunen treats direct and indirect questions as semantically equivalent. A direct question (a), in his view, expresses the same proposition as the sentence in (b).
a. Is it raining? (Karttunen 1973, p. 4)
b. I ask you (to tell me) whether it is raining.

The derivation in (10) and the corresponding semantics are shown in (11). The meaning of an individual answer to the question (9) is defined as a set of propositions, such that there exists an *x*, *x* is a grade, and it is true that for all *y*, where *y* is a student, a relationship holds that a student *y* deserves grade *x*. The derivation in (11) also contains the restriction to true propositions; it is encoded as $^{\vee} p$. As a result, we get a set of true answers as the meaning of the question in (9). This set corresponds to a set of propositions of the form *every student deserves some grade x;* this set is non-empty in case there is a single grade that every student deserves.

(11) what-grade-every-student-deserves

$$\lambda p \exists x (grade'(x) \wedge {}^{\vee} p \wedge p = \forall y [student(y) \rightarrow deserve'(y,x)])$$ [3]

While the semantics of a single-answer reading of a question is rather straightforward to derive, PLAs are harder to account for within Karttunen's system. In order to get a pair-list reading indeed, the quantifier has to take scope over the *wh*-phrase. This scopal configuration can be achieved if the quantifier adjoins the CP as a last step in the derivation: the quantifier is then applied to a sentence *what grade* t_j *deserves*. This operation is referred to as quantifying in (Kaplan, 1968). However, quantifying in might be problematic in this case, since the sentence *what grade* t_j *deserves* bears the semantic type of a question[4], while for the derivation to go through, the quantifier can only combine with an expression of type <*t*>. The semantic formalism does not permit

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[3] In Karttunen's (1977) formalism, expressions of form *grade'* represent the meaning of an expression *grade* (function *'* is applied to an expression *grade*, and maps expressions to meanings).

[4] Montague (1970) introduces the basic semantic types <e> for entities and <t> for expressions that have a truth value. The type of a function from a to b is written as <a,b> and *et* is used as a shorthand for <e,t> in larger expressions. See also Partee (2007) on functional and intensional types.

combining a quantifier with a question, and the derivation of a PLA fails, because there is a mismatch in types of the expressions. The semantic function of type <a,b> takes arguments of type *a* and returns an expression of type *b*. Crucially, a function cannot apply to an expression which does not have the type *a*. The expression *what grade every student deserves* has to be of type <t> - the same type declarative sentences bear. In the derivation of PLAs the quantifier *every* of type <et,t> ends up combining with the phrase *what grade* t_j *deserves* of type <e,τ_q> (a semantic type corresponding to questions) as in (12). However, the derivation in (12) is impossible because the semantic types of the constituents cannot be combined by function-argument application.

(12) [every student $_i$ [what grade t_i deserves]]

In order to arrive at the proper semantics, Karttunen proposes an alternative analysis to derive PLAs. Instead of quantifying into a question, he proposes to convert a question into a declarative sentence of type *t* first, an operation which then allows the quantifier and the declarative sentence to combine, as their types license function-argument application. The conversion happens when a question is preceded by a special silent verb, like *tell me.* As a result, we get an expression that translates into (13).

(13) *For every student x*, [tell me] *what grade x deserves*.

The configuration in (13) corresponds to a pair-list reading of the question in (9). To summarize, Karttunen’s analysis provides semantics both for single answers and PLAs. However, the proposed analysis requires postulating a silent *tell me* operator.

1.2.2. Pair-list answers as functional answers

In Karttunen’s analysis (1977), the derivation of PLAs requires an operation of quantifying into a question. This requirement poses a problem for his analysis, as it creates a mismatch in semantics types – a quantified NP of type <et,t> cannot combine with a question of type $<e,\tau_q>$. The problem is solved by applying a performative verb phrase, such as *tell me*, to the question. A question is then converted into a declarative sentence of type <e,t>, and the operation of quantifying in becomes possible. However, several authors argue against such manipulations. Krifka (2001) points out that converting a question into a declarative sentence implies that every question also has a truth value that never plays a role. Krifka also mentions that quantifying in type of analysis does not explain why only universal quantifiers can outscope the silent performative verb. Karttunen’s analysis incorrectly predicts that PLAs should be possible for questions with non-universal quantifier like *most* but this is not empirically verified. PLA are not possible for sentence like (14), yet the semantics in (15) is well-formed in Karttunen’s system.

(14) Which dish did most guests make?

* John made pasta, and Bill made the chicken.

(15) $most(guests(\lambda y[ask(I, you, \lambda p \exists x[dish'(x) \wedge {}^{\vee}p \wedge p = made(x)(y)])]))$

For most guests *y*: I ask you which dish did *y* make.

(adapted from Krifka, 2001, p.5)

Engdahl (1986) argues that postulating the use of a silent performative verb is a disadvantage from the point of view of the mapping between syntax and semantics, as it assumes a stage of syntactic embedding without any overt evidence. Engdahl (1986) concludes that in order to account for the semantics of *wh*-questions with quantifiers, a different approach is needed. She proposes an analysis that views *wh*-phrases as relational elements bearing a relation to some other element in a sentence. A relational analysis involves the treatment of *wh*-phrases as being similar to personal pronouns. A *wh*-phrase carries a pronominal element that can be quantified over, so a *wh*-phrase can be bound by the quantifier phrase – a condition necessary for the derivation of functional and pair-list answers.

Engdahl views PLAs as a special case of functional answers, which allows building their derivation without the operation of quantifying in. As Preuss (2001) points out, for Engdahl the fact that questions with quantifiers allow three types of readings (leading to single, pair-list and functional answers) does not entail the fact that *wh*-/quantifier questions have three distinct answers. In fact, in Engdahl's (1986) analysis, all the answers simply constitute different ways of spelling out the same answer: functional answers represent an intensional definition of a function, while PLAs are an extensional way to represent the same function. An intensional definition of a function names a property possessed by all members of a certain set. An extensional definition of the same function arises when the members of the set of ordered pairs are listed individually. The question in (16) can be given both a functional (16a) and a pair-list answer (16b). A functional answer picks a property, being a favorite book of [a girl]; a PLA lists pairings of girls and their favorite books.

(16) Which book did every girl read?

a. Her favorite book.

b. Mary read “Harry Potter”, and Helen read “Cat in the hat”.

Chierchia (1993) further specifies that although functional answers often correspond to some natural function like, for example, *his mother*, nothing in principle prevents us from having arbitrary functions that establish a relation between individuals/objects. Those functions do not necessarily have a corresponding name in natural language. If functional answers may be described by arbitrary functions, it then becomes possible to account for PLAs that do not constitute a spell-out of some natural function preserving Engdahl’s (1986) framework. For example, the question in (17) might be asked in a situation where children are randomly picking numbers on the screen. In that sense, there is no particular relationship between numbers and children.

(17) Which number did every child pick?

Harry picked “1”, and Jessica picked “2”.

If we only think of functions as having a correspondence in natural language, it is impossible to account for the PLA in (17), since there is no function to derive a PLA from. On the other hand, if we follow Chierchia’s amendment, ordered pairs of children and numbers they picked could serve as an extensional definition of an arbitary function. As a result, within Engdahl's framework, the PLA in (17) could still be viewed as a way to spell-out a functional answer.

1.2.3 Against treating pair-list answers as functional ones

Groenendijk & Stokhof (1983, 1984) argue against treating functional answers as a compressed way (Bennett 1977) of expressing a PLA. If PLAs and functional answers represent the same kind of answer, then functional answers are expected to express the same amount of information as PLAs, but in fewer words. Groenendijk & Stokhof (1984) provide arguments to show that functional and pair-list answers do not always contain the same amount of information. A question like ((1), repeated here) may have as answer the functional reading *his mother*, if one assumes that it is generally true, that men love their mothers. That person may not necessarily know all the pairings of men and their mothers. In the situation described above, the functional answer *his mother* remains a true answer to (1). A PLA in the same scenario may not be accessible due to the lack of information the answerer may hold.

(1) Which woman does every man love?

The reverse situation is also possible: one may know the names of some men and the women they love, but be unaware of the fact that those women are their mothers. In that case, a person can provide a PLA to (1), but not a functional answer, such as *his mother*. Groenendijk & Stokhof present another situation where pair-list and functional answers are different. Take a model in which there are 3 men (John, Peter, and Tom) and

3 women (Mary, Sue, and Sarah) and there is a son-mother correspondence between them, and there is a *love* relation between them, it would be true to answer *his mother* to the question in (1). It would also be possible to give a pair-list answer, such as (18).

(18) John loves Mary, Peter loves Sue, and Tom loves Sarah.

If in the same situation, one of the men also loves another woman, a PLA would be different from spelling out of the functional answer. For example, John loves Mary (his mother) and Jane (his wife). A PLA (19) is now different from (18).

(19) John loves Mary <u>and Jane</u>, Peter loves Sue, and Tom loves Sarah.

The functional answer *his mother* is still true in the situation described in (19). But spelling out the functional answer by providing pairs of mothers and sons, gives a different output (18), than answering the question (1) with (19). Groenendijk & Stokhof conclude that functional answers represent a distinct kind of answer, and do not amount to a shorter way to express a pair-list one.

Finally, there are syntactic reasons to discriminate between functional and pair-list readings. Questions with downward entailing quantifiers[5], such as *no,* allow for a single answer (20a) and a functional one (20c), but not for a PLA (20b).

[5] Downward entailing quantifiers license inferences from supersets to subsets (Barwise & Cooper, 1981; Geurts & van der Slik, 2005). A quantifier is downward entailing if two conditions hold. First, a set described by (b) should be a subset of the set described by (a). Second, whenever (a) is true, (b) is also true. In other words, (a) entails (b). Let us consider two sentences with a quantifier *no* (a) and (b)
(a) *No man smoked at the party*.
(b) *No Italian man smoked at the party*.

(20) Which woman does *no man* love?

a. Mary.

b. *John loves Mary, Bill loves Suzy, ...

c. His mother-in-law.

The assumption that functional answers and PLA are variants of a same type clearly leads to the expectation that both answers should be available in the same circumstance. This, however, is empirically contradicted by questions that contain a downward entailing quantifier, where only the former, but not the later is a possible answer. Groenendijk & Stokhof (1983, 1984) argue that PLAs cannot be derived through the same mechanism as functional answers. Functional answers are derived through the use of Skolem-functions, and are available in a wider range of syntactic environments, than PLAs. In logic, Skolem-functions map entities to entities. A Skolem-function, when applied to an individual, returns another individual as its output. For example, a function 'mother of' applied to John, returns the value 'Mary', in a situation where Mary is the mother of John. Thus, under a functional reading of a question with a universal quantifier, we are looking for a function that maps individuals to individuals.

In order to account for the semantics of PLAs, Groenendijk & Stokhof develop a quantifying-in type analysis of Karttunen's (1977). They treat *wh*-phrases as scope-bearing elements, and describe the ambiguity of *wh*-/quantifier questions as a scopal

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In (a) *no* applies to a set of men, and means that the intersection of men and those who smoked at the party is empty. In (b) *no* applies to a subset of all men, namely Italian men. Truthfulness of (a) entails the truthfulness of (b), so the quantifier *no* is downward entailing.

ambiguity. Groenendijk & Stokhof propose to understand the meaning of a question as a relation between sets of possible worlds. This development of their theory allows accounting for the semantics of PLAs, and at the same time avoids the problem of type mismatch, when a raised quantifier has to combine with the rest of the question. The analysis of Groenendijk & Stokhof does not predict however, why PLAs are possible for subject-quantifier questions but not for object-quantifier questions.

1.2.4 Functional analysis revisited

The quantifying-in type of analyses of Karttunen (1977) and Groenendijk & Stokhof (1983, 1984) was later challenged in Chierchia (1993). Chierchia argues that the operation of quantifying in is not well defined for questions. Instead of deriving the PLAs and single answers via quantifying in, he proposes a semantic mechanism which respects the parallelism between functional answers and PLAs. Like Groenendijk & Stokhof (1983, 1984), Chierchia rejects the idea of treating functional answers as a case of PLAs. However, he observed that PLAs are possible in a subset of syntactic environments where functional answers are available. Chierchia therefore treats PLAs as *a special case* of functional answers and uses a common system to derive them.

In Chierchia's approach, the difference between PLAs and functional answers lies in the way the range of the function introduced by the *wh*-phrase is defined. To provide a functional answer, one does not have to know all the members in the range of the function. On the contrary, in order to produce a PLA, one has to know exactly who is referred to by the quantifier phrase *every man.* In semantics, the domain of a function is a set of arguments; the range of a function is a set of possible values a function takes when applied to an argument. In the case of functional answers, the *wh*-term defines the range of the function, for example a set of mothers-in law in (20). The domain in (20), the set of all men, is only indirectly specified. For PLAs, not only the range, but also the domain is defined: it is determined by the quantified NPs. For example in (1c) (repeated here), the range of the function *his mother* includes mothers; the domain is not specified, as the quantifier phrase *every man* refers to a set of all men. However, for (1b), both the domain and the range of the function are defined: the range is two mothers (*Mary* and *Sue*), and the domain contains two individuals (*John* and *Peter*).

(1) Which woman does every man love?

b. John loves Mary, and Peter loves Sue.

c. His mother.

Building on Engdahl (1986), Chierchia maintains that *wh*-phrases, like pronouns, can be bound. He proposes that the *wh*-term leaves a doubly-indexed trace. One of the indices is functional; it is bound by the question operator. The other index represents the argument of a function, and is bound by the NP. Postulation of two indices allows for a straightforward differentiation of asking for a function *vs.* asking for a complete listing of a function's extension. Both types of readings involve a function that relates the sets introduced by the *wh*-phrase and the quantifier phrase, the difference lies in the way constituents are grouped. While no special operation is required to obtain functional answers, the mechanics of a pair-list reading relies on Absorption - an operation that regroups constituents (Chierchia, 1993, see p. 210 for a definition). Consider a derivation of the PLA for the question in (21). The syntactic operations of movement and absorption create a new constituent structure [*who*$_i$ *everyone*$_j$] shown in (21). LF in (21) contains a doubly-indexed trace $e_i^{\,j}$, left by the *wh*-word. The structure in (21) is then interpreted as in (21) by a special semantic rule corresponding to absorption.

(21) Who loves everyone

a. [[who$_i$ everyone$_j$][t$_j$ loves e^j_i]]

b. $\lambda P \exists f \exists x (f \in [X \rightarrow X] \wedge x \in X \wedge p = {}^\wedge loves(x(f(x)))$

where X is the set of people

The notation [A →B] in (21) stands for the set of all total functions[6] from set A to set B (Chierchia, 1993, p. 209). In the case at hand, both sets correspond to X. The question in (21) then corresponds semantically to a set of true propositions of the form *x loves f(x)* where both *x* and *f(x)* belong to X. Such a question can be answered by giving a list of pairs <*a*,*b*> such that *a* loves *b* - a PLA.

Although the meaning of the question corresponding to the functional answer is different from the PLA meaning, the two derivations are structurally parallel and utilize the same mechanisms on Chierhchia's account. In contrast, the analysis in Groenendijk & Stokhof (1983, 1984) had to rely on two mechanisms for different answer types: quantifying in for PLAs and Skolem-functions for functional answers. Chierchia's analysis also covers universal and non-universal quantifiers, such as *two*, which makes the functional analysis of PLAs more universal.

[6] A total function *f* from domain *A* to range *B* is defined as follows: for every *y* in *A*, *f(y)* belongs to *B*, for all other values *f(y)* is undefined (Chierchia, 1993, p. 209).

1.3. Constraints on the availability of pair-list answers

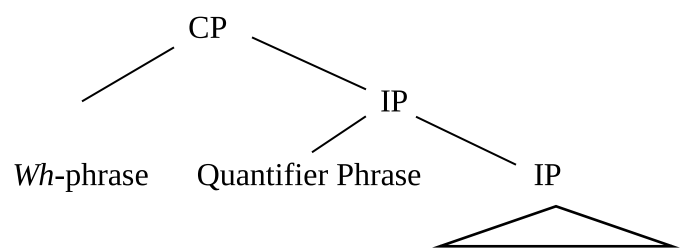
In the previous sections, I outlined 3 different approaches to the semantics of PLAs. Some (Karttunen, 1977; Groenendijk & Stokhof, 1983, 1984) provide a semantic account for Quantifier Raising (QR) analysis *wh*-/quantifier interactions (May, 1985, 1988). Others (Engdahl, 1986; Chierchia, 1993) build the framework for non-QR accounts of PLA distribution (Chierchia, 1997; Szabolcsi, 1997a). I now turn to distributional properties of PLAs, and discuss which factors make such answers possible.

1.3.1 Structural factors in the subject-object asymmetry

May (1985, 1988) noticed that PLAs are freely available for questions with quantifiers in subject position but not in object position. He attributed this restriction to structural constraints on Quantifier Raising (QR), a form movement at the level of Logical Form (Chomsky, 1976; May, 1977). In syntax, movement occurs in order to satisfy structural requirements. For example, in English, *wh*-phrases are required to move from their original position to the front of a question. QR, unlike other types of movement, is triggered not by structural but semantic and interpretative reasons (Chomsky, 1993, 1995; Fox, 1995). Depending on the particular position the quantifier targets in the course of QR, different interpretations become available. May's structural account of the subject-object asymmetry in the availability of PLAs is related to other subject-object asymmetries known as Comp-trace effects (Pesetsky, 1982, among others). The view that Comp-t effects result from characteristic structural asymmetry has been questioned in works starting with Déprez (1991, 1994a).

In May's analysis, for a pair-list reading to be available, the quantifier has to take scope over the *wh*-term at LF through adjunction to an IP node. In May's view, adjunction to CP is impossible. QR results in a formation of a Sigma-sequence – a sequence containing a *wh*- and a quantifier phrase. Members of a Sigma-sequence are dominated by the same maximal projection. An example in (22) contains a Sigma-sequence {*Wh*-phrase, Quantifier Phrase}.

(22)



In the case of *wh*-/quantifier questions, the only maximal projection dominating both the *wh*-phrase and the quantifier is a CP node, and hence government properly holds for the elements of a Sigma-sequence. According to an interpretative principle proposed by May (1985), members of a Sigma-sequence can freely take scope over each other. Thus, a question, such as (23), contains a Sigma-sequence {*who*, *everyone*}. When the *wh*-term scopes over the quantifier *who* > *everyone*, a single answer becomes available. A question in (23) could then be paraphrased in (24). When the inverse scope relation occurs *everyone* > *who*, a pair-list reading is derived, and a question can be paraphrased in (25).

(23) Who did everyone see?

$[_{CP}$ Who$_i$ $[_{IP}$ everyone$_j$ $[_{TP}$ t$_j$ [see $[_{NP}$ t$_i]_i]]]]$

(24) *Who is a person x, such that everyone saw x?*

(25) *For every person x, who did that person see?*

Questions with subject quantifiers (23) allow both readings (24) and (25). In (23) the paths of *wh*-movement and QR nest, making both a single answer and a PLA are available. For questions with object quantifiers, PLAs are not available, because the paths of QR and of *wh*-movement cross, violating the Path Containment Condition (Pesetsky, 1982), as can be seen in (26). According to the Path Containment Condition (PCC), paths resulting from movement should embed, like in (23), not cross. To avoid yielding crossing paths, the quantifier must be raised lower in the tree, adjoining to VP, and thus cannot scope over the question term[7], so in (26) the *wh*-phrase takes scope over the quantifier, yielding a single answer. The inverse scope is impossible, because the *wh*-term and the quantifier are too far from each other to form a Sigma-sequence, as there is no single maximal projection for both of them.

(26) *Who saw everyone?*

$$[_{CP}\ \text{Who}_j\ [_{IP}\ \text{everyone}_i\ [_{TP}\ t_j\ [\text{see}\ [_{NP}\ t_i\ ]_i]]]]]$$

Using restrictions on movement, May (1985) accounts for the subject-object asymmetry in the availability of PLAs. When movement constraints, such as the PCC, are satisfied, both types of answers are available. A violation of the PCC rules out the PLA, but does not affect single answers, since single answers correspond to surface scope of

[7] Another way to avoid crossing paths would be through adjunction to CP. Williams (1998) points out that May's analysis only gives the correct predictions in the case of the subject-object asymmetry if CP-adjunction is banned in the system.

the elements, and do not require the quantifier to be raised high in the structure to form a Sigma-sequence with the interrogative phrase.

1.3.2 Subject-object asymmetry as a result of Weak Crossover

Chierchia's analysis also predicts the restrictions on the availability of PLAs (1993). He describes the restrictions on the availability of PLAs in terms of Weak Crossover effects (WCO) (Postal, 1971; Wasow, 1972; Lasnik & Stowell, 1991, among others). WCO effects are a well-known property of grammar that illustrates conditions on pronominal binding. A reading under the indexing in (27) is ungrammatical.

(27) *Who$_i$ does his$_i$ mother love t$_i$?

*His$_i$ mother loves every boy$_i$.

In (27) the *wh*-phrase has to cross over the pronoun in order to bind it. However, this binding results in a Weak crossover violation, and the co-indexing of *who* and *his mother* is impossible.

Chierchia uses WCO to explain the cases of subject-object asymmetry in the availability of PLAs. *Wh*-words, according to Chierchia, are associated with two traces: a functional trace and an argument trace. The functional trace is bound by the *wh*-phrase that appears in Spec CP. The argument trace, co-indexed with an NP, acts like a pronominal element, and may be bound by the quantifier. If the binding is possible, the question has a pair-list reading (28). In (28) *everyone* binds an argument index *j*, and this binding allows extracting the information about the domain of a function. That function provides pairings of people and those who love them.

(28) *Who does everyone love?*

[Who_i [$everyone_j$ [love e_i^j]]]

[Who_i $everyone_j$] [[e_i^j] love t^j]

John loves Mary, and Peter loves Sue.

When the quantifier is in object position, the binding results in WCO, as in (29): *everyone*, on its way to bind the argument trace, crosses over that trace. Recall that according to Chierchia, argument traces are pronominal in nature. Crossing over a pronominal element gives rise to a WCO effect. Binding is not licensed, and the requested domain is not specified. As a result, a PLA is unavailable.

(29) *Who loves everyone?*

*[Who_i [e_i^j] loves $everyone_j$]

*John loves Mary, and Peter loves Sue

The attractiveness of Chierchia's analysis lies in the fact that it uses an existing condition on binding to account for the subject-object asymmetry. Chierchia also accounts for the absence of the subject-object asymmetry in questions like (30), which seem to provide a counterexample for the lack of PLAs to object quantifier questions. He claims that a PLA is possible for (30), even though the quantifier occurs in object position.

(30) Who put everything on the platter?

Bill, the chicken salad; Frank, the chow mein; ...

(from Chierchia, 1993, p. 183)

(31) Which student put everything on the platter?

*Bill, the chicken salad; Frank, the chow mein; ...

(from Chierchia, 1993, p. 184)

Chierchia (1993) suggests that PLAs are available for object-quantifier questions with a semantically plural *wh*-term like *who* (30), but not with a strictly singular *wh*-phrases, such as *which* (31). Thus, the subject-object asymmetry here surfaces only for a subset of questions: the strictly singular ones. PLAs are possible when the question term is plural or, like *who*, allows for a plural reading.

However, PLAs to questions involving interactions of pluralities may have a different nature, and therefore considering questions with plural terms may be misleading when studying scopal interactions of *wh*-phrases and quantifiers. PLAs that involve pluralities might be related to cumulativity. A phenomenon of cumulative readings was originally described by Scha (1978) for declarative sentences. I will first review his original proposal and then show how his analysis was later extended to questions. According to Scha (1978, 1981/1984/2003), a cumulative reading of a sentences with two or more noun phrases cannot be derived from either collective or distributive interpretations of the interacting noun phrases. He considers the following sentence (32) with a corresponding cumulative interpretation in (33).

(32) 600 Dutch firms have 5000 American computers (Scha, 1981, p. 500).

(33) The number of Dutch firms which have an American computer is 600, and the number of American computers possessed by a Dutch firm is 5000.

A distributive reading of (32) is true if each of the 600 Dutch firms owns 5000 computers. A collective reading is true if 600 Dutch firms together own 5000 computers (this might be true of a consortium of companies, where each individual company is not an owner, but they have a collective property of 5000 computers). The reading in (33) has different truth conditions from both a distributive reading and a collective reading: the reading in (33) is true each of the Dutch firms owns at least one American computer, the total number of firms is 600, and the total number of computers is 6000. A cumulative interpretation of (32) arises when two pluralities interact: a plurality of 600 Dutch firms, and another plurality of 5000 American computers. The precise mechanism of this interaction is debated (see Scha, 1981/1984/2003; Sternefeld, 1998; Kratzer, 2007).

The status of PLAs in examples like (30), where a plural *wh*-phrase interacts with a quantifier, has been addressed by several authors (Krifka, 1992; Srivastav, 1992; Dayal, 1996). Srivastav (1992) claims that these PLAs are distinct from answers that normally arise from *wh*-/quantifier interaction. Srivastav distinguishes two types of noun phrases (NP): quantificational NPs like *every*, *each*, *both*; and plural definite NPs with determiners like *the*, *these*, or NPs listing two or more individuals. Interaction of definite plurals and plural *wh*-terms can give rise to PLAs, but those answers do not serve as an indication of *wh*-/quantifier scopal interaction. PLAs like in (30) result from a different process – distributing some property over a group, and represent a spell-out of a cumulative answer. Srivastav extends Scha's (1981) analysis of cumulative readings and applies it to questions. Cumulative answers arise when two pluralities interact. In the case of *wh*-/quantifier questions, both a *wh*-term and a NP have to be plural. In (34) and (35) *these men* corresponds to a plurality of men, and the wh-word *who* picks out a plurality of individuals loved by men.

(34) Who do these men like?

John loves Mary, and Bill loves Sue.

(35) Who likes these men?

Mary loves John, and Sue loves Bill.

This analysis can be extended to cover the cases like (30) where a plural *wh*-term interacts with a quantificational NP. A pair-list reading in (30) results from spelling out of a cumulative answer, since both the *wh*-phrase *who* and the quantifier phrase can be understood as plural. Agüero-Bautista (2001) accounts for this pattern through a Double-Plurality Requirement. This requirement states that not only the *wh*-phrase but also the quantifier phrase should be semantically plural. Recall, that a cumulative interpretation can arise when two pluralities interact (Scha, 1981/1984/2003). Quantifier phrases like *everyone* or *everybody* can satisfy the plurality requirement. Their semantic plurality is shown through their ability to combine with collective predicates (Dowty, 1987) like *gather*, and contrasts quantifiers of the form *every NP*, which are morphologically and semantically singular, and therefore cannot combine with collective predicates, as shown in (36). A collective predicate requires a plurality, in the sense of Link (1983/2002), as a subject/agent, and may apply to a plurality even if it does not apply to individuals members.

(36) Everyone gathered in the hall.

*Every boy gathered in the hall

Plurality of a *wh*-phrase can be illustrated by a set of examples in (37). Only a *who*-question (37) can be answered by (37). A *which*-question (37) is strictly singular and cannot have a plural interpretation of a *wh*-phrase.

(37) a. Who came?

b. Which boy came?

c. John and Jack came.

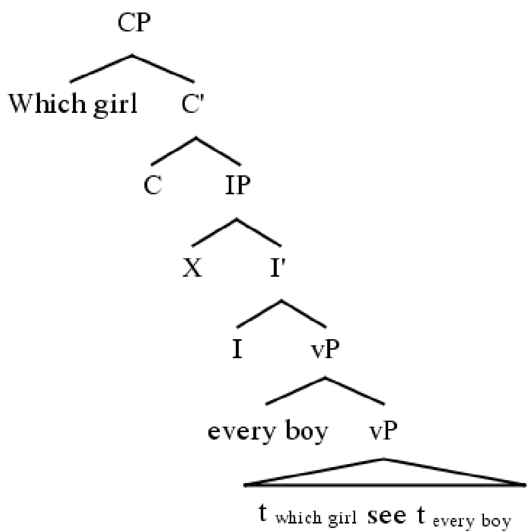
In (30) we have two interacting pluralities: one denoted by *who,* and the other denoted by the NP *everything.* The interaction of pluralities is different from a scopal interaction: it is not subject to restrictions on movement. That is why questions with plural *wh*-phrases and quantifiers do not exhibit a subject-object asymmetry. Questions, such as (30), may have PLAs that do not result from a scopal interaction, and they cannot serve as an indicator of the quantifier being able to take inverse scope.

1.3.3 Semantic factors in the availability of pair-list answers

A number of accounts (Beghelli, 1997; Beghelli & Stowell, 1997; Agüero-Bautista, 2001) proposed that the subject-object asymmetry only applies to a narrow case of interacting *wh*-terms and quantifiers. More specifically, these accounts maintain that morpho-syntactic properties of the interacting terms can enable the pair-list reading of a question with an object quantifier that would otherwise be unavailable. Agüero-Bautista (2001) suggests that for questions with object quantifiers, PLAs are only possible for non-presuppositional *wh*-phrases, such as *who*. Unlike the QR treatment of May (1985, 1988), and Chierchia's account (1993), Agüero-Bautista's (2001, 2010) analysis relies on the notion of reconstruction: interpreting an element not in its surface position but in a position where it either originated or moved through. According to Agüero-Bautista (2001), the D-linking status (Pesetsky 1987) of a *wh*-phrase affects its ability to reconstruct below the quantifier. While *which* is lexically presuppositional, or D[iscourse]-linked, *who* is not. D-linked *wh*-phrases such as *which* imply the existence of a set of entities the *wh*-phrase *which NP* is referring to (Frazier & Clifton, 2002). When a question containing a D-linked phrase is asked, the speaker is asking to provide a choice from that presupposed set of entities. Presuppositional *wh*-phrases cannot reconstruct into the position they originated from (a thematic position). Thematic positions are the positions where an argument can get its thematic role; these positions are in the c-command domain of a verb.

According to Agüero-Bautista (2001), reconstruction below a quantifier becomes a necessary condition for a PLA to be available. For a PLA to be possible, the quantifier has to bind a null variable in a reconstructed *wh*-phrase (Agüero-Bautista, 2011). A *wh*-phrase can reconstruct in Spec IP position (not a thematic position, since Spec IP is not part of the c-command domain of a verb) but not in Spec vP (a thematic position). Only the latter is a position below the quantifier, so a PLA is impossible for an object-quantifier question, as in (38).

(38) Which girl saw every boy?



In contrast, *who* can sometimes reconstruct below the quantifier, because the presuppositional status of *who* is determined by discourse, not by the lexicon. Agüero-Bautista predicts that a PLA is available for a subject *who* question interacting with object *every*. Using examples from Spanish, Agüero-Bautista also argues that it is not the plurality of a *wh*-word that makes a PLA possible, which goes against Chierchia's (1993) explanation of why questions with *who* may lack the subject-object asymmetry. Agüero-Bautista concludes that *wh*-/quantifier interactions do not always give rise to a subject-object asymmetry; instead the asymmetry is a phenomenon restricted only to a subset of *wh*-phrases and quantifiers, and only describes the cases that involve presuppositional or definite interrogative determiners (Agüero-Bautista, 2001).

1.3.4 Summary

PLAs are subject to restrictions on their distribution. They are argued to be possible for subject-quantifier questions but not for object-quantifier questions (May 1985, 1988). Table 1 summarizes the empirical predictions of the accounts reviewed above. All the accounts predict the unavailability of PLAs for questions where a presuppositional/singular subject *wh*-phrase interacts with object *every*. The accounts reviewed in this chapter also make a number of conflicting predictions. Chierchia (1993) claims that PLAs are possible for questions with a *wh*-phrase that can be plural, such as *who.* This claim entails that PLAs should also be possible for questions in which a plural *which*-phrase interacts with an object *every* quantifier. The latter structure is predicted to lack a list reading in the analysis of Agüero-Bautista (2001).

Table 1. Availability of PLAs for *wh*-questions with object quantifiers*

Subject questions	**May (1985)**	**Chierchia (1993)**	**Agüero-Bautista (2001)**
Who kissed every girl?	-	+	+
Which boy kissed every girl?	-	-	-
Which boys kissed every girl?	-	+	-

* A "+" sign corresponds to a PLA predicted to be possible, " –" sign – a PLA is lacking.

Depending on the role of the morpho-syntactic properties of the interacting terms, the subject-object asymmetry in the availability of PLAs may be treated as a phenomenon covering a wide set of quantifiers and *wh*-phrases, or as being quantifier and *wh*-phrase specific.

1.4. Testing the subject-object asymmetry experimentally

A number of factors have been claimed to affect the availability of PLAs. Some of these factors are subject to disagreement, and different theories have opposite predictions about the availability of PLAs. Moreover, the judgments reported in the literature seem to diverge as well. In the end, comparing theoretical accounts becomes increasingly more complex. In this dissertation, I show that systematic assessment of the factors affecting the availability of PLAs within an experimental framework, gives us a chance to re-evaluate the role of different factors determining *wh*-/quantifier interactions, as well as gain new understanding of the subject-object asymmetry. Experimental data can also shed light on the source of apparent disagreement in judgments reported in the literature. The data is expected to show which of the judgments can be confirmed with a larger group of speakers.

1.4.1 Experimental tools in linguistic research

Current analyses of questions with universal quantifiers (May, 1985; Chierchia, 1993; Engdahl, 1983; Dayal, 1996; Szabolcsi, 1997a; Beghelli, 1997; Agüero-Bautista, 2001; among others) derive generalizations from individual acceptability judgments. Methodology of obtaining informal judgments was questioned in a number of studies (Spencer, 1973; Schütze, 1996; Ferreira, 2005; Wasow & Arnold, 2005; Gibson & Fedorenko, 2010, 2013; Dabrowska, 2010; Gibson, Piantadosi, & Fedorenko, 2013, among others). Linguistic research often relies on informal acceptability judgments as a source of data (Gibson & Fedorenko, 2013). Judgments are elicited from a small number of speakers, usually the researcher and a few colleagues (Kawahara, 2011). Gibson & Fedorenko (2010, 2013) are also concerned with the fact that intuitive judgments may suffer from cognitive biases affecting researchers. A confirmation bias (see Nickerson, 1998 for a review) may lead a researcher to detect effects that support their hypothesis/analysis (Gibson & Fedorenko, 2010). When the researcher elicits informal judgments from his/her friends and colleagues, they might be affected by reactions coming from the researcher, and unconsciously produce judgments that favor the researcher's hypothesis. This effect became known in Cognitive Psychology as a "Clever-Hans effect" (Pfungst, 1911).

Experimental studies show that eliciting judgments in informal settings is generally efficient for syntactic theory construction, and widely accepted linguistic generalizations based on professional intuitive judgments overall turn out to hold when tested under more formal experimental designs (Phillips, 2010; Sprouse, 2009; Sprouse & Almeida, 2012). However, judgments may differ in how complex they are. When judgments about the availability of a certain interpretation are involved, the picture becomes less clear. I maintain that such acceptability judgments are more subtle and prone to the effect of discourse factors than purely syntactic effects are. In the area of *wh*-/quantifier interaction, the availability of a PLA is treated as a test of underlying *wh*-/quantifier configuration. Assessing the availability of a PLA, we do not simply judge how acceptable a certain construction is, but how acceptable an answer is relative to a question asked. Discourse-sensitivity, in turn, may give rise to variation in judgments and even disagreement over the empirical data. When there is disagreement in judgments as to whether particular sentence types are acceptable or not, it becomes difficult to decide which judgments, amongst the ones reported in the literature, reflect data accurately (Grudzinska, 2008). Experimental tools offer a new possibility of resolving disagreement or, at the very least, obtaining a more detailed picture of the phenomenon. The distribution of judgments elicited from a large number of speakers (as I show in the next sections), can reveal more variation in responses than predicted by theoretical accounts (May, 1985; Beghelli, 1997; Chierchia, 1993; Agüero-Bautista, 2001).

I use a set of psycholinguistic experiments to resolve the disagreement about data summed up in Table 1, and to determine what factors affect the availability of PLAs. Based on claims made by the accounts reviewed in section 1.1, the experiments were designed to test the effect of three main factors on the availability of PLA:

1) Structural position of the quantifier (May, 1985, 1988);

2) Presuppositional nature of the *wh*-phrase (*who* vs. *which*) (Agüero-Bautista, 2001);

3) Plurality of the *wh*-term (*which* singular vs. *which* plural (Chierchia, 1993).

Across the experiments, the stimuli contained subject *which* interacting with object *every*, where all the accounts reviewed predict the unavailability of PLA, as a baseline condition. Each experiment also manipulated the grammatical position of the quantifier, i.e., subject vs. object, as well as answer type, i.e. single answer vs. PLA. Participants were given question-answer pairs and had to judge, on a 1-7 scale, whether the answer in question was a possible answer for the relevant question. A scale was used instead of a binomial choice (i.e., Yes/No) because of the variation in judgments reported in the literature. A scale can show not only mean ratings assigned by participants, but, crucially, the degree of variation that exists in judgments, if there is any.

1.4.2 Experiment 1 *Who* / *Which*

1.4.2.1 Method.

Design. Experiment 1 was designed to test whether the structural position of the quantifier, as well as presuppositional nature of the *wh*-expression (*which* vs. *who*) (Chierchia, 1993; Agüero-Bautista, 2001) affects the availability of PLA. Question/answer pairs were constructed in such a way that they were as close to those discussed in the literature as possible in order to address the lack of convergence in the literature. A set of practice and control items ensured that participants understood the task, were able to assign low/middle/high ratings when required, and accepted PLAs as a possible answer type when appropriate. Three variables were manipulated: answer type, grammatical position of the quantifier, and the type the *wh*-term. There were two types of answers: single answers (39) and PLAs (40). *Wh*-phrase types included non-presuppositional *who* (39)-(40) and presuppositional *which* (41)-(42). Finally, half of the questions contained a quantifier phrase in subject position, such as in (42); and the other half had questions with an object quantifier phrase, such as in (41). Appendix A shows a full set of stimuli.

(39) <u>Who</u> invited <u>everyone</u> to watch the competition?

Sarah.

(40) <u>Who</u> kissed <u>everyone</u> on Valentine's Day?

Jim kissed Kitty, Mary kissed Mike, and Heather kissed Tom

(41) <u>Which student</u> recorded <u>everything</u> on camera?

Mat recorded the Dean's speech, Dan recorded the President's address, and Helen recorded the Committee talk.

(42) Which art project did every child make for the teacher?

Harry made a paper dog, Cynthia made a vase, and Brian made a greeting card.

In a 2x2x2 design, 2 (quantifier position: subject vs. object) x 2 (answer type: single vs. pair-list) x 2 (*wh*-type: *who* vs. *which*) all three factors were treated as within-subjects variables. Crossing of these factors resulted in 8 different combinations, illustrated in Table 2.

Table 2. Experiment 1. Sample stimuli

Question Answer	Quantifier Position	*Wh*-type	Plurality of *wh*-phrase	Answer Type
Q: Which girl did every boy meet? A: Mary.	**Subject**	Presuppositional	**Singular**	Single answer
Q: Who did every boy meet? A: Mary.	**Subject**	Non-presuppositional	**Can be plural**	Single answer
Q: Which girl met every boy? A: Sue.	**Object**	Presuppositional	**Singular**	Single answer
Q: Who met every boy? A: Sue.	**Object**	Non-presuppositional	**Can be pural**	Single answer
Q: Which girl did every boy meet? A: John met Mary, Nick met Jane, and Harry met Sue.	**Subject**	Presuppositional	**Singular**	PLA
Q: Who did every boy meet? A: John met Mary, Nick met Jane, and Harry met Sue.	**Subject**	Non-presuppositional	**Can be plural**	PLA
Q: Which girl met every boy? A: Mary met John, Jane met Nick, and Sue met Harry.	**Object**	Presuppositional	**Singular**	PLA*
Q: Who met every boy? A: Mary met John, Jane met Nick, and Sue met Harry.	**Object**	Non-presuppositional	**Can be plural**	PLA**

* Predicted to be unavailable.
** Judgments in the literature diverge.

Each trial consisted of a question and an answer to that question. The task was to determine whether that answer was a possible answer to the relevant question on a 1 - 7 scale (where 1 was ‘definitely no’ and 7 ‘definitely yes’, other values not labeled).

Participants. 35 undergraduate students, all native speakers of English, participated in this experiment. They received course credit for participation. Undergraduate students naïve to linguistic theory participated in the experiments to ensure that there was no effect of bias (see Gibson & Fedorenko, 2010; for a different approach see Sprouse & Almeida, 2010).

Materials and procedure. Participants were asked to rate 32 critical items (8 conditions, 4 items per condition) and 60 control/filler statements, which included answers to questions with *wh*-words only (43), quantifiers only (44), questions with clearly acceptable (45) or unacceptable answers (46), questions allowing PLAs (48), as well as questions with pragmatically odd answers (47).

(43) Which countries share a border with the US?

Canada and Mexico

(44) Did each doctor get a license?

No, only 2 of them did.

(45) Which animal in this zoo is the tallest one?

The giraffe.

(46) Did you read every book on the list?

Yes, I read 3 out of 8.

(47) Which girls ate the cake?

Mary.

(48) Who bought what?

Mary bought the cheese, Sue bought the milk, and Jim bought the potatoes.

Every participant saw all the experimental items in one of the four random orders (A, B, C, or D). The experiment started with the presentation of three practice questions, which showed possible (49), impossible (50) and 'intermediate' answers (51).

(49) Did you see an elephant at the zoo?

Yes, I did. (7 "definitely yes")

(50) Where are you from?

I don't really like chocolate. (1 "definitely no")

(51) What kind of music do you prefer?

Oh, I like music! (some value between 1 and 7)

Participants then took the main test that lasted approximately 15-20 minutes. Participants could take as long as they wanted to give their answers, but they were not allowed to return to a previous question and change their responses. All three experiments were run using the Survey Monkey software (SurveyMonkey.com, LLC).

1.4.2.2 Results and analysis. I begin this section by looking at the control items. The participants experienced no difficulty with the task and were indeed able to assign appropriate ratings. To be sure, participants assigned high ratings to 'appropriate answer' controls (mean = 6.8). They accepted PLAs when those were available (multiple *wh*-questions, such as (48)) (mean = 6.72). In the case of inappropriate answers, such as (46), they assigned low ratings (mean = 2.08). Participants were also sensitive to intermediate levels of 'appropriateness' (questions such as (47)) of an answer and were clearly able to use the middle of the scale when necessary (mean = 5.01).

I now turn to critical items. Data from psycholinguistic experiments is commonly analyzed using repeated measure ANOVA, treating subjects and items as a random factor (Baayen, Davidson, & Bates, 2008). However, ANOVA has a number of assumptions that may be difficult to meet in a psycholinguistic study that uses Likert-scales. First, ANOVA is optimal for normally distributed continuous outcomes, while scales belong to categorical outcomes[8]. Second, ANOVA lacks a flexible method to deal with missing datapoints (Baayen, Davidson, & Bates, 2008). Finally, variance might be uneven between conditions. Mixed models have solutions for many of these problems, and are suitable for categorical outcomes. For Experiment 1, ratings for different types of answers were analyzed using cumulative link mixed models. The analysis was performed by means of *ordinal* package (Christensen, 2012) in R open software (R Core Team, 2012).

The goal of Experiment 1 was to assess the validity of the subject-object asymmetry. I first examine the effects of quantifier position and type of answer on the availability of PLA. According to the theoretical predictions, we expect to see an interaction between answer type and quantifier position. The analysis revealed a significant effect of answer type ($p < 0.01$) with single answers scoring higher than PLA.

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[8] For a discussion of categorical data analysis see Agresti (2002), Jaeger (2008).

The interaction between answer type and quantifier position was significant (p < 0.01): ratings for single answers were similar for subject- (mean rating = 6.66) and object quantifier questions (6.71 on a 7-point scale), while PLAs were rated lower for object-quantifier questions (mean = 4.62) than for subject-quantifier questions (mean = 5.76) (p < 0.01) (Figure 1). This effect does not fully reflect the classic subject-object asymmetry described by May (1985), which predicts PLAs to be available for questions with subject quantifiers and not to be available for questions with object quantifiers. Here, we notice a relatively high acceptance rate for PLAs to both questions with subject and, importantly, object quantifiers.

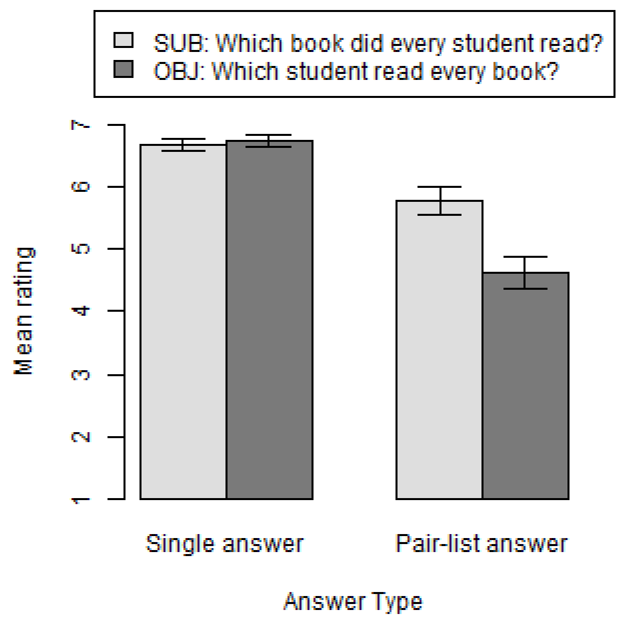

Figure 1. Mean ratings for different types of answers

I will now limit the data set to object-quantifier PLAs only in order to investigate the contribution of different factors. Now we can test more specific predictions concerning which factors affect the availability of PLAs. When both the subject- and object- quantifier questions were taken into account, the main effect of *wh*-type was not significant ($p = 0.448$). Moreover, a strong correlation between the ratings in *who* and *which* conditions ($r = 0.85$, $p < 0.01$) suggests that people who accepted PLAs with *who* also accepted PLAs to questions with *which.* This finding is noteworthy, because it does not accord with the predictions that the plurality of *who* (Chierchia, 1993), or its ability to allow reconstruction (Agüero-Bautista, 2001) should make PLAs to questions with *who* more available than to questions with *which* interacting with an object quantifier *every*.

However, a marginally significant effect of the *wh*-type ($p = 0.097$) was observed among object quantifier PLAs – an area where the type of a *wh*-phrase is predicted to make a difference. PLAs to questions with *who* may have received a higher rating than PLAs to questions with *which* due to possible plurality of the *wh*-phrase (Chierchia, 1993), or ability of *who* to reconstruct below the object quantifier (Agüero-Bautista, 2001). In Experiment 1, the stimuli were also balanced between *every + NP* type phrases and pronominal phrases like *everything*. If we follow Srivastav/Dayal's account (1992) that predicts a special type of PLA for questions with plural definites, we expect the type of *every*-phrase to matter for questions with a potentially plural *wh*-phrase (*who*), such as (52), and not for questions with singular *which* (53). PLAs are then expected to be available for (52), but not (53). In terms of experimental design, this effect should reveal itself in an interaction between the *wh*-type and the type of a quantifier phrase.

(52) Who put everything on the platter?

Bill put the chicken salad; Frank, the sandwiches; Robert, the pasta.

(53) Which guest put everything on the platter?

*Bill put the chicken salad; Frank, the sandwiches; Robert, the pasta.

The analysis reveals no significant interaction between the morpho-syntactic type of a *wh*-phrase (singular *which* vs number neutral *who*) and the type of quantifier phrase ($p = 0.259$), contrary to the predictions. Srivastav's (1996) account predicts that potentially plural quantifier phrases (*everybody, everything*) while interacting with a potentially plural interrogative phrase (*who*) should give rise to PLAs more easily. There should be no effect of possible plurality for questions with singular *which*-phrases. However, questions with a pronominal type quantifier, such as in (52) overall make a PLA more available (mean = 4.8) than questions with every + NP, such as (54), (mean = 4.4), $p < 0.05$. This effect does not depend on the type of the *wh*-phrase used (Figure 2).

(54) Who painted every box here?

Kim painted the big box; Sam painted the small one; and Michele, the small one.

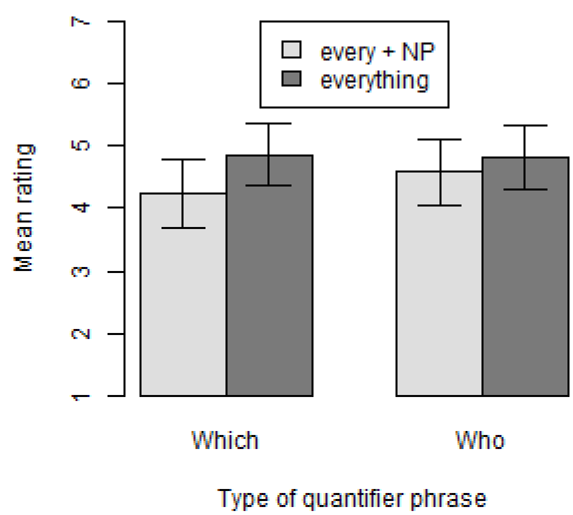

Figure 2. Effect of quantifier phrase type (object-quantifier questions)

1.4.2.3. Discussion

Overall, single answers were rated higher than PLAs. This effect might be due to the fact single answers correspond to the surface scope of the *wh*-phrase and the QP. Anderson (2004) attributed this asymmetry in scope to processing constraints and proposed the interpretative principle of Processing Scope Economy (55).

(55) The human sentence processing mechanism prefers to compute a scope configuration with the simplest syntactic representation (or derivation). Computing a more complex configuration is possible but incurs a processing cost.

Processing Scope Economy principle explains why in the acceptability judgment experiments single answers always received higher ratings than PLAs: a reading of a question that leads to a single answer corresponds to the surface scope, with the *wh*-phrase taking scope over the quantifier phrase. However, the Scope Economy principle does not capture the difference between subject and object quantifiers in their ability to give rise to PLAs.

Recall that singular presuppositional *wh*-phrase, like *which*, interacting with an object quantifier *every* are predicted to lack a pair-list reading, a conclusion shared by all theoretical accounts reviewed in this paper (May, 1985; Chierchia, 1993; Beghelli, 1997; Agüero-Bautista, 2001). Yet PLAs to questions with object-quantifiers appear to be acceptable: notice that PLA ratings for questions with object quantifiers appear relatively high for a type of answer, supposed to be unacceptable. PLA ratings for questions with an object quantifier are also significantly higher than ratings for unacceptable answers in the control conditions ($p < 0.01$, Kruskal-Wallis test). It is therefore possible, that PLAs are in fact possible in some circumstances.

I now turn to a more detailed analysis of the responses. Looking at the frequency distribution of PLA ratings can reveal how much variability can be found in the data. If there is little variability, we expect the ratings to be clustered toward one end of the scale. If, however, there is a lot of variability, the data will be spread over the whole range of values. Figure 3 shows the distribution of ratings assigned by the speakers to different types of questions.

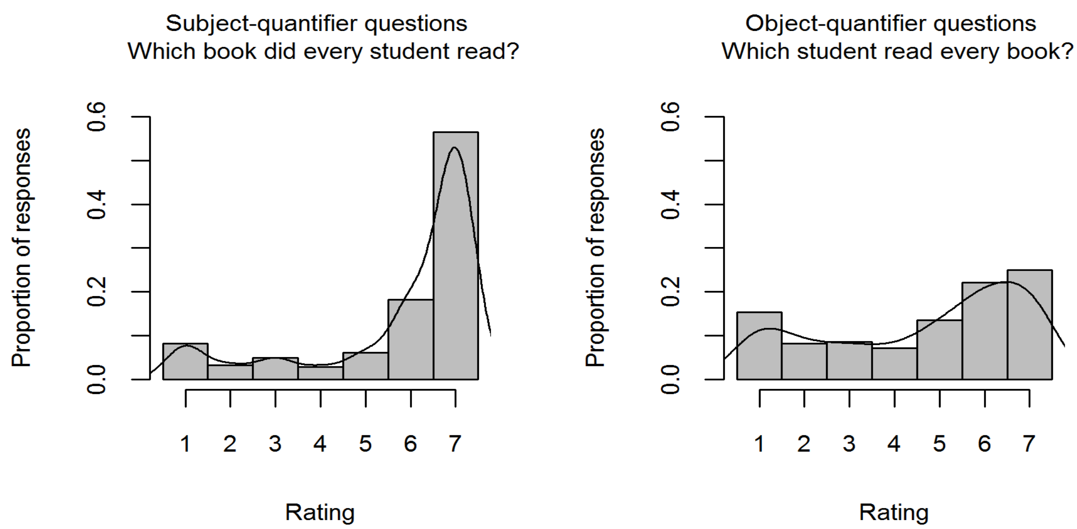

Figure 3. Distribution of ratings for PLAs

The results show that PLA were indeed well accepted in questions with subject-quantifiers (left histogram) since the largest proportion responses are bunched up towards the high end of the scale. Recall in contrast that object-quantifier questions are predicted to lack a PLA, and we should therefore observe low ratings on the right histogram. But for questions with object quantifiers, the prediction does not hold. The right histogram shows that there are clusters on both ends of the histogram, reflecting the fact that a number of PLA ratings are actually very high (6 or 7). This is unexpected if PLA were ungrammatical in object quantifier questions.

The statistical analysis shows no strong item-effects. However, across-subject variability is substantial (st. dev = 2.1, on a 7 point-scale, mean = 4.6 for object-quantifier PLA). Further analysis revealed that at least 26% of the participants (9 speakers out of 35) gave an average rating of 6 or more to object-quantifier PLAs. Some speakers also showed within-speaker variability in judgments, in other words they were not always consistent in their ratings for a certain type of PLA, suggesting that there might be other factors at play in determining the availability of a PLA beyond the purely structural ones. Both within- and between-speaker variation is illustrated by the boxplot in Figure 4 which shows a median split for each subject. Narrow boxplots belong to speakers who did not show much variation in their responses. Wide boxplots correspond to subjects who were not very consistent in their ratings. We can see that speakers vary in the degree of variation their ratings show.

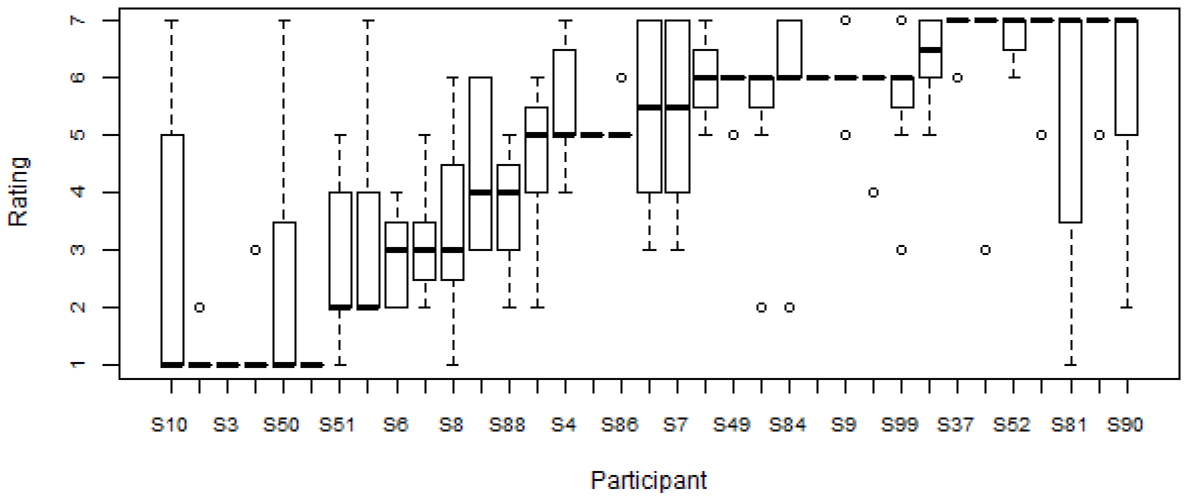

Figure 4. Individual data for object-quantifier PLAs

1.4.3 Experiment 2 *Which* sg / *Which* pl

The aim of Experiment 2 is to assess the contribution of plurality associated with the interrogative phrase on the availability of PLAs. Recall that according to Chierchia, PLAs are possible for questions with object quantifiers where the *wh*-phrase, such as *who*, could be interpreted as referring to a plurality. Results of Experiment 1 show no effect of the *wh*-phrase used. However, in that experiment I contrasted singular *which*-phrases with ambiguous *who*, that could potentially be interpreted either as a singular or a plural phrase. In this experiment, I use a more controlled comparison – between singular and plural *wh*-phrases. This experimental paradigm also allows me to eliminate the effect of difference in presuppositionality between *wh*-phrases, as here I focus on presuppositional *which*-phrases. Experiment 2, thus, addresses two main questions:

1) Are PLAs possible for questions with plural *wh*-phrases interacting with an object quantifier?

2) Are PLAs possible for object questions with plural *wh*-phrases interacting with object quantifier phrases, such as *everybody* but not *every* NP?

Questions 1 and 2 assess the claims made by Chierchia (1993) and Agüero-Bautista (2001) respectively. These authors make conflicting predictions as to whether only the *wh*-phrase or the quantifier phrase as well should be plural in order to give rise to a PLA, when a quantifier phrase is in object position.

1.4.3.1 Method.

Design. Experiment 2 tested the role played by the plurality of the *wh*-phrase (*which*-singular (56) vs. *which*-plural (57) Chierchia 1993, Agüero-Bautista 2001).

(56) Which student read every book last week?

(57) Which student**s** read every book last week?

Three factors were manipulated in the experiment: the syntactic position of the quantifier (subject vs. object), the type of answer (SA vs. PLA) and the morphological number of a *wh*-phrase (singular *wh*-phrases vs. plural *wh*-phrases). Experimental conditions and sample stimuli are shown in Table 3.

Table 3. Experiment 2. Sample stimuli

Question Answer	Quantifier Position	Plurality of *wh*-phrase	Answer Type
Q: Which girl did every boy meet? A: Mary.	**Subject**	Singular	**Single answer**
Q: Which girls did every boy meet? A: Mary and Jane.	**Subject**	Plural	**Single answer**
Q: Which girl met every boy? A: Sue.	**Object**	Singular	**Single answer**
Q: Which girls met every boy? A: Mary and Jane.	**Object**	Plural	**Single answer**
Q: Which girl did every boy meet? A: John met Mary, Nick met Jane, and Harry met Sue.	**Subject**	Singular	**PLA**
Q: Which girls did every boy meet? A: John met Mary and Jane, Nick met Helen and Ann, and Harry met Sue and Jennifer.	**Subject**	Plural	**PLA**
Q: Which girl met every boy? A: Mary met John, Jane met Nick, and Sue met Harry.	**Object**	Singular	**PLA***
Q: Which girls met every boy? A: Mary and Jane met John, Helen and Ann met Nick, and Sue and Jennifer met Harry.	**Object**	**Plural**	**PLA****

* Predicted to be unavailable
** Predictions in the literature diverge.

Participants. 33 Rutgers undergraduate students, all native speakers of English, participated in the experiments. They received course credit for participation.

Materials and procedure. The experimental procedure was the same as in Experiment 1. The speakers rated the sentences as possible or impossible answers to the question on a 7 point scale.

1.4.3.2 Results and discussion. The statistical analysis of mean ratings using cumulative link mixed models showed a significant effect of answer type with, again, single answers receiving higher ratings overall than PLAs ($p < 0.01$). There was also a significant effect of quantifier position ($p < 0.01$). The analysis revealed no significant difference between singular and plural *wh*-phrases ($p = 0.695$). The interaction of quantifier position and answer type was significant ($p < 0.01$). The ratings for PLA to object-quantifier questions with *which sg* and *which pl* were not statistically different from each other ($p = 0.476$). This finding goes against Chierchia's (1993) hypothesis and confirms Agüero-Bautista's (2001) idea based on informal judgment data from Spanish that the plurality of a *wh*-phrase alone does not affect the availability of PLAs to subject questions with object quantifiers.

Object-quantifier questions

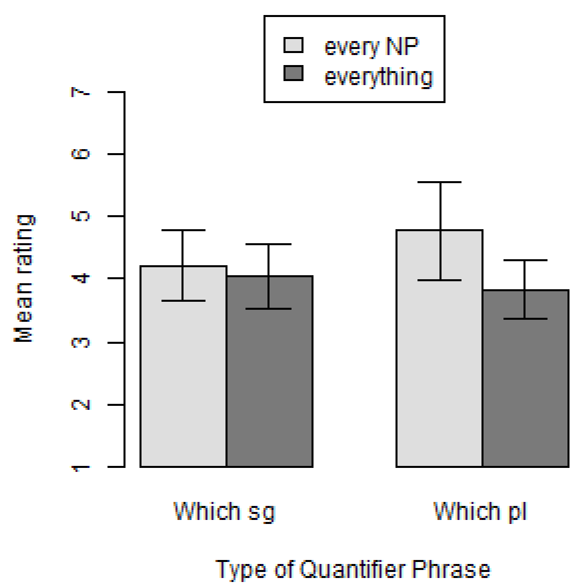

Figure 5. Effect of plurality of *wh*-phrase on PLAs

If PLAs are possible for plural *wh*-phrases interacting with a plural object-quantifier phrase, we expect the type of the quantifier phrase to make a difference in the *which plural* condition, however this prediction is not verified by the data. The results are summarized in Tables 4 and 5.

Table 4. PLA ratings for object-quantifier questions

	Who Experiment 1	**Which sg. Experiment 2**	**Which pl. Experiment 2**
Every + NP	4.6 (2.2)*	4.2 (2.3)	4.7 (2.2)
Everything/ Everyone	4.8 (2.2)	4.0 (2.1)	3.8 (2.3)

* Mean (standard deviation)

Table 5. PLA ratings for subject-quantifier questions

	Who Experiment 1	**Which sg. Experiment 2**	**Which pl. Experiment 2**
Every + NP	5.6 (1.9)*	5.6 (1.9)	5.9 (1.8)
Everything/ Everyone	6.2 (1.6)	6.1 (1.4)	6.2 (1.6)

* Mean (standard deviation)

1.5 General Discussion

In this section, I summarize the theoretical predictions of different accounts and demonstrate which of those predictions are confirmed experimentally. I then discuss the results in light of the subject-object asymmetry in the availability of PLAs. I am going to show that the structural account of the subject-object asymmetry is insufficient to properly account for the data. I began this Chapter with a sketch of three distinct semantic analyses of PLAs, followed by an overview of the factors that are claimed to affect the availability of PLAs: structural position of the quantifier (May, 1985), plurality of a *wh*-

phrase (Chierchia, 1993), and its presuppositional status (Agüero-Bautista, 2001, 2011). The goal of Experiments 1 and 2 was to answer the following questions:

1) Can subject-object asymmetry be confirmed experimentally?
2) Are PLAs more easily available for plural *wh*-phrases?
3) Are PLAs more readily available for non-presuppositional *wh*-phrases (*who*) than for presuppositional ones (*which*)?

Theoretical studies of the subject-object asymmetry were based on informal judgments, which did not always converge. My goal was to address this lack of convergence using formal tools from experimental psychology. Experimental findings do not fully support the subject-object asymmetry hypothesis. While the data confirm that PLAs for object-quantifier questions are indeed rated lower than PLA for subject-quantifier questions, the full picture is not as clear as predicted by theoretical accounts. First, PLAs to questions with object quantifier appear to be at least sometimes acceptable, since their average ratings are quite high for a type of answer that is predicted to be unavailable. Second, some participants found PLA answers at least sometimes acceptable in the object-quantifier condition. Finally, a number of speakers (26% in Experiment 1) consistently accepted object-quantifier PLAs. Current data are difficult to explain within existing accounts of the subject-object asymmetry.

How is it possible that 26% of participants showed no asymmetry, accepting PLAs to both subject- and object-quantifier questions? There might be several explanations for that effect. The first possibility is that subjects who find object-quantifier PLAs acceptable are speakers of a different dialect than those who reject PLAs to questions with object quantifiers. To be more precise, there are two dialects: one that has a grammar in which subjects and objects are asymmetrically structured, and this asymmetry matters for questions. The other dialect does not have the same grammatical constraints, and there is no asymmetry between subject- and object- quantifier questions. In order to entertain this hypothesis, we might be looking for extralinguistic factors to account for 26% of speakers not showing the subject-object asymmetry. If we assume that a dialect is defined by some non-linguistic factor specific to this group, then there might be extralinguistic characteristics, according to which the speakers are split. Unfortunately, there was not enough information collected in the survey to identify a subgroup under any particular non-linguistic factor.

High acceptability rates for object-quantifier PLAs might be at least in part due to certain parameters in the experimental design. I further explore this possibility in Chapter II where I manipulate the type of task and populations of speakers. I show that the choice of control items and fillers may have an effect on acceptability judgments. However, even in the situation of improved controls, some speakers still find PLAs to questions with object-quantifiers acceptable.

It might also be possible that constraints governing the subject-object asymmetry are not just structural but discourse-dependent. Evidence for that comes from variation both between speakers and within speakers. For clear-cut phenomena we expect significant variability neither within nor between speakers. Sprouse & Almeida (2010) show that in syntax many linguistic effects appear robust and hold with a low number of judgments and participants. Sprouse and Almeida (2010) performed a series of experiments testing island effects (Ross 1967) under experimental settings with large samples of participants. A syntactic island is a structure which does not allow extraction from it. An example in (58) shows an example of a *wh*-island: *when Jane was going to buy milk*. Since extraction is predicted to be impossible, we cannot make a question by fronting the object of the clause *milk.* As a result, formation of a question asking about what Jane was going to buy fails in (58).

(58) Mary asked when Jane was going to buy *milk*.

What$_i$ did Mary ask when Jane was going to buy t_i?

Concerns have been raised in the literature that small sample size, mediated by a small number of subjects, does not allow for generalizability of the observed patterns (Schütze, 1996). In order to assess the role of sample size, Sprouse & Almeida performed resampling simulations. In the course of a simulation, a random sample of a certain size was drawn from a pool of subjects. The pool contained subjects' estimates of a stimuli on a scale. Then a t-test was applied to find out whether significant differences can be detected between experimental conditions. A simulation was repeated 1000 times, and in the end, the proportion of significant outcomes was computed – a number referred to as detection rate. The authors showed that with a single judgment per participant given the smallest sample size of 5 there was a 70-75% detection rate for certain types of island effects. The detection rates rose to over 90% when four judgments per participant were used. The results show that even using a sample size of just five participants and one judgment per speaker would reveal the predicted effects. Moreover, Sprouse & Almeida demonstrate that participants never reported the effect in the opposite direction. When judging pairs of stimuli: one with an island violation and one without the violation, speakers never preferred a sentence without island violations to those containing island violations. In a different set of experiments they tested 469 data points from an introductory syntax textbook (Adger, 2003) and found out that the maximum replication failure rate between the informal judgments reported in the textbook and the formal experiments data was only 2% (Sprouse & Almeida, 2012). The authors conclude that informal judgments reported in the literature are in fact quite robust and there is no real evidence that informal acceptability judgments are unreliable.

Variability in the PLA acceptability data might be an indicator that a phenomenon is influenced by parameters of discourse. For example, if the presuppositional status of a *wh*-phrase is set by discourse, and in turn, the presuppositional status of a *wh*-phrase affects its ability to reconstruct below the quantifier, then changing the status of a *wh*-phrase would have a direct impact on the availability of a PLA for an object quantifier question. Object quantifier questions with a non-presuppositional *wh*-phrase would then yield a PLA; questions with a presuppositional *wh*-phrase would not. It is thus possible, that speakers who accept PLAs to questions with object-quantifiers are able construct a scenario where such answers become possible. The status of PLAs to object-quantifier questions then changes from ungrammatical to being, for one reason or other, difficult to access. This shift suggests a potential reconceptualization of PLA availability: it is no longer determined by the structural position of the quantifier. Instead, structural position of the quantifier affects the degree of acceptability with both subject- and object-quantifier PLAs being in principle acceptable.

In this Chapter, I also addressed the role of *wh*-phrase plurality in facilitating access to a PLA reading of a question with an object quantifier. Experiment 1 did not reveal significant differences between the questions with *who* and *which*. Plurality of a *wh*-phrase was additionally tested in Experiment 2 *Which* sg/*Which* pl + every. The analysis revealed no effect of the plurality of a *wh*-phrase on the availability of PLAs, contra Chierchia (1993). Agüero-Bautista (2001) refined Chierchia's hypothesis, claiming that not only the *wh*-phrase but also the quantifier phrase have to be plural in order to facilitate the access to a PLA. The analysis has revealed no effect of the type of the quantifier phrase (*every NP* vs. *pronominal everything*) neither in the *Which plural*, nor in the *Which singular* conditions. The data did not confirm the Double Plurality Hypothesis (Agüero-Bautista, 2001). According to this hypothesis, a pronominal quantifier phrase should have an effect on PLA availability only for questions with a *wh*-phrase unmarked for number, such as *who,* and should have no effect for singular *which* questions – a conclusion not supported by the data in Experiment 1. The effect of plurality on the availability of PLAs is disconfirmed.

1.6 Summary

In this chapter, I demonstrated that there is an asymmetry between subject- and object-quantifiers for the majority of speakers: PLAs for subject-quantifier questions are more acceptable than for object-quantifier questions. Neither presuppositionality of a *wh*-phrase nor its plurality facilitate access to a pair-list reading of questions with quantifiers. Recall that judgments reported in theoretical literature did not always converge. Interestingly, the same lack of convergence is found in experimental data: some speakers find PLAs to object-quantifier questions acceptable and show no subject-object asymmetry. I demonstrate that this pattern of responses is problematic for structural accounts of the subject-object asymmetry.

CHAPTER II

EFFECT OF EXPERIMENTAL MANIPULATIONS ON THE AVAILABILITY OF PLAs

In Chapter I, I described the factors that affect the availability of pair-list answers (PLA) to questions with quantifiers. Based on theoretical predictions, we expected to see participants accept PLAs for subject-quantifier questions, but reject them for object-quantifier questions. However, at least 26% of speakers in Experiment 1 did not demonstrate the subject-object asymmetry, and showed similarly high rating for both subject and object-quantifier PLAs. Under a structural view of the subject-object asymmetry, we do not expect PLAs to be possible for object-quantifier questions. In this Chapter, I examine possible factors that could have contributed to the lack of the subject-object asymmetry for some speakers. If PLAs are at least sometimes possible for object-quantifier questions, the structural analysis of the subject-object asymmetry has to be modified. It is therefore important to identify the source of the reported variability in judgments: do speakers indeed differ in how they understand *wh*-/quantifier questions, and this fact was not documented previously; or, alternatively, is the variability induced by experimental design and therefore represents an illusory effect while the asymmetry is in fact robust? In this chapter, I pursue the question of variability in linguistic data, and raise two questions:

1) Do we expect to see variability in the first place?
2) Can this variability indicate that mechanisms other than syntactic ones are involved in the regulation of PLA availability?

I further discuss whether the variability in the data is the result of testing naïve speakers, rather than professional linguists; and whether experts differ from naïve participants in their pattern of responses. Section 2.1 is devoted to the role of expertise in judgments. Sections 2.2 shows how manipulations with experimental instructions and controls affects subjects' behavior. A general discussion of experimental methodology, and its role in linguistic research follows in Section 2.3, followed by a summary in Section 2.4

2.1 The role of expertise in judgments

While the theoretical linguistic literature often relies on informal acceptability judgments elicited from professional linguists, experimental designs commonly target a different kind of population – naïve speakers. In the case of PLAs, we observed some mismatch between the data reported in the theoretical literature, and results that were obtained experimentally. The literature predicts PLAs to be lacking for object-quantifier questions with the universal quantifier *every*, but some people find them acceptable. To investigate the source of this discrepancy, I will first take a look at speakers who differ in their level of expertise, comparing naïve subjects, students pursuing a Ph.D. in Linguistics, and professional linguists. The goal of this section is to find out whether the subject-object asymmetry reveals itself in acceptability judgments of professional linguists. Among naïve speakers, we identified a group showing a lack of the subject-object asymmetry. If this result is confirmed with a group of professionals, it will reinforce the necessity for a modified analysis of the subject-object asymmetry. If, on the other hand, all professional linguists, who participated in the *wh*-/quantifier task, show the asymmetry between subject- and object-quantifier PLAs, several hypotheses might be pursued as to why the populations of speakers differ.

While for many syntactic effects the individual judgment data can be confirmed in experimental tasks, as discussed in the previous chapter, in controversial cases, the question about the source population is debated. The presence of the subject-object asymmetry in the availability of PLAs is known to be a controversial case, since it involves a judgment about the availability of a certain answer as a response to a particular question. This type of judgments seems to be quite different from acceptability judgments, where well-formedness of a certain sentence is evaluated. In the case of PLAs, the answers itself are grammatical and well-formed. It is the match between a questions and an answer that speakers have to evaluate. This level of abstractness, I believe, might be the source of controversy, since multiple factors could affect judgments. Speakers may find PLAs acceptable or not due to various reasons. Ultimately, I would like to find out whether speakers reject PLAs to object-quantifier questions for structural reasons, or because those readings are not very likely to arise, since appropriate contexts are difficult to construct. Since providing judgments on the acceptability of PLAs appears to be a complex task, testing professional linguists might offer additional insights, as they have extensive experience in producing metalinguistic judgments.

2.1.1 Experts' *vs.* novices' judgments in decision making literature

I begin the discussion of novice *vs.* expert judgments by looking at the problem in a broader perspective: from the point of view of cognitive science. Metalinguistic judgments can be viewed as a subtype of acceptability and evaluation judgments used in other areas of cognitive science. Thus, looking at what factors affect judgment tasks in other domains, might be revealing of some of the mechanisms at play in psycholinguistics judgments. Specifically, I am interested in the effect of expertise -

whether naïve and professional subjects evaluate linguistic stimuli differently. In the area of decision making, one of the fields allowing the study of expertise in judgments is folkbiology – ideas and concepts non-professionals have about the surrounding world. Booster & Johnson (1989) compared experts and novices in a classification task, where participants had to categorize fish. They uncovered that while novices rely on morphological features of fish, experts also take into account functional and utilitarian properties of fish. The authors argue that expertise brings deeper understanding of classification that goes beyond observable traits. Medin et al. (2002) studies different populations of subjects in the classification of fish. He maintains that experts may develop task-specific categorization schemes, as well as use goal-related knowledge. In other words, they adapt the categorization strategy depending on the task. In another task on tree classification, Medin and colleagues show that landscapers and taxonomists categorize trees differently, showing an effect of different goals they normally have in tree categorization (Medin et al., 1997).

Decision making research also reveals that expertise in a certain domain allows people to overcome some of their biases and contributes to making judgments more objective (Smith & Kauda, 1991; Bornstein, Emler, & Chapman, 1999; among others). Experts also display more confidence in their decisions (Mahajan, 1992; Spence & Brooks, 1997). Giardini et al. (2008) propose that confidence in a decision may be influenced by what they call a desirability bias – expecting a positive outcome, and being confident in such an outcome. It is not clear, however, which outcomes are considered ‘positive’ in categorization tasks. Spence & Brooks (1997) argue that experts perform better than novices when the problem is ill-formulated. In those circumstances, experts produce more accurate and consistent judgments. The effect of expertise decreases as the problems' internal structure is improved. In other words, experts seem to understand the task better and outperform novices in categorization problems.

2.1.2 Experts vs. naïve speakers in linguistic research

There are significant differences in how humans reason about plants and animals, and it might entail that results obtained from one group of participants may not be generalizable to other groups (Medin et. al, 2002). A parallel can be drawn here between reasoning about biological kinds and producing metalinguistic judgments: if judgments from groups of speakers differ, building theoretical accounts that are based only on a particular population of speakers might result in analysis only applicable to a narrow group of speakers. Some authors argue that judgments should be obtained from naïve speakers (Spencer, 1973, Gordon & Hendrick, 1997, Gibson & Fedorenko, 2010). Others maintain that professional linguists are a more reliable source of linguistic data (Newmeyer, 1983, Devitt, 2006a, 2006b).

When judgments reported in the literature are different from those of naïve speakers, some researchers conclude that the judgments of naïve participants should be used (Gibson & Fedorenko 2010, 2013). Gibson & Fedorenko (2013) looked at a number of case studies, one of which involves structures with superiority violations. Superiority violations correspond to an effect when in multiple *wh*-questions the fronted element is lower in the hierarchy than the element left in-situ. As discussed in the Introduction, subjects are higher in the structural hierarchy than objects (Keenan & Comrie, 1977). According to the Superiority condition (Chomky, 1973), if a *wh*-question has a *wh*-subject and *wh*-object, the *wh*-subject phrase must be fronted. The object phrase must be left in its original position, as in (59). Violation of this condition results in ungrammaticality, as in (60).

(59) Peter knows who bought what.

(60) *Peter knows what did who buy.

(61) Peter knows what who bought where.

Gibson & Fedorenko mention that according to Bolinger (1978) and Kayne (19833), the addition of another *wh*-phrase, such as *where* in (61), makes the question more acceptable. Gibson & Fedorenko tested this claim with embedded questions. They showed that naïve speakers found no differences between sentences, such as (60) and (61), contra claims in the theoretical literature. The authors conclude that to avoid possible effect of bias on acceptability judgments, data from naïve speakers collected in experimental conditions should be used.

The conclusions of Gibson & Fedorenko (2010, 2013) were challenged in a number of papers (Culicover & Jackendoff, 2010; Sprouse & Almeida, 2010). Sprouse & Almeida question the logic of their conclusions. If differences between judgments reported in the literature and data from naïve speakers are found, it is still unclear which judgments are more accurate. Moreover, we cannot be certain whether differences observed between naïve speakers and professional linguists are due to the fact that the former are typically tested in experimental settings while the latter produce informal judgments, or whether such effects result from genuine differences between the two groups. In Experiment 3, I compare different groups of speakers in a formal experimental task. This paradigm ensures that naïve participants and professional linguists see exactly the same experimental items, which makes the task of comparing the groups more controlled.

Newmeyer (1983) represents a position at the other end of the spectrum claiming that the judgments of professional linguists should be preferred over judgments from naïve speakers. Linguists can abstract away from individual lexical items, the plausibility of scenarios they are assessing, the length and complexity of sentences, etc. - all these confounds can interfere with acceptability judgments in naïve speakers. In other words, linguists understand better what the task is. With naïve participants, it is extremely hard to ensure that every one of them understood the task the way it was intended to be, therefore the results of formal experiments with naïve subjects are hard to interpret.

Culbertson & Gross (2009) investigate the role of expertise on judgments looking at how consistent speakers of each group are. They ask this question in a new perspective: if linguists are indeed a better source of acceptability judgments, why is it so? Devitt (2006b) argues that linguists are more familiar with syntactic theory, and that knowledge in turn gives them a better idea of what language contrasts are relevant. Culberston & Gross suggest instead that it is not knowledge of linguistic theory that makes a difference in judgments, but minimal task specific knowledge. In other words, the divide lies between speakers who never performed linguistic judgment tasks and those who have had at least some experience participating in such tasks. Culbertson & Gross raise the question of whether linguists' judgments are reliable, defining reliability as consistency in responses in different circumstances, regardless of accuracy. They tested professional linguists with substantial experience in syntax, students with at least 1 course worth of experience in generative syntax, and a group of naïve subjects with no experience in cognitive science. A comparison of students who had experience in generative syntax and another group who only had experience in other domains of cognitive science was intended to reveal whether the amount of task-specific knowledge affects the quality of judgments. Subjects evaluated sentences from a syntax textbook (Haegman & Guéron, 1999); the sentences were taken to represent grammatical, ungrammatical and questionable sentences. The analysis showed that speakers with no experience in cognitive science were less correlated with one another, while in groups with some experience in syntax the correlation was higher. In other words, speakers who had some task-specific knowledge were more consistent (showed less variability) in their responses as a group, and in Culbertson and Gross's terms – were more reliable.

The authors acknowledge the fact that consistency does not necessarily imply reliability in terms of an actual reflection of true syntactic processes. However, they suggest, it is implausible that a group of naïve speakers for some reason has more accurate judgments than speakers with some level of expertise. Interestingly, the amount of experience in cognitive science did not affect the consistency of judgments in any substantial way: students with one course in generative syntax were just as consistent as professional syntacticians with a Ph.D. Culbertson & Gross conclude that the uniformity of judgments is achieved through minimal task specific knowledge, and not knowledge of linguistic theory.

Both the decision making literature and studies of linguistic judgments show that expertise brings a better and sometimes qualitatively different understanding of the task itself. Some studies (Culberston & Gross, 2009) also suggest that task-specific knowledge insures consistency in the responses. Since professional subjects may show more consistency in their responses, testing professional linguists may be a way to filter some of the variability observed among naïve participants. Data from professional subjects will, therefore, address a potentially surprising result of Experiment 1, namely that PLAs to questions with object quantifiers appear to be acceptable. The goals of Experiment 3 is to find out whether the variability observed in PLA ratings is an effect stemming from testing naïve participants, or, rather, an effect arising from PLAs being indeed acceptable.

2.1.3 Effect of expertise in a *wh-*/quantifier task. Experiment 3

Experiment 3 is aimed at testing different populations of speakers with the following questions in mind:

1) Can we confirm the subject-object asymmetry with professional linguists as well as naïve speakers?
2) Naïve speakers display a large degree of variability in judgments. Does variability also apply to professionals?
3) Are experts more sensitive to subtle linguistic contrasts, such as the type of the *wh*-phrase?

2.1.3.1 Method.

Design. I used the experimental stimuli described in Table 2 and obtained data from new groups of speakers that differ in expertise. Recall that Experiment 1 was designed to manipulate answer type, the grammatical position of the quantifier, the presuppositional status of the *wh*-term (lexically vs. discourse presuppositional *wh*-phrases, as well as possibly plural vs. singular wh-phrases) – as within subject variables.

Participants belonged to 3 different groups depending on their level of linguistic training: undergraduate students, Ph.D. candidates in linguistics, and professional linguists with a Ph.D. Crossing the factors resulted in a 2x2x2x3 design: 2 (quantifier position: subject vs. object) x 2 (answer type: single vs. pair-list) x 2 (wh-type: *who* vs. *which*) x 3 (groups: undergraduate students, Ph.D. students in linguistics, and professional linguists)

Participants. The undergraduate group contained 33 Psychology students who received course credit for participation (dataset from Experiment 1). A group of 49 Ph.D. candidates in Linguistics also participated, as well as 42 professional linguists holding a Ph.D. Both professional linguists and doctoral students in Linguistics were recruited through the Linguist List. Among linguists, 28 listed English as one of their native languages, 13 were non-native speakers, 1 did not report their native language. Ph.D. candidates included 32 native speakers and 17 non-native speakers. Non-native speaker were excluded from further analysis. All undergraduate participants were native speakers of English. Professional linguists were also asked whether they were familiar with the literature on *wh*-/quantifier interaction and PLAs. They could indicate that they were not familiar with it (n=7), teach/have taught it in their courses or knew some literature (n=19) or did research on the topic (n=2). The analysis showed that the level of familiarity with the topic did not affect the ratings to target items in the experiment ($p = 0.224$). Participants were not required to specify their area of expertise.

2.1.3.2 Results and analysis

Analysis was performed using a cumulative link mixed model with subjects and items as random intercepts. The overall analysis, looking at all the groups together, revealed a significant effect of answer type ($p < 0.01$) with single answers scoring higher than PLA, and an effect of grammatical position of a quantifier ($p < 0.01$) as answers to questions with subject quantifiers received higher ratings compared to object quantifier questions. The main effect of *wh*-type was not significant ($p = 0.391$); an important point to which I return. For questions with object quantifiers (2), PLAs were significantly less acceptable than for those with subject quantifiers (1), which resulted in a significant interaction of answer type and quantifier position ($p < 0.01$).

The analysis confirmed that object-quantifier PLAs were less acceptable than subject-quantifier PLAs for all three groups of speakers (Figure 6): undergraduate students with no substantial linguistic training, Ph.D. candidates in Linguistics and professional linguists with a Ph.D. ($p < 0.01$). For PLAs to object quantifier questions, naïve speakers (undergraduates) were neither different from Ph.D. students ($p = 0.117$), nor from professional linguists ($p = 0.483$). The effects remained insignificant even after insignificant interactions were removed from the model.

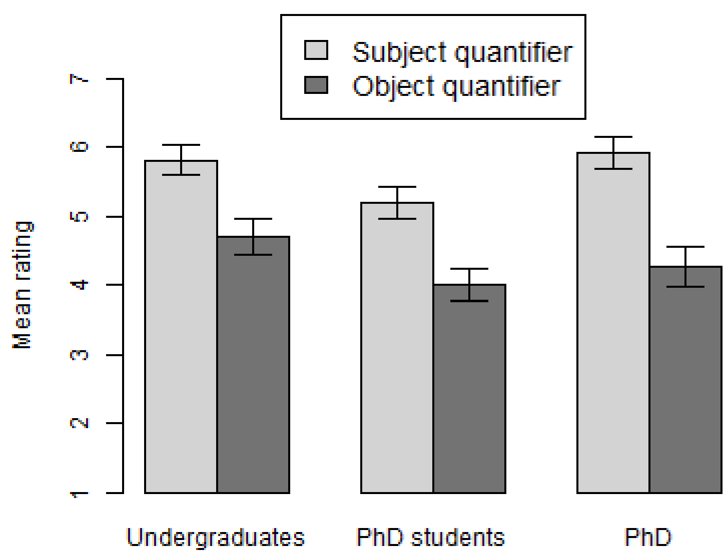

Figure 6. PLA ratings for different groups of speakers

To study the effect of manipulating the *wh*-term I now focus on object-quantifier questions only, because this is the area where the type of *wh*-phrase is predicted to affect whether PLAs are acceptable. The difference between the ratings for PLA to *who* and *which* questions was not significant either for professional linguists (p = 0.143), or Ph.D. students in linguistics (p = 0.142) or undergraduates (p = 0.403) (Figure 7).

Questions with object quantifiers

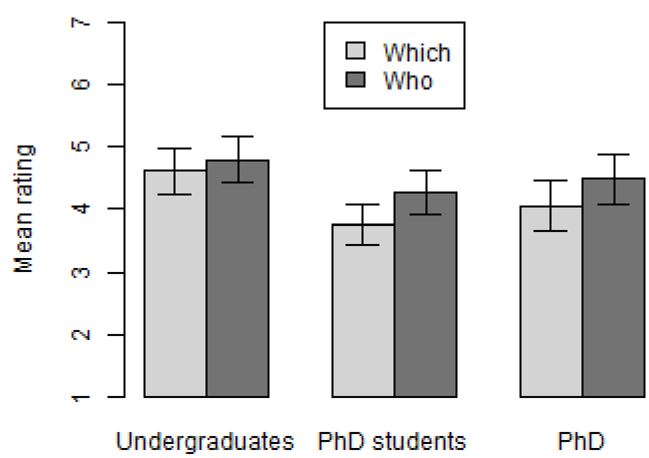

Figure 7. Effect of *wh*-type on ratings for PLAs

2.1.3.3 Discussion.

I now turn to the analysis of frequency distributions. Figure 8 illustrates the distribution of ratings assigned by speakers to PLAs. Recall that PLAs are predicted to be unavailable for object-quantifier questions, and we expect to see the data clustering on the left. To build the histograms in Figure 9, I first calculated an average PLA rating to object-quantifier questions for each participant. Speakers who reject PLAs would show a low overall rating (left part of the scale), while speakers with a high overall acceptance of object-quantifier PLAs show high ratings (right part of the scale).

Questions with object quantifiers

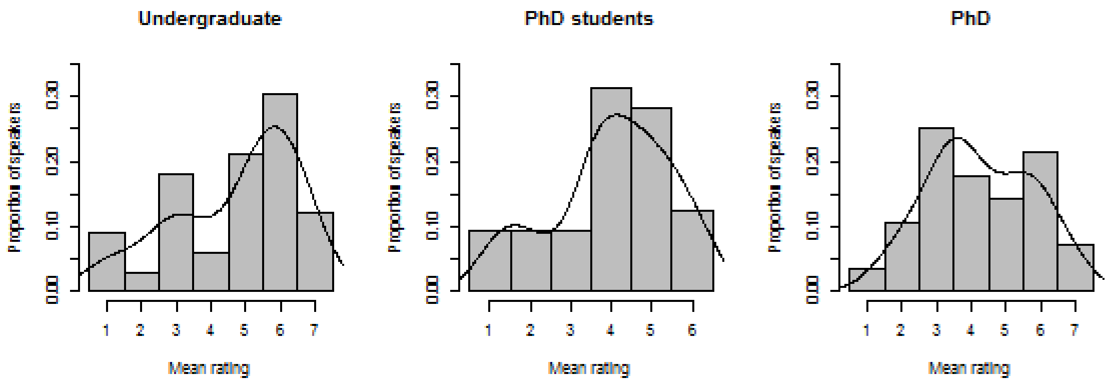

Figure 8. Distribution of PLA ratings for different groups of speakers

The mode of the distributions shifts towards the judgments reported in the literature as expertise of the group increases (Figure 8): among professional linguists the number of subjects who find object-quantifier PLAs acceptable is smaller. Naïve speakers may have treated *every* as being more distributive, similar to *each*. Strong distributivity enables the quantifier to take scope over the *wh*-phrase and give rise to a PLA (Beghelli, 1997). I discuss this account in greater detail, and test the predictions in Chapters III and IV. Linguists may be more aware of the contrast between the quantifiers *every* and *each* even when the contrast is not explicitly present in the experiment.

To preview, the presence of an explicit contrast between *every* and *each* within one experiment, makes naïve speakers rate PLAs to questions with object quantifiers lower than they did in the absence of the explicit contrast between quantifiers. This contrast resulted in a shift of the mode of ratings in Figure 9.

Object-quantifier questions

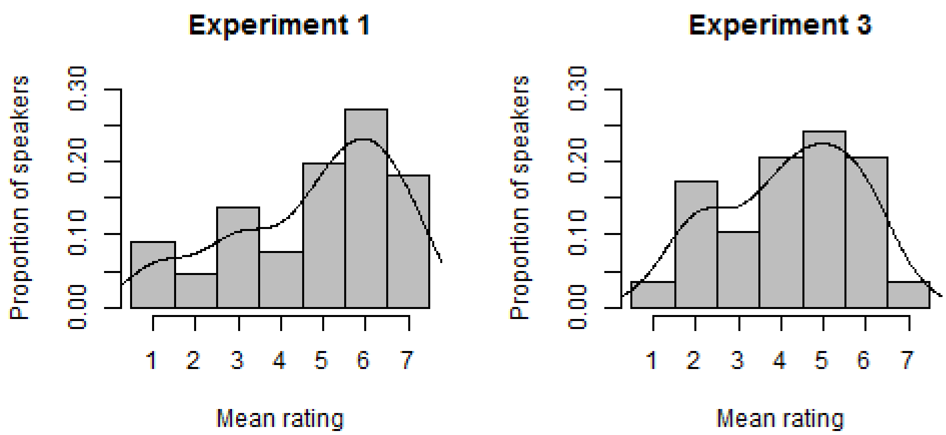

Figure 9. PLAs to questions with object quantifiers (naive speakers)

Pair-wise comparisons of professional linguists, Linguistics students and naïve speakers did not reveal a statistically significant effect of expertise on the ratings. Thus, the experimental results indicate that speakers of all three groups essentially patterned alike: they show the subject-object asymmetry. Importantly, variability in judgments is present for all three groups of speakers for the controversial object-quantifier questions, (2), but not for subject-quantifier questions (1). I showed earlier that the literature sometimes reports seemingly contradictory judgments as to whether PLAs are acceptable for certain types of questions. What is especially interesting, judgments obtained in experimental settings show variability as well. This observation gives us a new perspective of why PLAs for object-quantifier questions have received contradictory acceptability judgments in the literature: professional linguists differ in their acceptance of PLAs as much as naïve speakers do.

The absence of statistical differences between the groups provides ground for using the data from naïve speakers as a reliable source of acceptability judgments. This result is advantageous because naïve subjects are often easier to access as a population, and necessary experiments can be performed with large numbers of speakers. On the other hand, the findings also suggest that professional linguists as a group do not show effects of bias towards any particular judgments.

Despite the absence of statistical differences driven by expertise, there are some qualitative differences between the groups. Acceptability judgments in current experiments tend to get closer to those reported in the literature (rating a PLA to an object-quantifier question lower), as expertise increases. One possibility why linguists provide judgments that appear to be more consistent is that linguists learn to abstract away from such confounding variables as sentence length, complexity, and vocabulary frequency. As a result, they can detect subtle contrasts, such as a contrast between subject- and object-quantifier questions. An intriguing question is whether age – as opposed to level of expertise – might be driving the gradual shift observed towards the kinds of judgments reported in the literature. Indeed, as a group, our undergraduates are younger than our Ph.D. students, who are themselves younger than the linguists we tested. Moreover, there is independent evidence that age may affect metalinguistic judgments (Shademan, 2007).

2.2 Defining experimental task. Experiment 4

In Experiment 4, I make an attempt to trace whether high acceptability of PLAs to questions with object quantifiers observed among naïve speakers is a task effect. I present a different type of instructions in this experiment, aimed at specifying the task more precisely by demonstrating cases of structural ambiguity. In the Experiment 4, controls/fillers provided a better match to the critical items in types of violations. Questions with downward entailing quantifiers (see footnote 5), such as *nobody*, *most*, and *few* served as negative controls. An example in (62) shows a case where a PLA is not acceptable (confirmed in a pre-experimental pilot task).

(62) Who did nobody see?

Mary didn't see John, Sue didn't see Nick, and Helen didn't see Mike.

Multiple *wh*-questions, such as (63), provided examples of acceptable answers and were expected to receive high acceptance rates.

(63) Who bought what?

Lisa bought cheese, Sue bought milk, and Jason bought butter

2.2.1. Method.

Design. In this experiment, I concentrate on the case of *which* and *every* as it is the case where all the theoretical accounts, reviewed in Chapter I, predict a PLA not to be available. The current experiment uses a forced choice paradigm, where speakers are required to answer ‘yes’ or ‘no’ when they are asked whether a PLA is possible. The only factor manipulated in this experiment is the structural position of the quantifier. The critical items included 20 subject- and 20 object-quantifier questions. A set of controls (20 multiple *wh*-questions, 20 questions with downward entailing quantifiers) was designed to ensure participants understood the task.

Procedure. The experiment started with a set of instructions illustrating with examples that certain questions are ambiguous and may have multiple answers, while other questions only have one type of answer. The participants were then instructed to respond not on their preferences for a particular answer type, but on whether a certain answer is possible in principle. On each trial, a participant saw the following setup:

(64) Which driver took everybody home last night?

Tom took Ms. Franko, Bob took Ms. Dombovski, and Jack took Mr. Perkins.

Is that a possible answer? *YES* *NO*

Participants used the keyboard to enter responses, where the ‘y’ key corresponded to a ‘yes’ and a ‘n’ key corresponded to a ‘no’.

Participants. A total of 67 speakers participated in the experiment, all undergraduate students majoring in either Psychology or Linguistics. They received extra credit for participation. Among those, 4 participants were non-native speakers of English and their data were not used in the analysis. Another set of 9 speakers were excluded from the analysis because they erroneously pressed keys other than ‘y’ and ‘n’. Data from 55 speakers were entered into analysis.

2.2.2 Results and analysis. I begin presenting the results with the performance on the control items. Recall, that controls were designed in this task not only to ensure that participants behaved as expected, but also to calibrate their responses. As demonstrated in Figure 10, speakers behaved on the control conditions as predicted: they correctly accepted PLAs to multiple *wh*-questions, and rejected PLAs to questions with downward entailing quantifiers which are expected to lack a PLA.

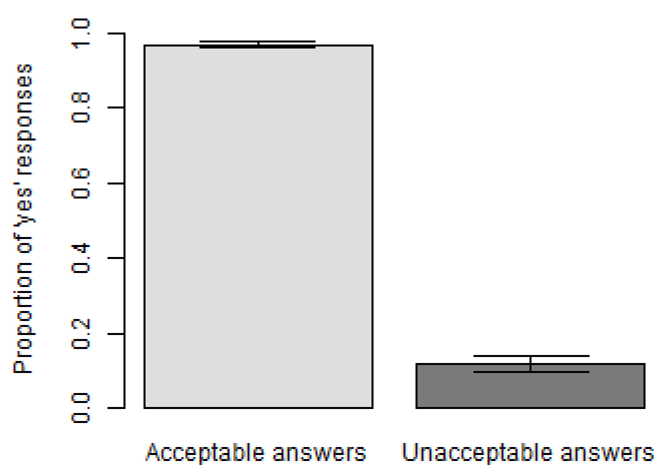

Figure 10. Experiment 4, mean rating for control conditions

I now turn to the analysis of critical items. If the use of new instructions and control items makes naïve speakers more aware of the task, we expect to see fewer acceptances of PLAs to questions with object quantifiers. The results reveal that indeed subjects rejected PLAs to questions with object quantifiers (Figure 11, left panel) more than they did in Experiment 1. The acceptance rate for object-quantifier PLAs (mean = 9%) is no different from that of unacceptable answers in the control condition (mean = 11%), p =

0.323. At the same time, participants found PLAs to questions with subject-quantifiers less than expected, their acceptance of PLAs (mean = 46%) is lower than acceptance of “acceptable” controls (mean = 97%), $p < 0.01$).

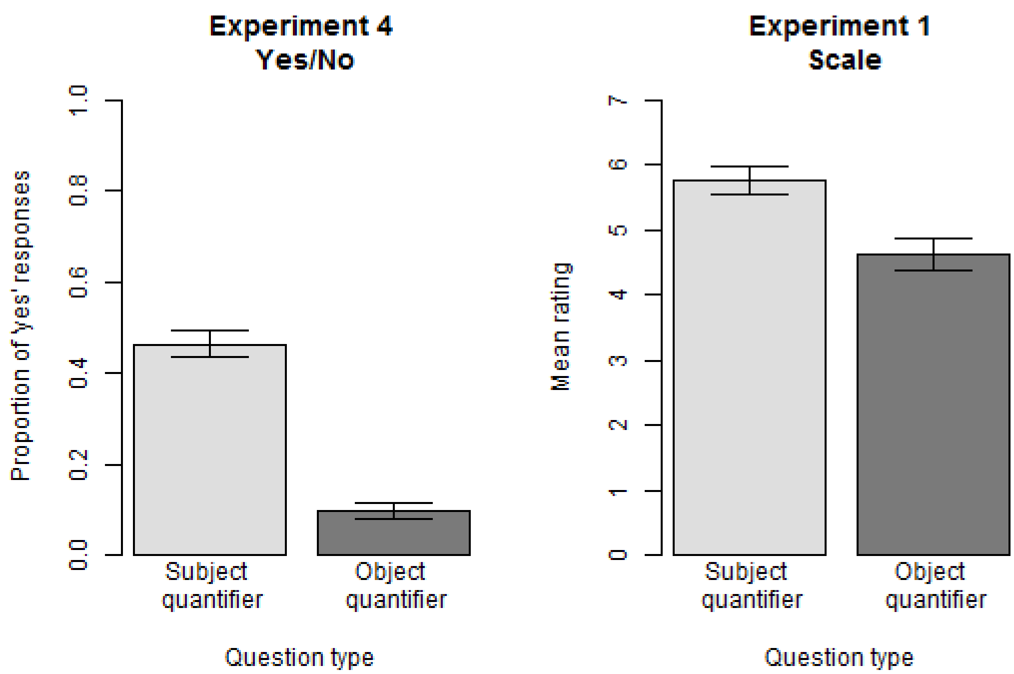

Figure 11. Experiment 4, mean acceptance rates for PLAs

The next pair of graphs allows comparing distributions of responses in Experiment 4 and Experiment 1. According to the theoretical predictions, participants should show high acceptance of PLA in question with subject quantifiers and rejection of PLA in questions with object-quantifiers. Consequently, in Figure 12 we expect data points to cluster in the upper left part of both graphs. In Experiment 1, a significant group of speakers (26%) show equivalently high acceptance of PLAs in both for question with both subject and object quantifiers. We hence expect that at least 26% of speakers fall on this line (Figure 12, right panel).

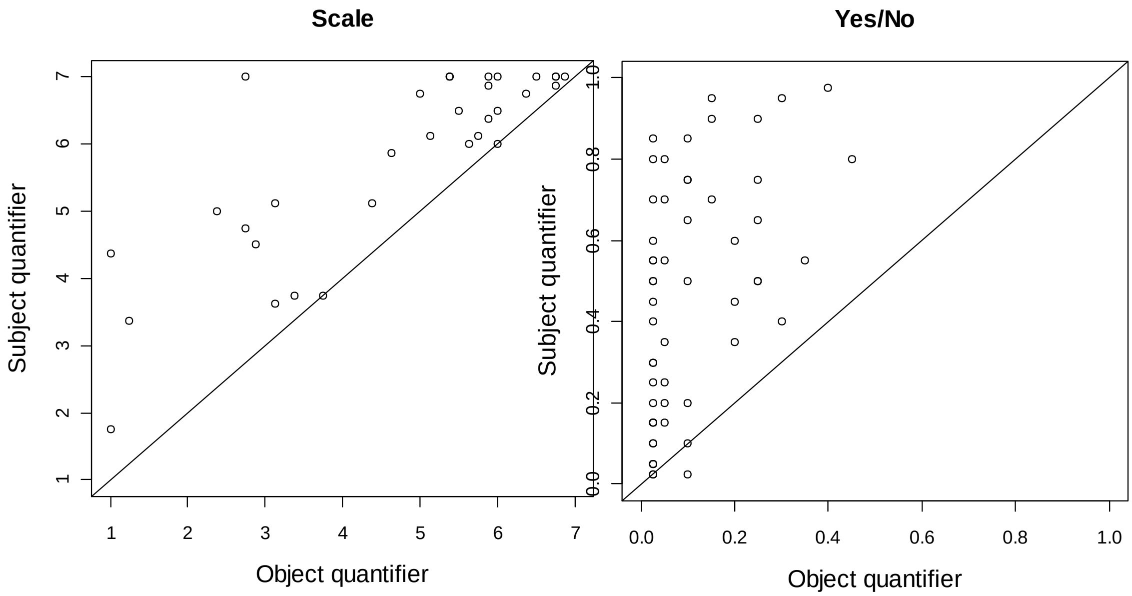

Figure 12. Comparison of average rating for scale *vs*. Yes/No experiment

However, the results do not support this prediction. For the Experiment 4 (yes/no), participants became a lot more conservative overall and rejected PLAs even to subject-quantifier questions. At the same time, even if there acceptance of subject-quantifier PLAs was not very high, it was still above the acceptance for object quantifier PL, and showed the subject-object asymmetry ($p < 0.01$).

The analysis of individual questions revealed no strong item effects (Figure 12). All PLAs to object quantifier questions received low acceptance rates that do not go higher than 20%.

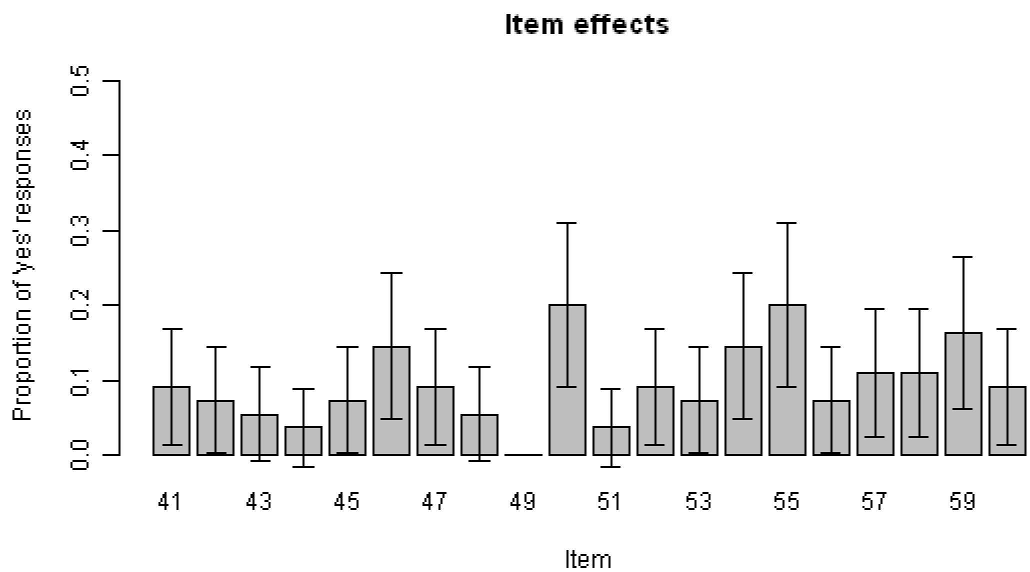

Figure 12. Items-effects

2.2.3 Discussion

The aim of Experiment 4 was to determine whether an elevated acceptability of PLAs to questions with object quantifiers was at least partially due to task effects. I show that in Experiment 4, which gives a more precise definition of the task for naïve participants, subjects become more conservative in their judgments and reject PLAs to questions with object quantifiers. However, this conservatism also extends to PLAs for questions with subject quantifiers – an area where PLAs are predicted to be possible. One thing that remains constant between the two experiments – there is a difference in acceptance rates of PLAs depending on the structural position of the quantifier. In fact, in Experiment 4, this difference is more pronounced. Potentially, a number of factors could have contributed to the effect when the asymmetry sharpens. One obvious dimension on which the experiments differed was the type of measurement (scale vs. yes/no judgment).

As some studies indicate, results obtained using a scale and a yes/no version of their experiment are highly compatible (Suarez (2011), Musolino (in prep.), Kawahara (2011) among others). Increasing the number of items should not have had an effect on the judgments either and can only show a cleaner picture of the responses. There are several factors that are likely responsible for the judgments becoming more conservative in the yes/no task.

First, this task contained a different set of controls/fillers. Participants might have become more sensitive to the task, and their evaluation scale got adjusted. In the original experiments, controls could have created an unexpected effect of making subjects rate PLAs as acceptable. Unacceptable controls in the original experiment, like in (65) contained such strong violations that they pushed up judgments for answers that were more acceptable, and certainly pairs of object-quantifier questions and PLAs sound better than (65), creating a false effect of pair-lists being acceptable.

(65) What is your name?
I'm not into Math.

Experiment 4 showed that more naïve speakers now show the subject-object asymmetry. Edelman & Christiansen (2003) argue that metalinguistic judgments may pose challenges for speakers, since in those tasks, language itself, rather than the contents, is being evaluated. In order to ensure understanding of the task, the yes/no experiment contained a training session, which demonstrated cases of structural ambiguity. As a result, subjects may have had a clearer idea of what was expected from them in the experiment: accept an answer when it was a possible answer to a particular question, and reject an answer when the match between the question and the answer was not acceptable. Knowing that not all structures are ambiguous, they rejected PLAs when such answers were, in their view, unavailable.

2.2.3 Signal detection analysis

I would like to take a step back now and summarize the empirical findings reported in the previous chapters. The data revealed that in Experiment 1 while most speakers reject PLAs to object-quantifier questions as expected, there is a number of puzzling facts. First, the ratings vary both between and within speakers. Second, some speakers assign high ratings to object-quantifier PLAs, which seemingly goes against the predictions of the structural accounts of the subject-object asymmetry. An interesting question arises: if speakers give high ratings to PLAs for questions with object-quantifiers, are they still sensitive to the subject-object asymmetry? In order to answer this question, I perform an analysis of sensitivity using the signal detection methodology.

2.2.3.1 Signal detection method. Signal detection (Macmillan & Creelman, 2005) is widely used in psychophysics to address the questions of whether subjects can detect stimuli under noisy conditions. In signal detection tasks, a participant sees stimuli which either contain or do not contain the target. Under this paradigm the following concepts are considered:

<u>Hit</u> – detecting a target when the target is present.

<u>Miss</u> – not detecting a target when present.

<u>False alarm</u> – detecting a target when there is no target.

Correct rejection – not detecting the target when it is absent.

Psycholinguistic experiments often involve answering the question of whether participants can detect a certain target, or detect a difference between two types of stimuli. Participants are then presented with a stimulus with or without the target, and the task is to answer 'yes' or 'no' to the question whether the target is present. Data from 'yes'/ 'no' experiments can be analyzed in terms of percent of correct responses, in other words, percent of the time when the subject detected the target. However, this methodology has a number of shortcomings. In a situation where there are two types of stimuli, one containing the target and the other missing the target, a participant may choose a strategy of saying 'yes' to any type of stimuli independent of whether the target was actually present. As a result, the participant will have a high percent of correct responses and consequently a high hit rate because they will detect a target every time it is present. At the same time, false alarm rate will be also high as a participant will say 'yes' even when there is no target. If both hit rate and false alarm rates are high, the person in fact cannot detect the stimulus under noisy conditions in spite of high percent correct.

Signal detection analysis provides two measures: a measure of sensitivity (d-prime) and a measure of bias (c). Bias does not deal with the actual information available to the person but with the decision criterion a person has: at which point and why a person makes a certain decision (Macmillan & Creelman, 2005). The criterion may change depending on the consequences of saying 'yes' or 'no'. If the penalty for missing a target is high, an observer may prefer to say 'yes' in the situation of uncertainty. On the other hand, false alarms, saying 'yes' when there is not target, may be highly undesirable as well. For example, a radiologist may be uncertain whether a certain image on a scan qualifies as a tumor. Qualifying the image as containing a tumor has serious consequences for the patient, and the cancer specialist may prefer to get more definitive results before announcing the diagnosis. On the other hand, missing a tumor carries risks for the life of a patient as well. In this situation, doctors may show different biases in the amount of evidence they require, in order to announce a diagnosis. Depending on their experience, training and personal characteristics, the doctors will differ in respect to the criterion – a point at which they decide the problem requires medical attention.

Higher values of d-prime correspond to greater sensitivity, meaning that a person can detect a target well, a d-prime of 0 means that a person is equally likely to say 'yes' independent of whether the target is present. Positive values of the criterion suggest that people tend to say 'no' under uncertainty, while negative values of c show the bias towards saying yes. Signal detection analysis allows separating sensitivity to the target from a bias of saying 'yes' or 'no' under uncertainty as it takes into accounts both hit rate and false alarm rate.

2.2.3.2 Signal detection in PLAs. In the case of PLAs, signal detection allows us to see whether speakers discriminate between two types of questions: subject-quantifier questions and object-quantifier questions. While in psychophysics the existence of a target is objective, in the case of PLAs we have to rely on theoretical predictions to determine hits and false alarms. Structural (May 1985), semantic (Chierhcia, 1993; Behgelli; 1997; Szabolsci, 1997), and discourse (Agüero-Bautista, 2001) approaches predict PLAs to be possible for subject-quantifier questions but not for object-quantifier questions. I therefore treat a PLA as a target, which would translate into the following table:

Table 6. Is a PLA available?

	Subject quantifier question	Object quantifier question
YES	Hit	False alarm
NO	Miss	Correct rejection

In this analysis, hit rates and false alarm rates were computed for each speaker. According to the theoretical predictions, accepting a PLA to a subject quantifier question translates into a hit, and accepting a PLA to an object quantifier question qualifies as a false alarm. If the theoretical predictions are correct, we expect speakers to have high sensitivity, in other words they should accept PLAs to subject-quantifier questions and reject those answers for object-quantifier questions. The described pattern is confirmed by the following distribution of d-primes, with higher d-primes corresponding to better ability to discriminate between the two types of questions. D-prime values from 55 subjects are distributed around the mean d-prime of 1.34, which is significantly different form 0 ($t = 12.59$, $p < 0.01$).

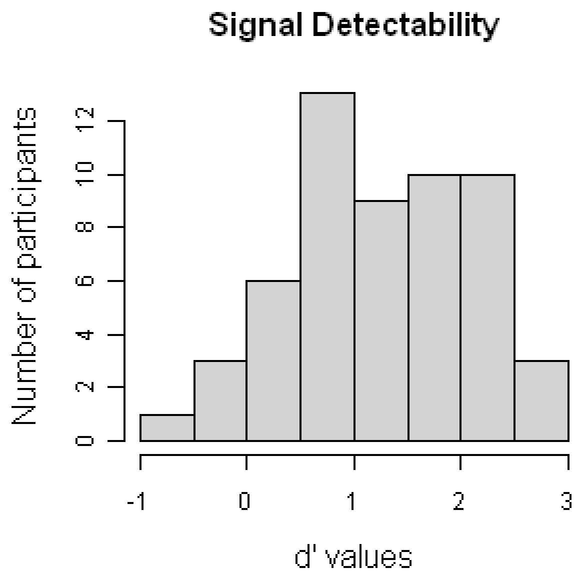

Figure 14. Distribution of d-prime values

To assess whether individual values of d-prime are different from 0, I performed a jackknife simulation (Tukey, 1958). Jackknife is a form of resampling that allows estimating the variation of a given measure. In the course of the simulation, one value from each sample is removed and the statistic is computed, then the item is returned to the sample. The procedure is repeated until all items have been removed; as a result we obtain a sample of statistics, in our case it is a series of d-prime values for each subject. Jackknife allows constructing confidence intervals around the observed d-prime value and performing significance testing. In the case of d-prime values, such analysis reveals whether any given individual d-prime is significantly different from 0, a d-prime of 0 means that a speaker does not discriminate between subject- and object-quantifier questions in their ability to result in pair-list answers. Such a claim would contradict the theoretical predictions. Only 3 d-primes were not significantly different from 0, all other participants (n = 52) showed the ability to discriminate between subject- and object-quantifier questions and their acceptance of a PLA ($p < 0.01$)[9]. The analysis of bias shows that many speakers exhibited a ‘no’ bias, in other words when uncertain about the response they tended to say ‘no’.

2.3 General discussion

Previous experiments confirmed that PLAs for object-quantifier questions overall received lower ratings than PLAs for subject-quantifier questions. At the same time, the analysis uncovered at least 26% of participants who accepted PLAs to both types of questions in Experiment 1. In this chapter I made an attempt to test the reliability of this result by 1) testing professional linguists as a population of speakers who are experts in an acceptability judgment task; and 2) modifying experimental instructions for naïve speakers. Among the professional linguists the proportion of speakers not showing the asymmetry was smaller but some professionals found PLAs to object-quantifier questions acceptable. In Experiment 4 (yes/no), specifying the task more precisely probably made participants more sensitive to the contrast between questions with subject and object quantifiers. 94% of naïve speakers showed sensitivity to the contrast between subject- and object-quantifier questions, reinforcing the subject-object asymmetry. Yet, even in this experiment a third of participants produced acceptance rates in the range of 20 - 40%,

[9] The jackknife simulation confirms that only 3 speakers out of 55 did not discriminate between subject- and object-quantifier questions. Statistically, this result may be driven by the fact that removing a single observation from a sample of 20 responses cannot significantly change the mean acceptance rate and consequently the d-prime. Therefore only those speakers who have a d-prime of exactly 0 show inability to discriminate between the two types of questions. Everybody else, even the d-primes that are very low and close to 0 turn out to be statistically different from 0, and therefore technically able to discriminate between the cases when PLAs are available and when they are not. At the same time, statistical significance does not straightforwardly translate into linguistic significance. In other words, even if technically a speaker has a d-prime of 0.2 that is statistically different from 0, it does not necessarily entail that the speaker indeed sees the difference in the availability of PLAs between subject- and object-quantifier questions.

which suggests that they find PLAs to object-quantifier questions acceptable at least in some circumstances. In sum, despite the fact that in Experiment 3 participants were professional linguists, and in Experiment 4 the experimental instructions were more precise, we still observe some speakers finding PLAs to questions with object quantifiers acceptable. This observation goes against theoretical predictions and asks for an explanation under what circumstances speakers find such PLAs acceptable.

A signal detection analysis offers a way to rethink the concept of the subject-object asymmetry as sensitivity to the structural position of the quantifier. As such, this view allows thinking of PLAs acceptability as being graded. If PLAs to object-quantifier questions are unacceptable (due to a violation of QR constraints, or WCO constraints), the subject-object asymmetry can be defined as the presence of a pair-list reading for subject-quantifier questions, and a lack of such reading for object-quantifier questions. However, the data are more varied than assumed under such a categorical account of the asymmetry. The analysis of the subject-object asymmetry as sensitivity to the position of the quantifier might be different from theoretical models of the asymmetry proposed in the literature. If we redefine the subject-object asymmetry as *sensitivity* to the position of the quantifier, the interpretation of the results changes. Speakers may still find PLAs to object-quantifier questions acceptable, but less so than PLAs to subject-quantifier questions. This interpretation is incompatible with May's (1985) view of the subject-object asymmetry, as it acknowledges that PLAs to object-quantifier questions might be possible, at least in some circumstances. We are no longer dealing with a categorical distinction of answers being acceptable or unacceptable. The task of accounting for the subject-object asymmetry now shifts to looking for factors that facilitate/restrict the access to a PLA.

Within the gradient grammar view, we can speak about relative acceptability of different PLAs, and we need a way to establish a difference in acceptability rates between different types of answers. Signal detection analysis provides a quantifiable measure of the asymmetry. Earlier, it was difficult to judge what difference in scores for subject- and object-quantifier PLA ratings should be considered sufficient to establish a subject-object asymmetry in a certain speaker. Statistically, comparing the ratings within each speaker was not very meaningful. Signal detection relies on a simulation that increases the number of trials, and makes it possible to compare subject- and object-quantifier PLA ratings for each speaker, revealing that the overall majority of participants are sensitive to the structural position of the quantifier (Figure 14).

2.4 Summary

This chapter was designed to address the role of experimental methodology in the judgments speakers produce evaluating PLAs. First, I examined whether judgments differ depending on level of expertise in Linguistics. The analysis shows no statistical differences between naïve subjects and professional linguists. Moreover, variability in judgments was present in both groups of speakers. I conclude, that high acceptance rates of PLAs to object-quantifier questions discussed in Chapter I is not simply a consequence of naïve speakers not being sensitive enough to the position of the quantifier. Instead, professionals also find that PLAs are at least sometimes available for object-quantifier questions. This conclusion challenges the categorical view of the subject-object asymmetry. A gradient grammar view, on the other hand, allows accounting for two facts simultaneously: a difference in acceptability of PLAs depending on the structural position of the quantifier, and a relatively high acceptability of object-quantifier PLAs in some speakers.

On a methodological note, two modifications of the task were implemented in Experiment 4: instructions that demonstrated cases of structural ambiguity and a set of controls that were closer in types of violations to the stimuli. In a modified yes/no task (Experiment 4), naïve subjects became more conservative and rejected PLAs to object-quantifier questions more than they did before in Experiment 1. Using relevant controls presumably ensured better understanding of the task, and allowed naïve participants to sharpen their judgments. As a result, acceptability patterns of PLAs became similar to those professional linguists demonstrated in Experiment 3. I conclude that both groups of speakers can serve as subjects in psycholinguistic experiments. However, naïve speakers require a more precise definition of the experimental task.

CHAPTER III

QUANTIFIER SEMANTICS AND ITS EFFECT ON PLAs

In this chapter, I explore the contribution of quantifier semantics and pragmatics on the availability of PLAs. Structural analyses discussed in Chapter I (May1985, 1988, Chierchia, 1993) view the subject-object asymmetry as a syntactic phenomenon, and imply a unified treatment of *wh*-phrases and quantifiers. However, such an approach predicts that the subject-object asymmetry should generalize to all quantifiers that allow PLA, including *all* and *each*. That is given a structural view of the asymmetry, we expect to PLA to be licensed with subject-quantifier questions, such as (66) and lacking for object-quantifier questions (67).

(66) Which girl did **each** boy kiss?

John kissed Mary, and Bill kissed Sue.

(67) Which boy kissed **each** girl?

John kissed Mary, and Bill kissed Sue.

However, it has been noted in the literature that with the quantifier *each* PLAs appear to be possible[10] even when the quantifier occurs in object position. If this is correct, a structural view of the subject-object as a structural phenomenon needs to be amended. If subject vs. object position of the quantifier determined the availability of a PLA, we would not predict a difference within the class of universal quantifiers. In this Chapter I examine whether certain semantic properties of quantifiers, such as

[10] Similar judgments are reported in Beghelli (1997), among others.

distributivity, allow to override structural constraints. In section 3.1 I provide a brief overview of a class of universal distributive quantifiers, and discuss their scopal patterns in section 3.2. Section 3.3 presents Tunstall's (1998) analysis allowing to account for differences in distributivity patterns from a semantic perspective. In section 3.4 I show how quantifier distributivity can be viewed in terms of conditions on specifying quantifier domains. I present experimental findings aimed at testing the acceptability of PLAs with different types of quantifiers in section 3.5, and general conclusions in section 3.6

3.1 The distributivity patterns of universal quantifiers

Several researchers observed that universal quantifiers do not show uniform scopal behavior (Kroch, 1979; Szabolcsi, 1997a), and that not all universal quantifiers exhibit the pattern of the subject-object asymmetry (Szabolcsi, 1997b, 2010; Williams, 1998). Beghelli (1997), Szabolcsi (1997a, 1997b). As an attempt to account for this observed diversity, Szabolcsi (2010) developed an alternative account of quantifier scope: one that provides a treatment of scope behavior based on the distinctive semantic properties of quantifiers. Following this view, Beghelli & Stowell (1994, 1997) developed a feature-based model of Quantifiers Raising that determines distinct positions, where the quantifier can or must move to check a feature and be interpreted. Taking as a starting point for their feature selection the semantic properties of quantifiers, Szabolcsi (1997b) and then Beghelli & Stowell (1997) propose the following classification of quantifier phrases (QPs):

- Interrogative QPs: *what, who, which man*
- Negative QPs: *nobody, no man*

- Universal distributive QPs: *every, each*
- Counting QPs: *few, at most*
- Group denoting: *a, some, several, all*

Each type of quantifiers has a specific position in the syntactic tree where it can raise at the level of LF and check the semantic feature that it bears. The target positions determine the syntactic behavior of quantifiers, including their ability to take wide or low scope with respect to one another. Within the class of universal distributive quantifier phrases, quantifiers differ in their scopal properties. Focusing on this class of quantifiers, I will review both the similarities and the differences that have been observed between the members of this class.

Universal quantifiers form a natural class of linguistic expressions as they share similar truth conditions. Let us consider a set of three girls: Ann, Jane, and Mary. For a sentence, containing a quantifier phrase *every/each/all girl(s)* to be true, the predicate has to hold of all members of the set, such as in (68) - (70).

(68) All the girls came.

(69) Every girl came.

(70) Each girl came.

I will now concentrate on the two distributive quantifiers *every* and *each*. Universal distributive quantifiers *every* and *each* are different in several aspects. Fodor & Sag (1982) argue that *each* has a tendency to take wide scope. In that sense *each* is sometimes called a wide scope version of *every*. Several authors address the semantic and pragmatic differences between *every* and *each* (Vendler, 1962, 1967; Hogg, 1977; Aldridge, 1982; among others). Vendler (1962) looks at a range of structures where *every* and *each* occur. He shows that only *every* can occur in partitive constructions like *every one of them*, while the use of *one* in *each one of them* is redundant. He suggests that *each* already implies *one* and draws our attention to individual elements. Vendler further points out that *each* applies to events that occur at different times. *Each* and *every* also differ in their ability to occur in generic sentences (see also Gil, 1991). *Each* is infelicitous in (71) (generic use) but felicitous in (72) (individual use). Contrary to *each*, *every* can be used in generic sentences, like for example (73).

(71) ?? Each raven is black. (from Tatevosov 2002)

(72) Each raven we inspected is black.

(73) Every raven is black.

Beghelli & Stowell (1997) maintain that only *each* (75) can be used to disambiguate sentence, such as (74), while *every* cannot (76). Disambiguation is only possible with *each*, since *each* is associated with strong distributivity. *Each* but not *every* can appear floated (Déprez, 1993, 1994b, 1994c).

(74) Three boys lifted a piano.

(75) Three boys each lifted a piano.

(76) *The boys every lifted a piano.

Another construction associated with strong distributivity is the binomial use of *each* (Safir & Stowell, 1988; Zimmerman, 2002; Blaheta, 2003; Dotlačil, 2011) (77). Use of binomial *each* in (77) multiplies the number of books (3 books) by the number of girls in the set denoted by the definite description *the girls*.

(77) The girls read 3 books each.

Beghelli & Stowell (1997) observe that the distributive nature of *each* makes it unable to combine with the particle *almost.* This particle modifies any quantifier that determines the end of a scale, in the case of universal quantifiers, the end of the scale is a full set. Ability to combine with *almost* correlates with exhaustivity of universal quantifiers. While exhaustivity is a determining feature of *every* and *all*, for *each*, such a feature is distributivity (Roeper, Pearson, & Grace, 2011). That is why expressions, such as *almost each boy* sound unacceptable. Beghelli & Stowell conclude that *each* rather than *every* is the canonical distributive quantifier in English. Unlike *each, every* can sometimes behave like *all,* placing *every* in the middle of the distributivity continuum with *each* on one side, and *all* – on the other.

3.2 The scopal behavior of distributive quantifiers

Syntactic properties of quantifiers can be seen in their interaction with other scope-bearing expressions and operators, such as negation. When negation interacts with *every* in subject position, both scopal configurations of the quantifier phrase and negation are possible (Musolino & Lidz, 2003)[11]. A sentence in (78) can either mean that there are

[11] While both readings are predicted to be available, speakers may have preferences for one reading over the other. For instance, adults and children differ in that respect (Musolino, 1998; Musolino, Crain &

some horses that jumped over the fence, in the case we say that negation takes scope over the quantifier phrase {not > every}. This reading could be paraphrased in (78)

(78) Every horse didn't jump over the fence.

(a) It is not the case that every horse jumped over the fence.

('some reading').

(b) For every horse it is true that it did not jump over the fence.

('none reading')

The pattern is, however, different for *each*, only the surface scope is available and the inverse scope is not possible. Beghelli & Stowell (1997) argue that at LF *each* occupies a position higher than negation (NegP), so the 'some reading' where negation takes scope over the quantifier phrase {negation > each} is unavailable.

(79) Each horse didn't jump over the fence.

(a) *It is not the case that each horse jumped over the fence.

('some reading').

(b) For each horse it is true that it did not jump over the fence.

('none reading')

Beghelli & Stowell (1997) establish a special position - Distributive Phrase - which attracts strongly distributive quantifiers like *each* to check their distributivity

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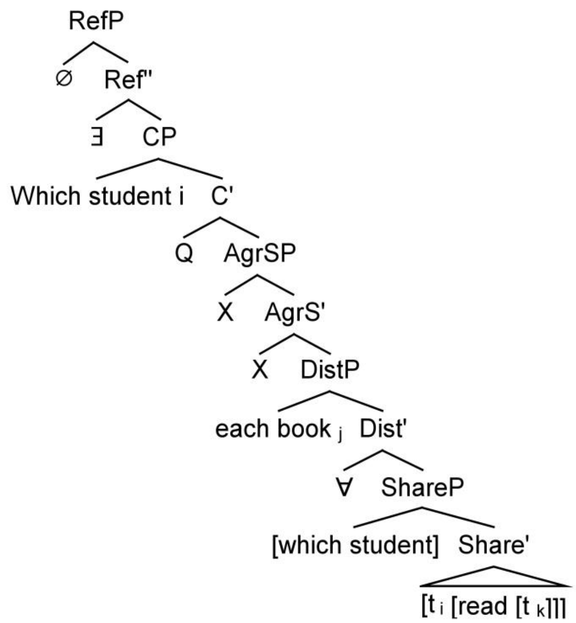
Thornton, 2000; Lidz & Musolino, 2002; Musolino & Lidz, 2006). Adults prefer the interpretation in (78) ('some reading'), where negation takes scope over the quantifier phrase. Children, on the other hand, follow the surface scope of the elements, and interpret (78) with the quantifier phrase taking scope over negation ('none reading') (78).

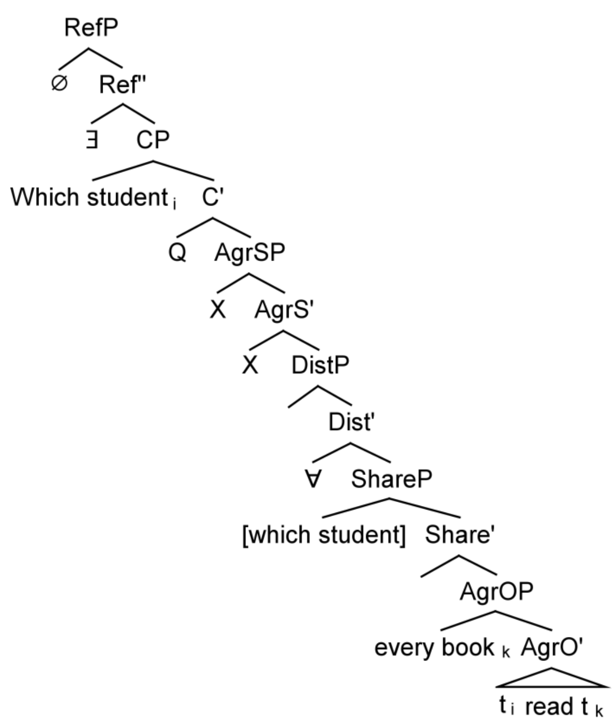
feature. For *every* to target the same projection, special conditions have to be met: its set variable has to be bound by existential quantifier over situations-times – an operator that appears high in the syntactic tree. Otherwise, *every* lands at a lower projection and acts as a 'pseudo-distributive' quantifier. The difference in landing positions explains why negation can take scope over *every* (and hence (78) is possible), while *each* stays above negation, and (79) is out.

The distributivity analysis also makes predictions for the subject-object asymmetry in the availability of PLA for *every* but not for *each*. Beghelli & Stowell (1997) maintain that scope assignment can be done both through upward movement (QR) or downward movement (reconstruction). This mechanism allows accounting for scopal ambiguities in sentences with multiple quantifiers, as well as in questions with quantifiers. While *each* in object position can raise high enough to take scope over the reconstructed subject *wh*-phrase (80), *every* in object position acts as a pseudo-distributive quantifier, and cannot go as high in (81). In (80) *each* is raised to Spec, DistP, where it takes scope over the *wh*-phrase reconstructed in Spec, ShareP. While for *each* it does not matter which position, subject or object, it originates from, for *every* the picture is more complicated. When *every* is raised from the subject position, it lands in AgrSP – a special functional projections where subjects go for agreement. When *every* originates from object position, like in (81), it can only reach AgrOP – a projection where objects check their agreement. This position is lower than ShareP, where the *wh*-phrase can be interpreted. As a result, the quantifier phrase headed by object-*every* is unable to take scope over the *wh*-phrase, and no PLA is possible for (81), while a PLA is readily available for (80).

(80) Which student read each book?



(81) Which student read every book?



Every introduces a set variable that has to be bound by the closest binder. In (81) the closest binder is the question operator Q, situated in the spec of CP. However, to follow the pattern of strong distributivity, *every* has to be bound by the existential operator in RefP, which is too far. As a result, *every* does not become strongly distributive, a PLA is lacking for object quantifier questions with *every*, such as (81). The same restriction does not apply to *each* because the distributivity of *each* is permanent and lexically encoded. Interestingly, in embedded questions, since such questions lack a question operator, *every* can be in fact bound by the existential operator. As a consequence, every *behaves* there as a strongly distributive quantifier. According to Szabolcsi (1997a), embedded questions with universal distributive quantifiers do not exhibit a subject-object asymmetry: PLAs are available there for both subject-quantifier and object-quantifier questions. The alleged absence of the asymmetry in embedded questions is another argument against a purely structural view of PLA availability.

In sum, the proposal of Beghelli & Stowell (1997) implies that certain lexical effects can override structural constraints on the availability of PLAs. The asymmetry surfaces only for pseudo-distributive quantifiers and not for strongly distributive quantifiers. In that sense, quantifier distributivity determines the availability of PLAs.

3.3 Distributivity and differentiation conditions

In this section, I focus on quantifier distributivity and how it can be used to differentiate *every* and *each*. Tunstall (1998) defines the term distributivity as having two meanings. Fist, *every* and *each* are distributive in a sense that a predicate applies to members of the set introduced by the quantifier phrase individually, and not as a whole. Tunstall uses Dowty's (1988) classification of predicates to show that *each* and *every* cannot combine with collective predicates, such as *gather*, but do combine with distributive predicates, such as *fall asleep*. There is also a group of predicates that can be interpreted either collectively or distributively, such as *lift.* Such predicates when occurring with *every* or *each* tend to be interpreted distributively.

For Tunstall, the second dimension of being distributive is a requirement on event structure: universal distributive quantifiers require distributive event structure, where members of the set introduced by the quantifier phrase are associated with subevents in the event structure (Tunstall, 1998). Events can range from collective to distributive, as well as fall somewhere in between the two poles of the continuum. Tunstall proposes that the difference between *each* and *every* lies in the extent they require event distributivity. To illustrate the concepts of event distributivity she uses an example where 5 apples are weighed. Ricky weighs apples 1, 2, and 3 separately and then apples 4 and 5 together; in this situation (82) felicitously describes what happened while (83) does not.

(82) Ricky weighed *every* apple.

(83) Ricky weighed *each* apple.

Each only applies to events that have a totally distributive event structure, requiring each member of the set to be associated with a separate subevent. *Every* is less restrictive to event structure and only requires at least two subevents, some objects in the subevents can be affected by the predicate as a group (e.g. several apples can be weighed together). These requirements are formulated as an event distributivity condition (84) for *every* and a differentiation condition for *each* (85) (Tunstall, 1998, p. 124).

(84) Event distributivity condition

A sentence containing a quantified phrase headed by every can only be true of event structures which are at least partially distributive. At least two different subsets of the restrictor set of the quantified phrase must be associated with correspondingly different subevents, in which the predicate applies to that subset of objects.

(85) Event differentiation condition

A sentence containing a quantified phrase headed by each can only be true of event structures which are totally distributive. Each individual object in the restrictor set of the quantified phrase must be associated with its own subevent, in which the predicate applies to that object, and which can be differentiated in some way from the other subevents.

Tunstall (1998) claims that the effect of *each* showing a preference for wide scope arises from the fact that *each* applies to situations with totally distributive event structure. A requirement for a totally distributive event structure has consequences for the availability of certain readings in questions with universal quantifiers. A question with *each* presupposes that the event structure is distributive. A PLA provides explicit pairings of participants, and as such, emphasizes the distributive structure of the event. Tunstall's analysis of quantifier distributivity predicts that PLAs will be more readily available for questions with *each*, than for questions with *every*, independent of the structural position of the quantifiers.

3.4 Domain of quantification

In this section, I am going to discuss how the distributivity force of a quantifier might be understood in terms of restrictions on quantifier domains. If the amount and the kind of background information about the set introduced by the quantifier phrase affects the ability of the quantifier to take wide scope, then acceptability of a PLA is determined by the quantifier distributivity, which in turn is related to its backgrounding status.

Whether a quantifier is interpreted collectively or distributively at least in part depends on the way the domain of quantification is specified. I first provide a general overview on how the domains of quantification are set, and then see whether we can detect any differences between *each* and *every* in that area. The domain of quantification is usually determined by the context, which limits the domain to relevant discourse. Von Fintel (1994) illustrates this well-known observation of the sentence in (86).

(86) Everyone had a great time. (from von Fintel, 1994, p.28)

If (86) is uttered in a situation where a group of people went out for a pizza, (86) is interpreted not to mean that everyone in the world had a great time, but only a relevant portion of participants (those that went out for a pizza) had a great time. According to von Fintel, every quantifier has an implicit domain variable. The value of such variable is supplied by the context. Just like pronouns, the context variable can be deictic, anaphoric or bound. If a speaker utters (87) upon entering a room, the quantifier phrase *everyone* refers to individuals in the room. In that sense, the context determines the deictic use of the quantifier. The domain of quantification can be determined linguistically, and in that sense it is anaphoric. In (87) the domain of *everyone* is set by the clause *when I walked into my class today*.

(87) Everyone is so quiet. What's wrong?

(88) When I walked into my class today, everyone was really quiet.

(from von Fintel, 1994, p. 31)

Von Fintel uses an example from Heim (1991) to show a situation where the domain variable is bound. In (89) *no student* is likely interpreted *as no student in class x*, and the variable *x* is bound by the phrase *one class*.

(89) Only one class was so bad that no student passed the test.

Postulation of a domain variable provides an explicit way of connection for semantics and pragmatics. The value of the variable has effects for the truth conditions and it is filled by context. Following Roberts (1991), Rooth (1985, 1992) and Schwarzschild (1993), von Fintel maintains that the interpretation of quantifiers is a part of anaphoric system of natural language. He further suggests that anaphors may be generally controlled by discourse topics. Discourse topics are construed of sets of propositions, conversational background, common ground, *etc*. All these discourse elements may contain possible antecedents for anaphors. Sentence topics refer to discourse topics, and in that way they also become a part of anaphora resolution: they set quantifier domains.

Whether a quantifier can be interpreted distributively seems to depend on its presuppositional status. For the quantifier phrase *each boy* to be used felicitously, first a set of boys must be introduced; in other words, members of the set must be in the common ground. For *every*, this condition is less strict: we can refer to a set of boys by saying *every boy* without knowing exactly the members of the set of men. It seems that the difference between the quantifiers can be explained in the extent they are presuppositional. I would like first to clarify which sense of the term ‘presupposition’ I am not going to use. Universal quantifiers are sometimes said to be presupposition triggers: if we utter a sentence in (90), then a presupposition of existence arises that there are some boys for whom the predicate holds (Geurts & van der Sandt, 1999).

(90) Every boy came to the birthday party.

For universal quantifiers, the domain of the quantifier coincides with the set selected by the quantifier. In that sense, both *every* and *each* are strong quantifiers, and they both trigger a presupposition of existence.

The term ‘presuppositional’ can also refer to lexical entries that have been backgrounded in discourse. Von Fintel (1994), following Stalnaker (1974), defines presupposition as a requirement that a sentence can be uttered in a certain type of context (p. 27). Lexical items can require presuppositions as well, for example they may be felicitous only when there is some prior information in the contexts. In that sense, Agüero-Bautista (2001) differentiates between presuppositional and non-presuppositional *wh*-phrases: *which* and *who*, respectively. In this use, ‘presuppositional’ could mean d[iscourse]-linked (Pesetsky, 1987; Enç, 1991), or backgrounded in discourse. D-linking, in turn, is related to the information structure status of an element. For example, in Romanian, there is a distinction between D-linked and non-D-linked quantifiers (Alboiu, 2002), which is correlated with the ability of certain quantifiers to behave like topics[12]. If the notion of D-linking can be extended to quantifiers, in English, *every* may be viewed

[12] In Romanian, D-linked quantifiers behave like topics. Such quantifiers can undergo clitic-doubling, and the clitic acts as an anaphoric operator (Alboiu, 2002). Non-D-linked quantifiers in Romanian cannot have clitic-doubling. Romanian data indicate that D-linking and topichood are interrelated phenomena.

as a non-D-linked universal quantifier, while *each* requires obligatory D-linking. If D-linking is related to topichood, like it is in Romanian, discourse characteristics of the quantifier could contribute to its ability to take wide scope. *Each* is obligatorily/lexically D-linked and therefore more easily takes wide scope, than *every*. I return to the intricate relation between topichood and scope in the final chapter, where I propose based on Krifka (2001) and Eilam (2011) that the ability of a question to give rise to a PLA depends on the ability of a quantifier phrase to be construed as a question topic.

Another dimension, on which *each* and *every* differ, is specificity. Enç (1991) defines specificity for NPs as establishing a link between an NP and a previously mentioned referent. Quantifier phrases also show specific/non-specific distinctions. Quantifier phrases headed by *each* are specific, and they refer to a predetermined set of objects/individual. Quantifier phrases with *every* may be specific or non-specific, and even generic. There is independent evidence that specific elements tend to take wide scope. Fodor & Sag (1982) argue that specific indefinites always take the widest scope[13].

Liu's (1997) account relates the subject-object asymmetries in quantifier interactions to a property he calls generalized specificity (G-specificity). Linguistic analysis of specificity was originally developed as characterizing a particular semantic behavior of indefinites (Ioup, 1977). Consider an example in (91):

(91) Melinda wants to buy a motorcycle. (from Ioup, 1977, p. 233)

[13] The claim that specific indefinites take the widest was challenged in Kasher & Gabbay (1976), Farkas (1981), & Geurts (2010).

The indefinite NP *a motorcycle* in (91) can have two possible readings making the sentence ambiguous. Under a specific reading of the indefinite, the NP in (91) refers to a particular motorcycle Melinda wants to buy. It is also possible to understand (91) as expressing a statement about *some* motorcycle. The latter reading of the indefinite NP is non-specific. If *a motorcycle* is interpreted as specific, the example in (91) can have a continuation in (92). However, when *a motorcycle* is non-specific, only the continuation in (93) is possible.

(92) She will buy it tomorrow.

(93) She will buy one tomorrow.

(from Ioup, 1977, p. 233)

In Liu's account, the possible scopal relations between noun phrases (NPs) are related to their generalized specificity. In this analysis, only the non-specific NPs can be scope-dependent while the G-specific NPs are scope-independent.

Geurts (2010) mentions that specific indefinites tend to be interpreted distributively. However, he maintains that it is not specificity itself that drives the wide scope interpretation. He relates specificity and presuppositions in a more general notion of backgrounding (Geurts, 1999, 2000, 2010). In his view, specific indefinites tend to take wide scope when they are backgrounded. Geurts follows Foley & Van Valin (1985) and Foley (1994) and defines foreground and background based on information prominence. He provides an operational definition of background as something that remains when the most important information is taken out. The status of the background information does not imply that it is unimportant, however, background information is secondary compared to foregoround. Interestingly, under this view, background is not the same as given; information maybe of secondary importance (backgrounded) and at the same time new. According to the Buoyancy Principle (Geurts, 2010), backgrounded material tends to float up towards the main discourse representation structure.

Geurts' Buoyancy principle extends the discourse representation theory (Kamp, 1981). In this theory, presupposition is treated as a sort of anaphora. When an utterance contains a presupposition-inducing element, the hearer either binds it (finds an appropriate antecedent) or accommodates it if binding is unavailable. Accommodation happens through insertion of a presupposition into some discourse representation structure, and a presupposition is added to discourse (Lewis, 1979). Discourse representation structures have a hierarchical organization, and the binding theory requires a presupposition to be satisfied at the highest level of the structure. When material is backgrounded, it rises higher in the discourse representation structure, and elements of the background material, if they are scope-bearing ones, can take wide scope.

If backgrounded quantifiers indeed take wide scope more easily than non-backgrounded ones, we could explain why PLAs are available for *each* but not for *every*. Since the set introduced by *each* is presupposed, it is also backgrounded. As a consequence, *each* can always take wide scope over the *wh*-phrase in questions with quantifiers, and PLAs are available. It seems though, that this account would make no distinction between the position of the quantifier, subject or object.

In what ways, if any, are the domains of *each* and *every* specified differently? Both quantifiers are universal, so they select a full set of objects/individuals denoted by the quantifier phrase. However, for *each* the set is more strictly defined: we know a full list of its members. For *every*, the domain of quantification may not be specified explicitly. For sentence subjects, the contrast between *every* and *each* is less obvious, since subjects are often sentence topics, they are introduced in prior discourse. Objects, on the other hand, often bring new information (Lambrecht, 2001). The question in (94) can be understood as asking not about a pairing of books and students, but all the books as a whole, since a full list of books may be unknown. In (95) such underspecification is not allowed.

(94) Which student read every book?

(95) Which student read each book?

3.5 Experiment 5 *Each / every*

In this section, I use experimental tools to investigate whether lexical properties of certain quantifiers can override structural constraints on their interpretation. Some accounts of *wh*-/quantifier interactions (Ioup, 1975; Williams, 1988; Beghelli, 1997; Szabolcsi, 1997; Agüero-Bautista, 2001) predict the subject-object asymmetry should hold for *every* but not for *each*, since *each* allows for a pair-list reading of a questions even when the quantifier is in object position. In Experiment 5, I compare *every* and *each* in their ability to give rise to PLAs. If indeed PLAs are acceptable for questions with object *each*, we would expect to see essentially equally high ratings both for object-quantifier and subject-quantifier questions with *each*. Besides, the acceptance rate for object-*each* questions is expected to be higher than the acceptance rate for questions with object-*every*. The aim of this experiment is to find out what role the type of quantifier has in pair-list readings, and assess the contribution of lexical factors in mediating PLA availability.

3.5.1 Method

Design. In Experiment 5, the following factors were manipulated: answer type (PLA and SA); quantifier position (subject vs. object) and quantifier type (*each* vs. *every*), yielding in a 2x2x2 design. *Wh*-type was held constant in this experiment, namely *which sg*, since this is a case where the literature seems to converge in predictions. This design resulted in 8 conditions, illustrated in Table 7. The actual stimuli are shown in Appendix D.

Table 7. Experiment 5. Sample Stimuli

Question Answer	Quantifier Position	Quantifier Type	Answer Type
Q: Which book did <u>each student</u> read? A: Introduction to Psychology	**Subject**	**Each**	**Single answer**
Q: Which book did <u>every student</u> read? A: Introduction to Psychology	**Subject**	**Every**	**Single answer**
Q: Which student read <u>each book</u>? A: John.	**Object**	**Each**	**Single answer**
Q: Which student read <u>every book</u>? A: John	**Object**	**Every**	**Single answer**
Q: Which book did <u>each student</u> read? A: John read Syntax, Mary read Semantics, and Sue read Phonology.	**Subject**	**Each**	**PLA**
Q: Which book did <u>every student</u> read? A: John read Syntax, Mary read Semantics, and Sue read Phonology.	**Subject**	**Every**	**PLA**
Q: Which student read <u>each book</u>? A: John read Syntax, Mary read Semantics, and Sue read Phonology.	**Object**	**Each**	**PLA**
Q: Which student read <u>every book</u>? A: John read Syntax, Mary read Semantics, and Sue read Phonology.	**Object**	**Every**	**PLA***

***** Predicted to be unavailable according to theoretical analyses.

Participants. 29 Rutgers undergraduate students, all native speakers of English, participated in the experiment. They received course credit for participation.

Materials and procedure. Participants judged pairs of questions and answers and rated acceptability of an answer using a scale. They were instructed to assign a rating of 1 when a certain answer was not possible, and 7 when the answer was definitely possible. A sample stimulus is shown in (96).

(96) Which doctor treated each patient last month?

Dr. White treated Helen, Dr. Paterson treated Sue, and Dr. Brown treated Anne.

The experiment contained 32 critical items and 60 controls. Controls were the same as in Experiment 1.

3.5.2 Results and analysis

As in Experiment 1, the dependent measure was the rating assigned to various types of answers; the data were analyzed using cumulative link mixed models with subjects and items as random factors. The analysis revealed a significant effect of answer type ($p < 0.01$), quantifier position ($p < 0.01$), and quantifier type ($p < 0.01$). PLAs to questions with subject quantifiers PLAs receiving higher ratings than questions with object quantifiers, showing a significant interaction of quantifier position and answer type ($p < 0.01$). A significant interaction of quantifier type and quantifier position ($p < 0.01$)

suggests that PLA are more readily available for questions with an object quantifier *each* than with *every*, as predicted by Beghelli (1997), and Agüero-Bautista (2001).

Pair-list answers

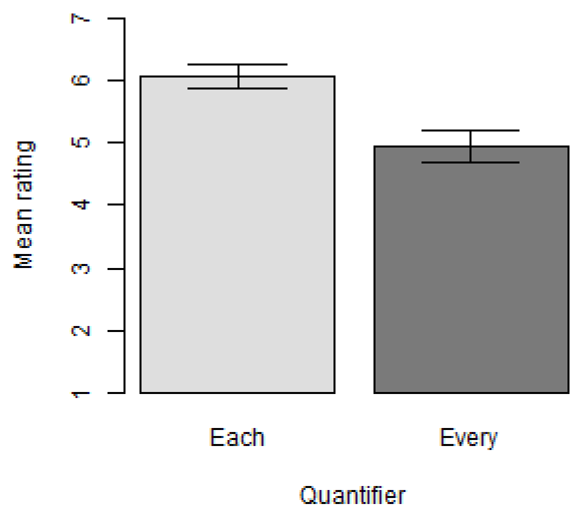


Figure 15. Mean ratings for PLAs depending on the quantifier

According to Beghelli (1997), PLAs are available for questions with *each* regardless its structural position: subject or object. If so, we expect to see no difference in ratings for PLAs to questions with *each*. However, Figure 16 demonstrates that the structural conditions on the availability of PLAs matter not only for questions with *every* but also for questions with *each*, a result that we do not expect if lexical effects outweigh structural restrictions on quantifier interpretation.

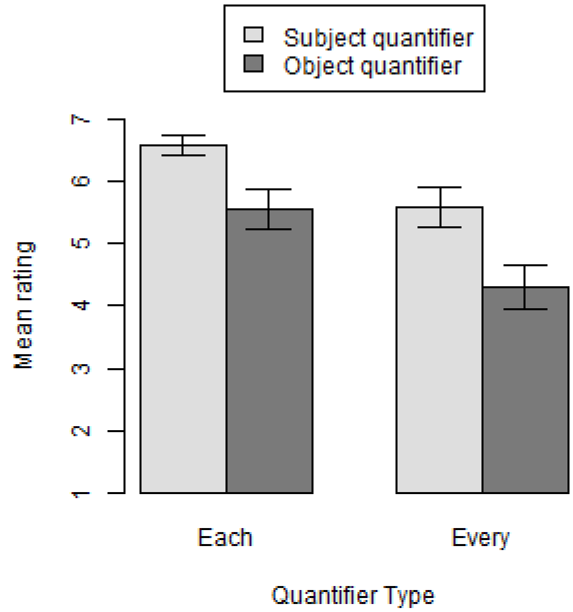


Figure 16. Effect of quantifier type on PLAs

3.5.3 Discussion

The results of Experiment 5 confirm that strongly distributive quantifiers, such as *each*, differ in their behavior from pseudo-distributive quantifiers, like *every*. The data reveal an unexpected effect for PLA to questions with *each:* object-quantifier PLAs are rated lower than subject-quantifier PLAs. In other words, we observe an asymmetry between subjects and object quantifiers in their ability to give rise to a pair-list reading of a question, and this effect is present not only for questions with *every*, but also for questions with *each* (Figure 16). What is striking, the magnitude of a difference between subject-quantifier and object-quantifier conditions is similar for the two quantifiers (a factor of 5 on a Bayesian t-test[14]). This conclusion suggests that the role of structural constraints might be similar for both quantifiers. Interestingly, the subject-object distinction does not create an acceptable/unacceptable distinction for PLAs to questions

[14] A Bayes factor of 5 corresponds to substantial evidence on Jeffreys scale (1961).

with *each*: here we speak about object-quantifier question PLAs being less acceptable than subject quantifier PLAs, but crucially still grammatical. Since the scope of the difference for the subject-quantifier and object-quantifier PLA ratings is similar for *every* and *each*, I hypothesize that for *every* as well, both subject-quantifier and, importantly, object-quantifier PLAs are ultimately acceptable, but their acceptability rates differ.

I would now like to return to some puzzling facts about high acceptability rates that naïve subjects provided for objet-quantifier PLAs in Experiment 1. In Chapter I, I identified a group of speakers who did not show the subject-object asymmetry for questions with *every*, suggesting that PLAs are at least sometimes possible for object-quantifier questions. Possibly, those subjects treated *every* as being similar to *each*. If *each* and *every* differ in how their domains are set, domain restriction might be one of the mechanisms that affect the ability of a quantifier to take wide scope. It might be possible to restrict the domain of *every*, and make it more similar to *each*. In that case we would predict that PLAs may become available for questions with object-*every*. If we determine the set in the domain of quantification, and bring a list of the members into discourse, *every* essentially becomes like *each.* One of the linguistic means to achieve this effect is to limit the domain of quantification by a prepositional phrase, compare examples in (97) and (98).

(97) Which student read every book?

(98) Which student read every book on the shelf?

An informal pilot test showed that a PLA is more readily available when the domain of quantification is restricted with a prepositional phrase, such as in (98). It seems that access to a PLA depends on how restricted the domain of quantification is, as well as how much backgrounding goes into a quantifier phrase. Under this view, acceptability of PLAs appears to be graded rather than categorical. Since acceptability of PLAs is at least partially mediated by discourse-related factor, it is possible to imagine a situation where discourse would favor a pair-list reading of a question, even if the quantifier phrase there occurs in object-position. For instance, a situation where an object-quantifier phrase is made the topic of discourse or the domain of quantification is explicitly narrowed. An account of *wh*-/quantifier interactions that acknowledges the role of quantifier domain restriction also explains why the structural position of a quantifier also matters for *each:* from the point of view of information structure, a different amount of backgrounding goes into subjects and objects, and it has consequences for the availability of PLAs.

3.6 Summary

According to Beghelli & Stowell (1997), the ability of a quantifier to give rise to pair-list readings, depends on the distributive force of the quantifier. Experimental findings confirm that strongly-distributive quantifiers, such as *each*, more easily give rise to PLAs, than pseudo-distributive quantifiers, such as *every*. Since the availability of certain readings of questions with quantifiers is mediated by the quantifier semantics, such an approach suggests that lexical may cancel structural constraints on quantifier interpretation. However, I demonstrate that for both *every* and *each* structural position of the quantifier affects acceptability of PLAs. Existing analyses of the subject-object asymmetry (May, 1985; Chierchia, 1993; Beghelli, 1997; Agüero-Bautista, 2001) are unable to capture two facts taken together 1) a difference between strongly-distributive and pseudo-distributive quantifiers; 2) the asymmetry in ratings for both types of quantifiers. In the final chapter, I discuss how information structure analysis of the subject-object asymmetry can account for both of these facts.

CHAPTER IV.

ACQUISITION OF WH-/QUANTIFIER INTERACTIONS

The aim of the current chapter is to look at PLAs in developmental perspective. In Chapter I, I propose that high acceptability ratings for PLAs to questions with object *every* may be in part due to the fact that speakers treat *every* as being similar to *each*. Looking at child data allows testing this hypothesis more precisely, since children have been shown to experience difficulties with *each* (Roeper, Pearson & Grace, 2011; Syrett & Musolino, in press). If children do not fully differentiate quantifiers *every* and *each*, their production of PLAs might be similar for both quantifiers. In some circumstances, adults may also treat *every* and *each* as being similar in their distributivity force, and therefore they find object-*every* PLAs acceptable.

In order to further investigate this hypothesis I turn to developmental data. Data on the acquisition of *wh*-/quantifier interactions reveal contradictions regarding the children knowledge of PLA availability (Achimova *et al*, 2013). First, some authors observe that children aged 3-5 overproduce PLAs (Roeper & de Villiers, 1991; Lewis, 2000) while others (Yamakoshi, 2002) argue that children at that age have adult-like grammars, and their patterns of PLA production are not different from that of adults. Second, previous studies show a variety of problematic confounds in experimental design that could have contributed to the reported patterns of PLA production. As a result, current evidence do not let us give an accurate evaluation of children's command of *wh*-/quantifier interactions. Moreover, given that some adults do find object-quantifier question PLAs acceptable, we can now re-evaluate the status of PLAs in child grammars.

It is possible that children's so-called 'overproduction' of PLAs stems not from grammar immaturity but immature lexicons.

I pursue two goals in this chapter: 1) to determine whether the range of factors affecting acceptability of PLAs in adults also affects children's understanding of questions with quantifiers; 2) if overgeneralization of PLAs is confirmed, re-examine the nature of this effect, whether it stems from immature grammars, or rather other factors, affecting the interpretation of questions.

The organization of this chapter is as follows: in section 4.1, I review previous studies on the acquisition of *wh*-/quantifier interactions, with a short summary in section 4.2. Section 4.3 lays out a new experiment on production of PLAs, followed by a discussion in section 4.4, and an overall summary in section 4.5.

4.1 Production of pair-list answers

4.1.1 Roeper & de Villiers (1991)

Roeper & de Villiers (1991) were the first to observe that children show a puzzling behavior in the area of *wh*-/quantifier interaction: they produce PLAs not only to subject-quantifier but also to object-quantifier questions. In the course of experiments, children were shown pictures accompanied by stories like the one in (99). These were followed by subject or object questions such as (100) or (101). In this example, the picture showed the sister pulling the boy, the Daddy pulling the sister, and the horse pulling the dad.

(99) A little boy got stuck in the mud. He called his sister for help. She tried pulling him, but was unable to get him out. Then they called Daddy, who could not help either. Finally, a horse came and pulled the Daddy, and look, out came the boy!

(100) Who did everyone pull?

(101) Who pulled everyone?

The subject-quantifier question in (100) has two possible answers: either that everyone pulled the boy (a single answer), or a list of pairs in which the first member pulled the second one (a PLA). The percentage of answers reported by Roeper & de Villiers is presented in Table 8. Table 8 shows that children allowed single answers, as expected. Surprisingly, however, we also see that children preferred PLAs for both question types – even for questions with object quantifiers like (101), where PLA should be unavailable. Roeper & de Villiers conclude that children are insensitive to the attested subject-object asymmetry and therefore have an immature grammar.

Table 8. Production of PLAs in Roeper & de Villiers (1991)

Question	Single answer	**Pair-list answer**
Who did everyone pull *t*? (subject)	11%	**73%**
Who *t* pulled everyone? (object)	26%	**69%**

4.1.2 Yamakoshi (2002)

Yamakoshi (2002) later attempted to replicate these results, but included a follow-up phase, where an experimenter asked children whether they thought the horse also pulled the boy. 73.8% of the children replied 'no', presumably indicating that they did not recognize that the horse indirectly pulled everyone, even though it only directly pulled the father. Yamakoshi reasoned that they were therefore unable to access the single answer and only had the PLA as an option. Yamakoshi's experiment avoided the indirect-force scenario. She reported that rate of PLA production were lower in object-quantifier than in subject-quantifier questions, as shown in Table 9. Yamakoshi concluded that children age four and five are capable of producing PLAs, and their production of PLAs is restricted by principles governing the *wh*-/quantifier interaction in adults. In other words, children's production of PLA in Yamakoshi's experiment shows the subject-object asymmetry.

Table 9. Production of PLAs in Yamakoshi (2002) and revised count in parentheses

Question	Single answer	**Pair-list answer**
What did everyone take *t*? (subject)	0%	**62% (94%)**
Who *t* took every vegetable? (object)	69%	**8% (26%)**

However, there are a number of factors that could have contributed to such a sharp subject-object asymmetry effect in Yamakoshi's (2002) study. First, he employed a conservative method of tallying PLAs. A partial answer or one that only listed one member of a pair was not counted as a PLA, and was instead classified as 'other'. In the course of my own experiments, I observed that children often provided such partial answers in response. For example, when asked *Which game did every friend play?* children would answer, *Candy Land, Sorry, and Monopoly*. Moreover, some children did not respond verbally, instead pointing to items on the screen. If we return to Yamakoshi's data and count such answers as PLAs (since they are clearly not single answers, and indicate a character-object mapping as in a PLA), we obtain a much higher rate of PLAs. This higher rater is indicated in the percentages in parentheses in Table 2. As a result, Yamakoshi's findings may need to be re-evaluated. While it is true that children produced fewer PLAs to object-quantifier questions than to subject-quantifier questions, thus demonstrating the subject-object asymmetry, the PLA production rate for object-quantifier questions appears unusually high for a type of answers predicted to be ungrammatical.

4.1.3 Lewis (2000)

Lewis (2000) experiments also assess children's knowledge of the subject-object asymmetry, but additionally tested whether WCO analysis of the asymmetry (Chierchia, 1993) gives accurate predictions for developmental data. Recall, that according to the WCO account of the asymmetry, PLAs are impossible for object-quantifier questions, since the quantifier trace has to cross over the pronominal *wh*-trace (for details see § 1.3.2). Lewis designs a set of stimuli to assess whether children respect the WCO constraint independently, and whether they also respect the subject-object asymmetry in the interaction of universal quantifiers and question words. Following Thornton (1990), Lewis adopts a view that the WCO constraint is acquired, as opposed to innate and part of Universal Grammar. If at a certain stage of development children do not respect this constraint, they will not exhibit the subject-object asymmetry either. However, if children are sensitive to WCO, and at the same time overgeneralize PLAs to object-quantifier questions, then the WCO analysis might be in fact not applicable to the subject-object asymmetry.

First, Lewis assessed children's knowledge of WCO with a Truth Value Judgment Task (TVJT), based on the experimental design in Thornton (1990). Children see animated stories and have to assess statements, such as (102), where the pronoun *his* could be potentially co-referenced either with one of the characters named in the sentence, or some other character introduced in prior discourse. Such examples allow testing whether children respect constraints on co-reference.

(102) I think I know who his mother kissed: Elmo, Grover, and Cookie.

(from Lewis, 2000, p. 514)

In the course of the story two readings are made possible. At some point, each character is kissed by his own mother, and then the character carries the sign of her lipstick (all mothers have a different color lipstick). Another scene shows Grover's mother hugging Oscar. According to Lewis, if children interpret (102) distributively and accept the statement, it would suggest that they do not respect WCO constraints yet. Lipstick marks also support the deictic reading, where *his* is interpreted as *Grover's.* If children obey the WCO restrictions, they will opt for the deictic reading of *his*. Data from 58 children (range 2;11 – 7;1) were entered into analysis. Lewis discovered that 49 children out of 58 accepted (102) in violation of WCO. The author concludes that the constraint is not yet developed in the children he tested.

The second type of stimuli was designed to test children's knowledge of *wh*-/quantifier interactions. Children watch an animated story, followed by a statement. Their task is again to assess the truthfulness of the statement. A script of a sample story is shown in (103). Then Sherlock, the detective in the story, makes a statement in (104).

(103) Oscar and Grover are playing a game: they are trying on cowboy hats. Sherlock enters the room after they finished and guesses who tried on different hats. First, Grover puts on a green and a brown hat. Oscar asks Grover to give him a white and a black hat. In the end, there are two hats on Grover (brown and green) and two hats on Oscar (white and black).

(104) Ahh, that's a clue. That means every cowboy hat is on someone's head. <u>And I think I know who put on every cowboy hat.</u> I heard what Oscar said to Grover, so I know Oscar put on the green hat and the brown hat; and from what Oscar said to Grover, I think he put on the white hat too. Am I right?

(adapted from Lewis, 2000, p. 515)

If children do not respect the subject-object asymmetry, they will access the pair-list reading of (104) and accept the statement. If they can only provide a single answer to the question in (104) they are expected to reject the statement[15].

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[15] Lewis admits that the design is complicated and somewhat confusing even for adults, but testing the knowledge of the subject-object asymmetry is not a primary interest for him. The author's main interest in

Out of 58 children, 12 demonstrate the knowledge of the subject-object asymmetry. Half of those 12 children, show lack of WCO constraints, a result not predicted by Chierchia's account. What is important for the goals of this review, 43 children out of 58 permit the pair-list reading of the embedded question in (104), even though such reading is predicted to be banned for object-quantifier questions.

The proportion of children who find PLAs to object-quantifier questions acceptable is quite high in Lewis (2000) and reaches 74%. However, there are a number of confounds that could have contributed to the overgeneralization of PLAs. First, stimuli contain questions with *who*, and Lewis himself admits that such questions with object quantifiers may sometimes allow PLAs. Second, target questions are indirect embedded questions – a manipulation that, as some researchers suggest, changes dramatically the syntax of a question. According to Szabolcsi (1997b), embedded questions with quantifiers may lack the subject-object asymmetry. Direct questions with *every in object position* do not have a PLA because the quantifier follows a pseudo-distributive pattern and does not rise high enough in the tree to take scope over the reconstructed *wh*-phrase (see p. 98 of this dissertation). As I discuss in Chapter III, embedded questions are different in Szabolcsi's approach. Because there is no question operator that intervenes between the quantifier and the existential closure, the existential operator manages to bind the set variable introduced by *every*, and *every* becomes strongly distributive, just like *each*. I have already presented both theoretical and experimental evidence in Chapter III that PLAs are possible for adults for questions with object *each*. If *every* acts like *each* in embedded questions, there is no reason to expect that speakers, children or adults,

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this paper is to assess whether WCO and the subject-object asymmetry are acquired simultaneously or there is a particular order of acquisition.

should reject PLAs to embedded questions with object *every*. In that sense, 74% of children in Lewis's experiment are not doing anything abnormal, and their acceptance of PLAs no longer qualifies as overgeneralization.

4.2 Experiment 6. Acquisition of *wh*-/quantifier interactions

Concerns with previous experimental methodology and lack of convergence in the reported results motivated revisiting children's comprehension of *wh-/*quantifier questions. Whether or children actually overgeneralize PLA still remains unsettled. As per theoretical predictions, earlier studies assumed that PLAs are not possible for object-quantifier questions. Since the analysis in earlier chapters showed that it is not always the case, obtaining an adult baseline in a production experiment became important. This baseline allows for a straightforward comparison of children's and adults' data. Recall, that several factors were predicted to affect the availability of PLAs. Since we did not observe a clear effect of type of *wh*-phrase in adult acceptability judgments experiments reported in previous chapters, the type of *wh*-phrase is fixed to *Which + NP* in the acquisition experiment. Recall indeed that this is in any event the most stable predicted case. Questions with presuppositional singular *wh*-phrases, such as *which*, and an object quantifier are expected to lack a pair-list reading under all of the theoretical accounts reviewed in this dissertation.

On the other hand, the availability of PLAs was shown here to be affected by the type of quantifier phrase involved. Adults accepted PLAs to questions with object *each* significantly more than to questions with object *every*. Testing the effect of quantifier phrase will give us a more detailed picture of children's command of quantifiers. A comparison of the two types of quantifiers (*every* vs. *each*) can also reveal whether overgeneralization of PLAs, if confirmed, applies to a wider range of quantifiers than those considered in previous studies. Experiment 6 was designed to (a) assess the rate of PLAs for children and adults in response to subject- and object-quantifier questions involving *which* (to ascertain the presence of a subject-object asymmetry); and (b) find out whether the availability of PLAs is sensitive to quantifier type (*each* vs. *every*).

4.2.1 Method

Participants. A total of 57 children participated, 8 children who did not successfully complete the practice trials were excluded from the analysis. The dataset therefore contained responses from 49 children between the ages of 41.5 and 79 months (mean 59.4 months). Children were divided into two age groups: the younger group included 24 participants (mean age 53.8 months (4 years 6 months), range 41.5 – 59.6). The older group had 25 children (mean age 64.4 months (5 years 5 months), range 60 – 79 months). Rutgers undergraduates (n = 28) served as an adult control group.

*Design and procedure***.** In a 2x2 production design, syntactic position of the quantifier (subject vs. object) was manipulated within subjects, while quantifier type (*each* vs. *every*) was treated as a between-subject variable. The *wh*-word was always *which,* since *which*-questions are predicted to lack a PLA when interacting with object *every*. The experiment began with a 2-item practice session, which was followed by an experimental session consisting of 12 items (6 critical and 6 control trials). Control trials aimed at testing whether children understand questions without quantifiers, are able to produce PLA and single answers in general, as well as whether children treat *every* and *each* as universal quantifiers.

Participants were tested individually. They watched a story animated on a computer monitor and narrated by the experimenter. For adults, the narration and question were pre-recorded; for children, these were presented live by a female native speaker of English. The story was followed by a *wh*-/quantifier question. Each story had the same template: there were three characters and three objects. All of the characters first interacted with one of the objects. Then two of the characters interacted with another object. The narrative and question from a sample story is presented in (105), accompanied by the on-screen display in Figure 17.

(105) Buzz, Jesse, and Woody decided to play board games. They played Candy Land first. But then Buzz wanted to play another game, so he played Monopoly. Jesse also wanted to play another game, and so she played Sorry. **Which game did <u>every</u> friend play?**

Figure 17. Subject-quantifier story

The single answer, in which the *wh*-phrase takes scope over the quantifier, should be *Candy Land*. The PLA, derived from the quantifier taking scope over the *wh*-phrase, should be *Woody played Candy Land, Jesse played Sorry, and Buzz played Monopoly*. For each story, we used verbal cues and visual aids, such as footprints in this example, to make both readings salient.

The example in (106) and the scene in Figure 18 accompanied an object-quantifier question. Here, only the single answer are predicted be available.

(106) Princess Belle, Princess Jasmine, and Princess Cinderella are going to have some snacks. Jasmine gets three goodie bags. Inside she finds a Crunch Bar, a Snickers and a Kit Kat bar. She gave a Crunch Bar to Jasmine, and a Kit Kat bar to Belle. **Which princess got <u>every</u> candy bar?**

Figure 18. Object-quantifier story

Participants, who are aware of the constraints associated with the type and position of the quantifier, are expected to provide the single answer - *Jasmine*. If, however, child participants overgeneralize PLAs (and if adults allow the quantifier to take scope over the *wh*-phrase), they should provide an answer such as *Belle got a Crunch bar, Jasmine got a Snickers, and Cinderella got a Kit Kat bar*.

During the experiments, an assistant who was not interacting with a child recorded all the responses verbatim. The assistant also categorized answers into single answers, PLAs or others. Answers listing only characters or only objects, such as “Belle, Jasmine, and Cinderella” to the story illustrated in Figure 16 were treated as PLAs. Whenever such responses were produced, children often accompanied them with pointing. Responses listing only characters or only objects do not exactly confirm to full PLAs, however, they cannot be viewed as instance of either single or even cumulative answers, since the latter arise when a plural *wh*-phrase interacts with a plural quantifier phrase.

4.2.2 Results and analysis

I begin with the results for the quantifier *every*, which is predicted to exhibit a subject-object asymmetry. In other words, we expect adults to produce PLAs only to subject-quantifier questions but not object-quantifier ones. Participants showed a strong preference for single answers over PLAs, even in situations where both answers are allowed. Adults produced PLAs only 6.6% of the time for subject-quantifier questions, and never produced them for object-quantifier questions (Figure 19).

Children, by contrast, produced PLAs to subject-quantifier questions approximately half of the time and significantly more than adults ($p < 0.01$). The crucial test of their grammatical competence came with the object-quantifier questions, where PLAs are predicted to not occur. Here, children produced PLAs 33% of the time, again significantly more than adults ($p < 0.01$). Thus, children do overgeneralize PLAs in response to object-quantifier questions with *every*. Children, however, produce fewer

PLAs to object-quantifier questions than to subject-quantifier questions, showing the effect of structural position of the quantifier phrase on the availability of PLAs.

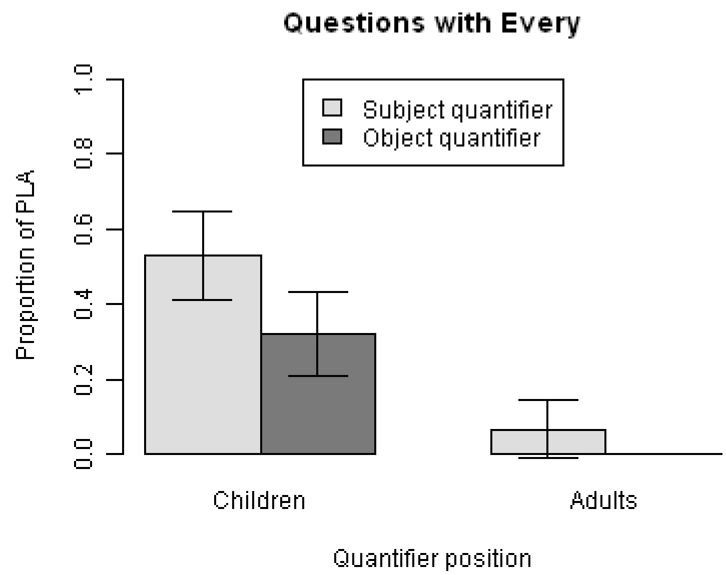

Figure 19. Production of PLAs for questions with *every*

I now turn to the results for the quantifier *each*. Recall, that because *each* lands in a position high in the syntactic tree, and can take scope over the subject *wh*-phrase at LF, PLAs are predicted to be permitted with both subject- and object-quantifier questions. Interestingly, adults – who resisted PLAs with *every* – are drawn to them with *each* (Figure 20). In addition, as predicted by Beghelli (1997), adults produced significantly more PLAs to *each* object-quantifier questions, than to *every* object-quantifier questions ($p < 0.01$).

Given the results with *every* and the distributivity properties of *each*, children were expected to increase their rate of PLAs with this quantifier. If overgeneralization of PLAs is a result of a lack of constraints on the interpretation of questions with quantifiers, children should demonstrate an even higher rate of PLA production with *each*. However, their rate of PLAs remains comparable for subject-quantifier questions and *decreases* for object-quantifier questions.

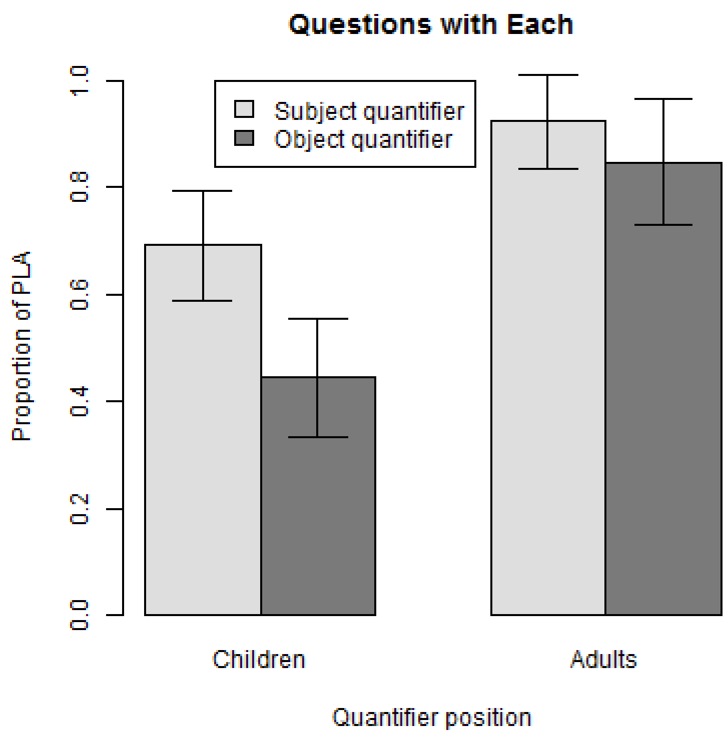

Figure 20. Production of PLAs for questions with *each*

In other words, compared to adults, who in fact produced PLA to questions with both subject- and object-quantifier questions, children under-produced PLAs to question with *each*. Moreover, children did not show a strong sensitivity to the choice of the quantifier (Figure 19).

I would now like to look at the data in terms of the subject-object asymmetry. Just like adults in acceptability judgment experiments, children show sensitivity to the position of the quantifier (Figure 21). Children preserve the contrast between subject- and object-quantifier questions not only for *every* but for *each* as well. The difference in production rates is significant for both types of quantifiers ($p < 0.01$).

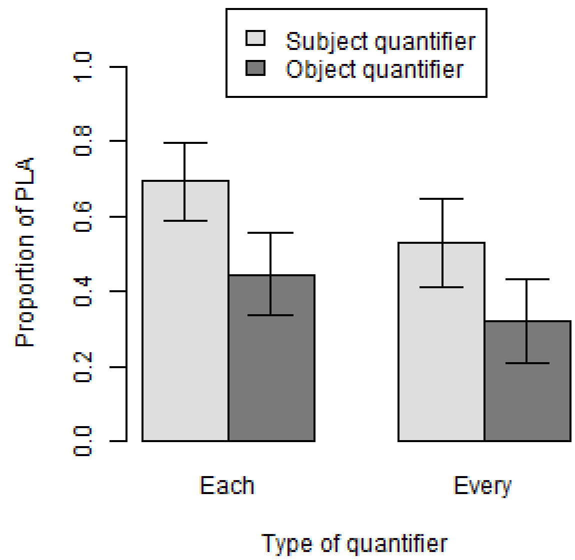

Figure 21. Production of PLAs depending on quantifier, children.

I now examine developmental trends in PLA production, splitting children's response according to age group. For questions with *every*, production of PLAs decreases with age. Children in the younger group produce more PLAs than older children ($p = 0.08$), and older children produce more PLAs than adults ($p < 0.01$). See Figure 22. For *each* the pattern is different: children do not show an effect of age ($p = 0.636$) but as a group produce fewer PLAs than adults ($p < 0.01$). See Figure 23.

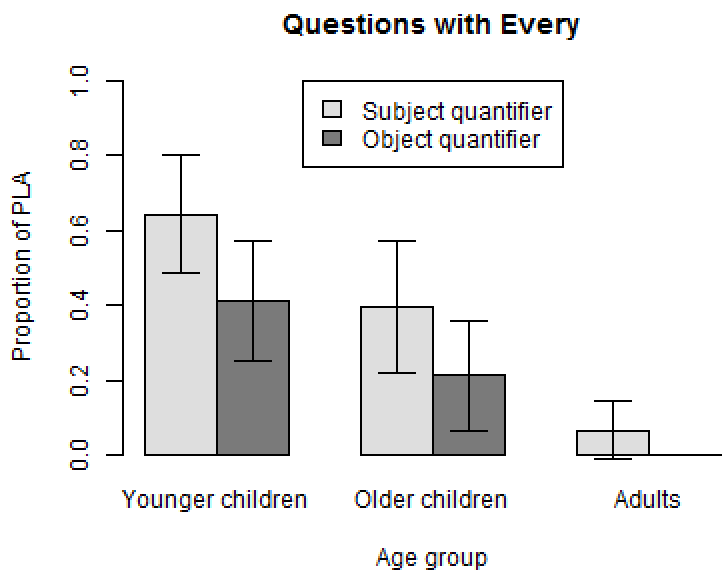

Figure 22. Production of PLAs by age group (*every*)

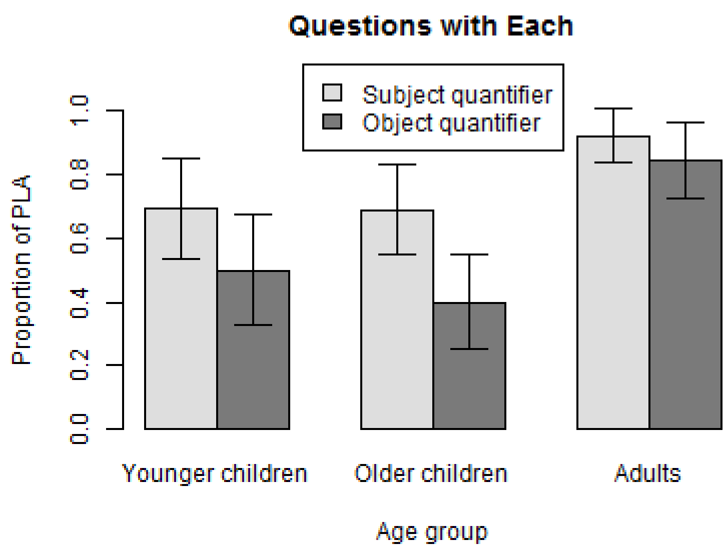

Figure 23. Production of PLAs by age group (*each*)

4.2.3 Discussion

In line with previous results from Roeper & de Villiers (1991), I showed that children do indeed overgeneralize PLAs relative to adults, producing them with *every* questions, regardless of quantifier position. The fact that they did so with *which* object-quantifier questions (claimed to unequivocally bar PLAs) reinforces this observation. Adults did not display the anticipated subject-object asymmetry (allowing PLAs with subject-quantifier questions, but not allowed them with object-quantifier questions), because they seemed to strongly prefer single answers to *every* questions across the board.

The picture was different with *each*. Here, the strongly distributive quantifier was expected to give rise to PLAs more easily (Beghelli 1997, Szabolcsi 1997). This prediction was confirmed by the adults, who – in contrast to their performance with *every* – strongly preferred PLAs with *each*. Children were strikingly different. They not only produced fewer PLAs than adults, but displayed performance similar to those they demonstated in questions with *every*. Thus, children do not seem to have drawn a sharp distinction between the two universal quantifiers.

This observation is not entirely surprising, given the results from recent child language studies, which show that children have a different interpretation of *each* than adults do. For example, Roeper, Pearson & Grace (2011) found that when faced with a choice such as the one shown in Figure 24, and asked to judge two separate sentences (*Every flower is in a vase* and *Each flower is in a vase*), children chose picture C as the best match for the target sentence with *every*, and were evenly distributed across A, B, and C in their choice for the best match for the *each* sentence. By contrast, while adults sometimes found C acceptable for the *each* sentence, they never picked C as the best match.

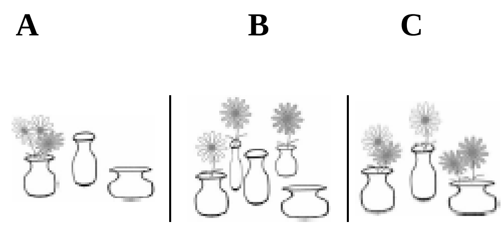

Figure 24. Stimuli for *every* and *each* from Roeper, Pearson & Grace (2011)

Roeper, Pearson & Grace argue that for children, exhaustivity of the quantifier is its defining property (and so children want all vases to be filled), and distributivity is not yet projected as a lexical feature.

Syrett & Musolino (*in press*) also observed that children differed from adults in their interpretation of *each*. When asked to judge sentences such as *Two girls each completed a puzzle* in a scenario in which both girls had worked together to complete one puzzle (a ‘collective’ context), children accepted the sentence, indicating that each of the girls had participated in the puzzle event. Thus, they did not predicate the property ‘complete a puzzle’ of each girl, but rather allowed each girl to have participated in a ‘puzzle completion’ event.

The reasons why children would exhibit non-adult-like behavior with *each* in these experiments and the current one reported here are not completely clear at this point. One explanation might come from the fact that they are still learning what *each* means, and that they interpret it as a quantifier that bears properties of both *every* and *each*, allowing for both weakly and strongly distributive patterns. Possibly, in the child grammar, *every* can rise higher in the tree, just like *each* in the adult grammar. Children could therefore access a PLAs for questions with object *every*. That would explain why the production rates for PLAs are similar for *every* and *each* for children but different for adults. A question remains as to why children do not always produce PLAs to questions with *each*. It is possible that in child language *each* has properties similar to those of *every*, namely it does not always act as a strongly distributive quantifier, failing to take scope over the *wh*-phrase.

In sum, the results reported in this chapter favor an immature lexicon rather than a immature grammar explanation (Roeper & de Villiers, 1993) to the children's previously observed overgeneralization of PLA in questions with *every*. While the data do not reveal when the adult interpretation of *every* and *each* emerge, it should manifest itself when children have fully acquired the distributive properties of each quantifier and can therefore target the right landing site in the syntactic structure.

From many acquisition studies we know that children at the age of four and five have complex and abstract language representations in many domains, such as knowledge of binding principles (Chomsky, 1981) A, B (Wexler & Chien, 1985; Chien & Wexler, 1990), and C (Crain & McKee, 1986); interaction of quantifiers and negation (Musolino, 1998; Musolino et al., 2000; Musolino & Lidz, 2003; Musolino & Lidz, 2006), and syntactic islands (Abdulkarim, Roeper & de Villiers, 1997). All these studies suggest that children's grammars at the age of five are quite developed.

The term 'overgeneralization' of PLAs implies that children are producing PLAs in situations, where adults find such answers unacceptable. While theoretical accounts predict PLAs to be lacking for object-quantifier questions, experimental data from

Chapter I shows that under some circumstances PLAs appear to be possible to object-quantifier questions with *every*. Children, as we could see, also sometimes produce PLAs for object-*every* questions. In that sense, they are not constructing an ungrammatical reading of a question. They access a reading that is for some reason dispreferred, but ultimately possible, as data from adults suggests. If so, our interpretation of the results changes: a different pattern of PLA production among children stems from immature lexicon and, possibly, discourse parsing strategies, not grammar.

I began this chapter by asking whether children's data can help us gain understanding of high acceptability of objet-*every* PLAs in adults (Experiment 1). In adults, this effect may stem from the fact that they treat *every* as being similar to *each*. Acquisition data confirms that insufficient differentiation between the two quantifiers can indeed result in a higher rate of PLAs for questions with object *every*. While children's lexicons might still be developing at the age of five, the immature lexicon explanation is unlikely to apply to adults. It is possible however, that certain discourse manipulations that change the distributive force of a quantifier might lead to *every* acting like *each* in questions. In Chapter III, I discuss that *every* and *each* may differ in the amount of backgrounding these quantifiers require. I discuss in Chapter V that one of the ways to change the backgrounding status of a quantifier and its ability to give rise to PLAs is to convert the quantifier phrase into a question topic.

4.3 Summary

Developmental studies of *wh*-/quantifier interactions were primarily concerned with the fact that children, as late as age five, do not respect constraints on the interpretation of questions with quantifiers, and access the unavailable pair-list readings.

New data on the status of such readings, which some speakers find possible, motivated revisiting the acquisition puzzle. The analysis showed that children indeed generate PLAs in response to object-quantifier questions. However, this behavior is not a result of a general strategy to interpret the quantifier as always taking scope over the *wh*-phrase: children overproduce PLAs only to questions with object-*every*, and underproduce PLAs to questions with object-*each*. This seemingly contradictory behavior does not agree with an immature grammar hypothesis. Instead, it indicated that it is the lexicon, rather than grammar, still developing in children. Possibly, children at the age of four and five, do not have full semantics and pragmatics of universal distributive quantifiers. Once they acquire all the properties of quantifiers, including their distributivity patterns, overgeneralization of PLAs is predicted to disappear.

Looking back at experiments with children and adults, we now see a range of facts that question the structural explanation of the subject-object asymmetry. Under the structural view of the asymmetry, a categorical dichotomy is created: PLAs are available for subject- but not object-quantifier questions. However, the data reveals that not only children, but adults as well, sometimes allow for PLAs to object-quantifier questions. At the same time, most subjects shows sensitivity to the position of the quantifier. In the next chapter I discuss how an information structure account of *wh*-/quantifier interactions could account for all these facts, and what implications this analysis has for developmental data.

CHAPTER V.

THE NATURE OF THE SUBJECT-OBJECT ASYMMETRY

The aim of this chapter is to bring together the data from adults and children, and make an attempt to find an analysis of *wh*-/quantifier interactions that could potentially account for the data. I used experimental tools to test some of the factors predicted to affect the availability of PLAs. The experiments confirmed the role of structure: PLAs to subject-quantifier questions are more acceptable than PLAs to object-quantifier questions. The results, however, go beyond experimental confirmation of theoretical claims. In fact, acceptability judgments reveal that structural position of the quantifier matters not only for *every* but for *each* as well. In other words, lexical effects do not completely cancel the structural constraints – an unexpected result given current analyses of feature-based QR (Beghelli, 1997). Two additional results require explanation: first, relatively high acceptance rates for PLAs to questions with object *every*; and second, the divergence of PLA production patterns between children and adults. I show, that all these results taken together cannot be accounted within a purely structural account of *wh*-/quantifier interaction where syntactic position is assumed to act as a factor that determines the grammaticality, and hence the availability of PLA.

Following the analysis in Krifka (2001) and Eilam (2011), I propose that the conditions on availability of PLAs can be formulated in terms of the information structure of a question. The proposed approach is in line with Chierchia (1993) who argues that *wh*-quantifier interactions should be treated as parallel to WCO effects. However, Eilam (2011) suggests that the WCO effects are handled not by structural constraints, but by information structure restrictions. Thus the treatment of WCO effects proposed by Eilam can be extended to analyze the subject-object asymmetry. The resulting theory agrees with the experimental results and covers a significantly wider range of judgments than initially assumed by Chierchia (1993). I conclude that the subject-object asymmetry is mediated by a combination of structural, semantic, pragmatic, and information structure parameters of a question, including the position of the quantifier, distributive force of the quantifier, which in turn depends on its presuppositional status.

In what follows, I will first give some background on information structure (IS)[16] (section 5.1). The Information Structre (IS) account of WCO and its extension to the subject-object asymmetry is described in 5.2. Some additional evidence in favor of the proposal is discussed in 5.3, and section 5.4 concludes.

5.1 Information structure and scope

A number of studies observed a correlation between a phrase's ability to take wide scope and its status as topic in the information structure of a sentence (Szabolcsi, 1997a; Krifka, 2001; Willis, 2008; Eilam, 2011). In fact, Krifka (2001) and Eilam (2011) argue that a quantifier phrase can only take wide scope if it is a topic (107).

(107) Inverse Binding Generalization: Inverse variable binding is possible iff the intended binder is interpreted as a topic.

(from Eilam, 2011, p. 191)

[16] I will use the term Information Structure (IS) to refer to the IS of sentences and questions. The term is sometimes used in the linguistic literature to refer to the IS of discourse (Roberts, 1996).

In these accounts, the subject-object asymmetry in the availability of wide-scope readings is related to the fact that subjects are naturally found to be topics. Evidence for this generalization comes from the works of Li & Thompson (1976), Reinhart (1981), Lambrecht (1994), Erteschik-Shir (1997), and Krifka (2001).

Following Vallduví (1990), Eilam defines three IS categories: focus, topic and tail. Topic and tail together form the ground. Focus constitutes new information for the hearer (Vallduví, 1990; Ward & Birner, 2001). Focused constituents are marked with stress, pitch, lexical markers, and movement, among others. It is sometimes possible to override the default topic-focus structure by assigning stress to elements other than the subject of a sentence. Eilam' generalizations deal with thematic topics and not contrastive topic[17], the latter constituting a separate linguistic category (for a discussion of contrastive topics see Büring, 1997, 2003, Lee, 1999, 2002, 2006, Vermeulen 2009, Umbach, 2001, Titov 2010, Tomioka, 2010, Wagner, in press).

Eilam uses the following example (108) to illustrate the concepts of IS. In (108) the noun phrase *beavers* is the topic, and the predicate *build dams* is the focus.

(108) a. What do beavers do?

b. Beavers build dams. (from Eilam, 2011, p. 4)

In questions, the meaning of topic and focus is different. Jaeger defines the topic of a question as "what the question primarily requests information about" (2003, p. 187). *Wh-*

[17] Lambrecht (1994) proposes that such terms as "contrastive topic" and "contrastive focus" should be understood in a general, non-grammatical sense. They belong to the study of conversational implicatures. Contrastive focus introduces a correction or a contradiction. Contrastive topic adds a new referent to discourse.

phrases are often found to be IS focus, but they do not contribute new information, instead they are used to request new information. In (109) the *wh*-phrase *What* serves as the focus, and the name *John* is the topic.

(109) [$_{FOC}$ What] did [$_{TOP}$ John] read for the book report?

(from Eilam 2011, p. 40)

Thus, it is commonly assumed in the literature that *wh*-phrases belong to focus (Campos 1986, Rochemont, 1986, Horvath, 1986, Culicover & Rochemont 1983, Lambrecht 1994). However, at least for some examples, the distribution of topic and focus in questions is debated. Vallduví (1990) argues that *wh*-phrases do not necessarily constitute focus of a question from the informational point of view. Jaeger (2003) demonstrates that in Bulgarian *wh*-phrases can be turned into topics when they undergo fronting and are marked with clitic-doubling. Grewendorf (2012) shows that in German *wh*-phrases differ in their ability to serve as topics depending on their D-linking status. *Wh*-phrases occurring in topic position have also been found in Chinese[18] (Xu & Langendoen, 1985, Wu, 1996), Japanese (Miyagawa 1987), and American sign language (Niedle et al., 1998).

5.2 Information structure account of *wh*-/quantifier interactions

The main idea of the IS account of scope is that only the IS topics are allowed to exhibit non-surface scope (Eilam, 2011). On the other hand, inverse scope is impossible for IS foci (Krifka, 2001). I argue that the IS account of inverse scope can explain the observed effect of the subject-object asymmetry both with the quantifier *every* and *each*. I

[18] There is an ongoing debate as to whether *wh*-fronting in Chinese should be considered topic or focus movement. For a discussion see Neidle et al. (1998), Pan (2011).

propose that if the quantifier phrase can be interpreted as a topic, a PLA is possible. For subject-quantifier questions this option is available, as subjects can be topics. Objects are less likely to be topics, and therefore PLAs for object-quantifier questions are harder to access. As a result, we see the effect of the subject-object asymmetry. In what follows, I first show that the IS account is more flexible than structural accounts, and hence it can explain the experimental data better (section 5.2.1). In section 5.2.2, I argue that the IS theory also accounts for the observed differences between quantifier words (*every* vs. *each*) in the availability of PLAs. Finally, section 5.2.3 shows that the IS account of *wh*-/quantifier interaction maintains a structural parallel between questions with quantifiers and WCO effects (Chierchia, 1993). Section 5.2.4 gives a summary of the proposed account.

5.2.1 Judgment variability and the information structure constraints

The fact that PLAs to questions with object quantifiers appear to be at least sometimes is hard to understand under a purely structural view of the subject-object asymmetry. An assumption would have to be made that constraints governing the subject-object asymmetry do not hold for the speakers who accept/produce PLAs to object-quantifier questions. For overproduction of PLA among children, the structural account would entail that children lack certain grammatical constraints – a conclusion quite unlikely in light of the other available evidence on the grammatical development in children of that age.

The IS account in contrast, offers the possibility of a qualitative change in the interpretation of the data. According to Newmeyer (1983), variation among speakers reflects in part the fact that speakers create different contextualizations of the possible readings of a sentence, if that sentence is ambiguous. Thus, variability is actually expected for phenomena that are influenced by information structure. I propose that in the area of PLAs, variability stems from reanalysis of topic-focus configurations of questions. While objects are not normally topics, it is possible to construct contexts that will turn object quantifier phrases into topics. In such contexts, an object quantifier phrase can take wide scope over the *wh*-phrase, and PLA becomes available for an object-quantifier question. In order to illustrate this idea, I will take a story (106) that was used in Experiment 5, and modify it in such a way that a summary line precedes the question with an object quantifier. The summary line (underlined in (110)) is designed to emphasize that the story was about candy bars, making candy bars a topic of the target question. According to the information structure analysis, I predict PLAs to be more available for the *wh*-/quantifier question in (110) where the topic of the question is set to the quantifier phrase.

(110) Princess Belle, Princess Jasmine, and Princess Cinderella are going to have some snacks. Jasmine gets three goodie bags. Inside she finds a Crunch Bar, a Snickers and a Kit Kat bar. She gave a Crunch Bar to Jasmine, and a Kit Kat bar to Belle. <u>This was a story about candy bars.</u> **Which princess got every candy bar?**

If indeed discourse manipulations can facilitate access to object-quantifier PLAs, questions with object universal quantifiers may be ambiguous as well, just like subject-quantifier questions. However, processing costs possibly prevent the reanalysis of objects as topics in most cases, making speakers reject PLAs to object quantifier questions.

Under such a view, PLAs to object-quantifier questions are now not ruled out by the grammar, but made unlikely, given the default topic-focus structure of questions. Speakers can override the default topic-focus structure to a different extent, resulting in the observed between-speaker variation.

Some other context manipulations can also override the standard topic-focus structure of questions and make PLAs possible for object-quantifier questions (Eilam 2011). In the domain of *wh*-/quantifier questions, such manipulations can be illustrated with the following questions:

(111) [$_{\text{TOP}}$ Which student] recorded [$_{\text{FOC}}$ <u>every speech</u>] on camera?

(112) [$_{\text{FOC}}$ Exactly which student] recorded [$_{\text{TOP}}$ <u>every speech</u>] on camera?

(113) Paul recorded the Dean's address, and Jane recorded Dr. Brown's talk.

While (113) is predicted to be impossible as an answer to (111), it seems acceptable as an answer to (112). Examples in (111) and (112) differ in their information structure. In (111) the quantifier phrase *every speech* is the information structure focus, and it is unable to take scope over the wh-phrase *which student*. Topichood of the *wh*-phrase is also supported by the presuppositional status of the *wh*-phrase in this example. *Which*-phrases are lexically D-linked and require the NP set to be introduced in prior context (see section 5.2.2 for further discussion of the relation between D-linking and information structure). On the other hand, in (112) a focus particle *exactly* is added to the *wh*-phrase. Therefore the *wh*-phrase becomes a likely focus and the quantified NP *every speech* is now easier interpreted as topic. As a result, the PLA in (113) is now possible.

The information structure analysis of the subject-object asymmetry predicts that PLAs are sometimes possible for object-quantifier questions if the quantifier phrase can be interpreted as a topic. An important aspect of this principle is that it is conservative enough: it does predict that there are cases where a PLA is not possible at all, for example for questions with negative quantifiers, such as *nobody:*

(114) Who did nobody visit last summer?

(115) *Peter did not visit his parents, and Sue did not visit her best friend.

Accoring to Eilam (2011), negative quantifier phrases are non-referential in nature, and therefore cannot be topics As a result, they cannot take wide scope and make PLAs available, even when they occurs in subject position.

Information structure analysis ties together the variability of adults' data on the one hand, and overproduction of PLAs by children on the other hand. If PLAs to questions with object quantifiers are in fact possible in some circumstance, overproduction of PLAs in children is no longer an indication of their immature grammars. Rather, children's immature lexicon allows them to generate PLAs for questions with object quantifiers, such as *every*, while the majority of adults find these PLAs less acceptable.

5.2.2 D-linking and the information structure status of quantifiers and question words

D-linking is crucially related to topichood in that the D-linked phrases are more likely to be topics than other phrases (Jaeger, 2003; Comorovsky, 1996; Scott, 2003, among others). The IS account of *wh*-/quantifier interaction predicts that the D-linked phrases will thus more likely activate wide scope readings and consequently favor PLAs. This prediction is borne out in the observed difference between *every* and *each* in their ability to give rise to PLAs. Recall that as discussed in section 3.4 of this dissertation, *each* can only be used if a set has been specified in prior discourse, while for *every,* in contrast, the conditions are less strict. Thus *each*-phrases are always D-linked, and hence they are better topics. It is not surprising then that quantifier phrases with *each* can take wide scope at LF, resulting in a PLA, while the parallel questions with *every* are predicted to lack a PLA.

A similar asymmetry arises with regard to question words *which* and *who. Which* is lexically marked as D-linked while the presuppositional status of *who* is not lexically predetermined, and can be specified by the context. As a result, it is easier to override the standard topic-focus structure of a *wh*-/quantifier question with *who*, making the quantifier phrase the information structure topic and as a consequence allowing a PLA. In line with the IS account, a number of authors reported PLAs to be more easily available for questions with *who*-phrases than for questions with *which*.

5.2.3 WCO analysis of the subject-object asymmetry

We can now return to WCO analysis of the subject-object asymmetry proposed in Chierchia (1993). In Chierchia's analysis, the absence of a PLA for object quantifier questions results from the prediction that the quantifier phrase cannot properly bind the functional variable left by *wh*-movement. Recall that in order for a PLA to be available for (116), the quantifier phrase *every book* has to bind the index $_i$ carried by variable *e*. However, this configuration results in a WCO violation, since the variable *e* acts like a pronominal element. Impossibility of variable binding in (116) is parallel to standard WCO configurations, such as in (117). The sentence in (117) is predicted to be ungrammatical under the reading where the quantifier phrase and the pronoun are co-referenced, since the pronoun is not properly bound: there is no antecedent that c-commands the pronoun.

(116) [Which student $_i$ e^{i}_{j} [read [every book] $_j$]]

(117) *[His $_j$ mother [loves [every boy] $_j$]]

This approach predicts the asymmetry to surface with both universal distributive quantifiers, *every* and *each*.

It has long been recognized that not all speakers reject sentences with WCO (Postal 1972, hence the label *weak*). According to Eilam (2011), the ‘weakness’ of WCO can be expected, if these constraints are formulated in terms of information structure and not in terms of syntax/semantics. In the information structure analysis, the WCO results from failure to meet topichood of the binder. In order to reanalyze the information structure of questions, focus is placed on the phrase containing the potential bindee, and the binder needs to be part of the topic. Compare the following pair of examples (118)-(119):

(118) His mother$_i$ will accompany every boy$_i$ the first day of school.

(119) [$_{FOC}$ Only *his* MOTHER] will accompany [$_{TOP}$ *every boy*$_i$] the first day of school.

(from Eilam, 2011, p. 188)

The example in (118) shows a standard WCO effect, where the pronoun *his* is not properly bound by the quantifier phrase *every boy*, resulting in ungrammaticality. Eilam claims that (119) eliminates the WCO effect. Examples in (118) and (119) are minimally different: (119) contains a focus particle *only* which makes the phrase containing the pronoun (the bindee) focused, and as a result the quantifier phrase (the binder) becomes topic. As a topic, the quantifier phrase can now take wide scope and properly govern the pronoun.

If we now adopt Eilam's information structure treatment of WCO, we see that inverse binding of e_i in (116) is degraded due to the fact that object quantifier phrases are not normally topical. Inverse binding is only felicitous, in Eilam's view, when the binder is the IS topic. Therefore inverse binding is difficult to achieve for some object-quantifier questions. Standard WCO treatment of the subject-object asymmetry (Chierchia, 1993) does not predict the possibility of a PLA for questions with object *each*. However, if we adopt Eilam's IS account of WCO, the explanatory force of the WCO analysis of the subject-object asymmetry is greatly increased: we can now also account for the acceptability of PLAs to questions with object *each*. Unlike *every*, *each* is lexically presuppositional (D-linked), and a quantifier phrase with *each* can become a topic even when it occurs in object position. The presuppositionality status of the quantifier, therefore, affects its ability to be a topic, and consequently its ability to give rise to PLAs. In sum, PLAs are available for questions with universal distributive quantifiers, as long as the quantifier phrase serves as IS topic in those questions.

The IS analysis also has all the advantages of relating the *wh*-/quantifier questions to WCO. Thus, it does not involve quantifying into a question (Karttunen 1977) and therefore provides a more elegant semantic analysis of PLAs. Second, from the acquisition perspective, reducing the constraints on the subject-object asymmetry to other more general mechanisms, such as WCO, solves the problem of postulating additional stipulations about the rules of the grammar. From learnability point of view, having fewer principles that have more predictive power is beneficial for a language learner.

5.2.4 Interim summary

We have identified the main factor responsible for availability of wide-scope readings (and hence PLAs) with an IS concept of topichood. An IS approach is better able to explain the attested between-subject variability in the availability of PLAs, and provides a better fit with developmental data than the structural approach because it is capable of taking into account the asymmetry between subjects and objects not only for *every* but crucially for *each* as well, the latter predicted from the structural point of view to show no subject-object asymmetry effects in questions. Finally, the IS account is compatible with the idea that subject-object asymmetry in questions with quantifiers can be reduced to the general mechanisms governing the WCO effects.

5.3 Interpretation of quantifiers: factors beyond the structural position

In the study of quantifier raising in questions, we have seen that (i) adults exhibit variability in the availability of wide-scope readings and (ii) children seem to admit the wide-scope readings even more easily than adults. Other existing studies of Quantifier Raising also find similar patterns of responses. Thus, the proposed theory receives indirect confirmation from experiments showing that the interpretation of quantifiers is affected by non-structural factors.

Syrett & Lidz (2011) investigate antecedent-contained deletion in matrix and embedded clauses. Antecedent-contained deletion is a type of VP ellipsis when the site of ellipsis is contained in its antecedent (Syrett & Lidz 2006, 2011). For (120) QR within the clause corresponds to an interpretation where John wants to visit every city Bill visits; QR to the matrix clause results in the interpretation where John wants to visit every city that Bill *wants to visit*.

(120) John wants to visit [QP every city Bill does]

When the antecedent occurs in a non-finite clause, Quantifier Raising (QR) can target either a landing site within the clause or out of the clause. Quantifier phrases contained within a finite clause are predicted to stay within their clause, as QR is clause-bounded. Only the embedded clause interpretation is predicted to be possible, the one where Mary and Bill visited the same cities.

(121) John said that Mary visited [QP every city Bill did].

(from Syrett & Lidz, 2006)

In a series of experiments children and adults watched a story together with a puppet. At the end of the story the puppet made a statement about the contents. Experimental stimuli were constructed in such a way that the embedded and the matrix interpretations differed in their truth values: one of them was true, while the other was false. A sample test sentence is shown in (122).

(122) Clifford said that Goofy read every book that Scooby did.

b. … *read t* . (*embedded* reading)

c. … *say that Goofy read t* . ($^{*/?}$*matrix* reading)[19]

Syrett & Lidz predict that adults should reject the statement associated with a matrix reading (122) if they are guided by the QR principles of Scope Economy (movement cannot be semantically vacous) and Shortest Move (movement has to target the closes landing site that yields the desired interpretation) (Syrett & Lidz 2006). If children, unlike adults, do not respect the locality conditions on QR, they might accept both the embedded and the matrix interpretations. The results of this study are interesting in two ways. First, while adults indeed prefer the embedded interpretation as expected, some adults nevertheless find the matrix reading possible. Second, children diverge from adults and accept the matrix reading significantly more often.

The authors entertain several explanations for the observed effects. The one that seems most relevant to our study relies on the account of QR that places Scope Economy and Shortest move not in the structural component of QR but outside of the grammar domain into the area of sentence processing. Syrett & Lidz suggest that if QR out of a tensed clause is not strictly ungrammatical, but unlikely due to processing costs or other interpretations being for some reason more likely, then children are not operating

[19] In fact, Cecchetto (2004) suggests that the matrix reading is licensed by the grammar, given the Phase Impenetrability Condition.

different grammatical constraints on QR than adults do. In fact, a small number of adults can access an interpretation involving QR out of a tensed clause, just like children do. Both a small group of adults and children might be computing a costly but not impossible interpretation. Under this view, interpretative constraints on QR, such as Scope Economy and Shortest move, belong to the more general processing component of language.

There are a number of similarities between the study of PLAs and the experiments conducted by Syrett and Lidz (2006). Both studies deal with ambiguity generated as a result of quantifier interpretation. One of the readings, in the case of Syrett & Lidz, the one involving scoping out of tensed clause, and one of the readings in our case – namely the case where object quantifier phrase is taking wide scope over the *wh*-phrase, are predicted to be ungrammatical within theories of QR that rely on structural constraints on raising. Finally, a group of adults in both studies access the supposedly ungrammatical interpretation, just like children do. In the case of Syrett & Lidz, a processing, rather than a purely structural account, gives more accurate predictions about the performance of children and adults in sentences with antecedent-contained deletion. In sum, conditions on the interpretation of quantifiers indeed seem to be influenced not only by the structural positions of the quantifier phrases but processing and discourse factors. Both adult and developmental data that I report in this dissertation, show the effect of discourse on the interpretation of questions with quantifiers: a number of speakers find PLAs possible to object-quantifier questions. I suggest that these PLAs are in fact licensed by the grammar, and restrictions on their availability are of pragmatic nature. In this chapter I suggested how information structure could be one of the ways how discourse affects the interpretation of questions with quantifiers.

5.4 General conclusions

The theoretical approaches to *wh*-/quantifier interactions make subtle predictions and disagree about particular cases. I have examined the subject-object asymmetry in *wh*-/quantifier interactions using experimental tools. On the one hand, all populations of speakers: adult naïve speakers, professional linguists, and children – show sensitivity to the position of the quantifier phrase in its ability to give rise to pair-list readings of a question. On the other hand, some speakers find PLAs to questions with object quantifiers nevertheless acceptable, even though less so than for subject-quantifier questions. I argue that purely structural constraints are unable to capture all the observed data, especially in light of the fact that the asymmetry is present for quantifiers, such as *each*, which are supposed to be able to give rise to PLAs regardless of their grammatical position. Integrating theoretical and experimental perspectives in the study of quantifier interactions gives us a qualitatively new account of the subject-object asymmetry. I suggested that the results are better explained by an account where subject-object asymmetry results from IS constraints.

Establishing a new empirical basis for adult acceptability judgments allowed revisiting the developmental data as well. If earlier it has been assumed that children's pattern of responses is deviant from that of adults, we can now see that in some circumstances adults actually produce PLAs to object-quantifier questions. Thus, what children do is by no means abnormal. Rather, four and five-year olds can be said to somewhat exaggerate a strategy that some adults use: they find inverse scope of the quantifier- and the *wh*-phrase possible in a wider range of circumstances. Children's overproduction of PLAs may be a consequence of a developing language system.

Specifically, I have argued that children have the adult-like knowledge of syntactic structure, but may still be learning the principles that govern discourse structure as well as the discourse-related properties of lexical items (e.g. D-linking).

A systematic study of PLAs allowed controlling the factors related to the experimental procedure, such as the use of expert linguists vs. naïve subjects. Results presented in Chapter IV demonstrate that both naïve subjects and professional linguists can serve as sources of linguistic data. A high degree of agreement exists between naïve subjects and professionals. However, naïve subjects may be more sensitive to task effects. When testing naïve subjects in an acceptability judgment task, one needs to ensure that subjects understand the experimental task as intended. Finally, the agreement in experimental results between the subjects with different levels of expertise does not entail that the non-controlled judgments of experts should always be trusted. The present study revealed that some of the factors which are reported as relevant by experts in the theoretical literature do not actually affect the responses in a controlled experiment, and vice versa - experimental data uncovered important variability which was previously unknown to the experts. For instance, I confirm the role of the quantifier phrase distributivity in the availability of PLAs; but disconfirm the role of plurality associated with the *wh*-phrase.

The information structure analysis assumes that only those quantifier phrases that can be construed as topics are able to take wide scope. Importantly, the information structure constraints allow for between and within subject variability – exactly the effect we observe with PLAs. The proposed analysis also integrates the questions with quantifiers with WCO effects. The reasons why it is the topic status of a phrase that makes inverse binding possible are not completely clear at this point. One possible explanation, that relates topichood and specificity, comes from works of Portner (2002), Portner & Yabushita (2001), and Schwarzschild (2002), among others. Portner (2002) maintains that for indefinites, specificity relates to their interaction with a topical domain. He argues that specificity is a matter of degree: “the narrower the topical domain, the more specific the indefinite” (p. 275). It is possible that universal quantifiers can be specific if they refer to unique individuals/objects present in discourse. In that sense, the notion of specificity is related to D-linking. If a quantifier requires obligatory D-linking, it also has a better chance of entering the topical domain. Therefore, D-linked quantifier phrases allow for inverse binding more easily, resulting in PLAs being possible for questions with such quantifiers.

Historically, theoretical analyses of *wh*-/quantifier interactions developed from viewing the subject-object asymmetry as a general mechanism, to almost eliminating the subject-object asymmetry from the picture, and treating it as applicable to a very narrow subclass of *wh*-phrases and quantifiers. In this dissertation, the subject-object asymmetry is supported with new experimental data, and the theoretical generality of the asymmetry is recast in its relation to information structure.

Appendices

Appendix A: Experiment 1, stimuli

Practice trials

a) Did you see an elephant in the zoo? (7 definitely yes)

Yes, I did.

b) Who gave you this box? (7 definitely yes)

My mum.

c) Where are you from? (1 definitely no)

I don't really like chocolate.

d) Which item is the most expensive in this store? (1 definitely no)

I have never been to Italy.

Critical items

<u>Single answers, questions with a subject quantifier</u>

1. Who did every boy greet at dinner yesterday?

   Mr. and Mrs. Smith.

2. Who did everyone call yesterday?

   Ms. Lamkin.

3. Who did every teacher praise?

   Charles and Carol.

4. Who did everyone see on TV last night?

   The President.

5. Which book did every student read?

   Introduction to General Psychology.

6. Which boy did every girl in class kiss?

   Justin.

7. Which guest did everybody meet at dinner yesterday?

   Mr. Junaid.

8. Which famous landmark did everybody see in Paris?

   The Eiffel Tower.

<u>Single answers, questions with an object quantifier</u>

9. Who took every present from the basket?

   Mickey and Jane.

10. Who took every guest to their room last night?

    The bell boy.

11. Who invited everyone to watch the competition?

    Sarah.

12. Who bought everything for the party?

    The Simpsons.

13. Which applicant completed everything before the deadline?

    Katherine Mitchel.

14. Which musician played every piece at last night's concert?

    Mark Weinstein.

15. Which woman met everybody at the entrance?

    Maria.

16. Which waiter served every patron yesterday?

    Sam.

Pair-list answers (PLAs), questions with a subject quantifier

17. Who did every girl welcome at the ceremony?

    Anne welcomed Ms. White, Jessica welcomed Ms. Johnson, and Julia welcomed Ms. Carpenter.

18. Who did everyone visit for Christmas?

    Patrick visited his mother, Mary visited Ms. Wilson, and Sharon visited Mr. Campbell.

19. Who did every professor email?

    Professor Davis emailed Brian, Professor Gassner emailed Natalie, and Professor Mitchell emailed Kathy.

20. Who did everyone meet in the park yesterday morning?

    Sue met her cousin, John met Mr. Brown, and Tony met Anne.

21. Which sports game did everybody play last week?

    Mark and John played tennis, Bill and Angelica played soccer, and Jenna and Matilda played golf.

22. Which art project did every child make for the teacher?

    Harry made a paper dog, Cynthia made a vase, and Brian made a greeting card.

23. Which family member did everybody visit during Spring Break?

    Jane visited her mom, Caroline visited her grandfather, and Peter visited his sister.

24. Which animal did every zookeeper feed?

    Tom fed the bear, Anne fed the lion, and Jimmie fed the giraffe.

Pair-list answers (PLAs), questions with an object quantifier

25. Who put everything on the platter?

Bill put the chicken salad, Frank put the sandwiches, and Robert put the pasta.

26. Who took every visitor to the welcome party?

    John took Sue, Frank took Lisa, and Harry took Ann.

27. Who kissed everyone on Valentine's Day?

    Jim kissed Kitty, Mary kissed Mike, and Heather kissed Tom.

28. Who decorated every box?

    Kim decorated the big box, Sam decorated the middle-sized one, and Michele decorated the small one.

29. Which student recorded everything on camera?

    Mat recorded the Dean's speech, Dan recorded the President's address, and Helen recorded the Committee talk.

30. Which woman brought every dish to the party?

    Ms. Simpson brought lasagna, Ms. Miller brought Caesar salad, and Ms. Park brought peach cobbler.

31. Which professor recommended every student?

    Professor Collins recommended Jane, Professor Ortiz recommended Emily, and Professor Jacobs recommended Rosemary.

32. Which driver took everybody home last night?

    Tom took Ms. Franko, Bob took Ms. Dombovski, and Jack took Mr. Perkins.

Appendix B: Experiment 2, stimuli

Practice trials and controls are the same as in Experiment 1.

Critical items

Single answers, questions with a subject quantifier

1. Which book did every student read?

   Introduction to General Psychology.

2. Which boy did every girl in class kiss?

   Justin.

3. Which guest did everybody meet at dinner yesterday?

   Mr. Junaid.

4. Which famous landmark did everybody see in Paris?

   The Eiffel Tower.

5. Which toys did every boy bring to kindergarten?

   Cars.

6. Which flowers did everyone grow in their garden this season?

   Roses.

7. Which artists did everybody admire in the 20th century?

   The impressionists.

8. Which singers did every pianist accompany at the concert?

   Luciano Pavarotti and Placido Domingo.

Single answers, questions with an object quantifier

9. Which applicant completed everything before the deadline?

   Katherine Mitchel.

10. Which musician played every piece at last night's concert?

    Mark Weinstein.

11. Which woman met everybody at the entrance?

    Maria.

12. Which waiter served every patron yesterday?

    Sam.

13. Which teachers praised every student after the contest?

    The English teachers.

14. Which doctors vaccinated everybody in the hospital?

    Dr. Tran and Dr. Velardi.

15. Which students read every book this semester?

    Steven and Elise.

16. Which students answered every question during the exam?

    Tiffany and Fred.

<u>Pair-list answers (PLAs), questions with a subject quantifier</u>

17. Which sports game did everybody play last week?

    Mark and John played tennis, Bill and Angelica played soccer, and Jenna and Matilda played golf.

18. Which art project did every child make for the teacher?

    Harry made a paper dog, Cynthia made a vase, and Brian made a greeting card.

19. Which family member did everybody visit during Spring Break?

    Jane visited her mom, Caroline visited her grandfather, and Peter visited his sister.

20. Which animal did every zookeeper feed?

Tom fed the bear, Anne fed the lion, and Jimmie fed the giraffe.

21. Which birds did every girl see during the field trip?

    Lisa saw pigeons, Mary saw robins, and Kelly saw blackbirds.

22. Which berries did everyone pick last weekend?

    Ms. Kleiman picked strawberries, Ms. Grace picked blueberries, and Mr. Alne picked raspberries.

23. Which undergraduates did everyone teach last year?

    Professor James taught Mary and Nikki, Professor Glass taught Kim and Nidia, and Professor Thompson taught Hannah and Caroline.

24. Which crayons did every child use to draw a picture?

    Mike used the blue crayons, Dominic used the red ones, and Lisa used the orange ones.

<u>Pair-list answers (PLAs), questions with an object quantifier</u>

25. Which student recorded everything on camera?

    Mat recorded the Dean's speech, Dan recorded the President's address, and Helen recorded the Committee talk.

26. Which woman brought every dish to the party?

    Ms. Simpson brought lasagna, Ms. Miller brought Caesar salad, and Ms. Park brought peach cobbler.

27. Which professor recommended every student?

    Professor Collins recommended Jane, Professor Ortiz recommended Emily, and Professor Jacobs recommended Rosemary.

28. Which driver took everybody home last night?

Tom took Ms. Franko, Bob took Ms. Dombovski, and Jack took Mr. Perkins.

29. Which salespersons helped everybody today?

    Danielle and Judy helped Ms. Smith, Laura and Kathleen helped Ms. Rowland, and Joanna and Arielle helped Ms. Stephens.

30. Which detectives interviewed every suspect?

    Detectives Jones and Smith interviewed suspect A, Detectives Mills and Holmes interviewed suspect B, and Detectives Richards and Brown interviewed suspect C.

31. Which children ate everything at dinner?

    Sally ate potatoes, Jim ate pasta and Bob ate pizza.

32. Which applicants submitted everything before the deadline?

    Ben and Jack submitted transcripts, Ken and Laura submitted statements of purpose, and Nick and Daniel submitted writing samples.

Appendix C: Experiment 4, stimuli

Questions with a subject quantifier

1. Which sports game did everybody play last week?

   John played tennis, Bill played soccer, and Jenna played golf.

2. Which family member did everybody visit during Spring Break?

   Jane visited her mom, Caroline visited her grandfather, and Peter visited his sister.

3. Which guest did everybody meet at dinner yesterday?

   Laura met George, Harry met Betty, and Scott met Martin.

4. Which book did everybody read for school?

   John read War and Peace, Mary read Of Mice and Men, and Jill read The Catcher in the Rye.

5. Which color shirt did everybody choose for their team?

   Louis chose red, Shannon chose yellow, and Mike chose green.

6. Which fruit did everybody eat as a snack?

   Tom ate an apple, Rick ate an orange, and Kathy ate a strawberry.

7. Which continent did everybody visit last summer?

   Rich visited Europe, Sam visited South America, and Olivia visited Africa.

8. Which state did everybody vacation in last month?

   Sally vacationed in Florida, Paul vacationed in California, and Jamie vacationed in Hawaii.

9. Which vegetable did everybody eat for dinner?

   Valerie ate broccoli, Matt ate cucumbers, and Irene ate cauliflower.

10. Which kitchen appliance did everybody buy for the apartment?

Brian bought the blender, Frank bought the toaster, and Henry bought the can opener.

11. Which art project did every child make last week?

    Allie made a paper dog, Cynthia made a vase, and Ryan made a greeting card.

12. Which animal did every zookeeper feed yesterday?

    Tom fed the bear, Anne fed the lion, and Jimmy fed the giraffe.

13. Which professor recommended every student for the internship?

    Professor Collins recommended Justin, Professor Ortiz recommended Emily, and Professor Jacobs recommended Rosemary.

14. Which breakfast food did every person eat this morning?

    Helen ate waffles, Bob ate pancakes, and Greg ate an omellete.

15. Which beverage did every person drink for lunch?

    Eric drank soda, Martha drank water, and Alice drank juice.

16. Which class did every student take last semester?

    Anna took psychology, Carl took linguistics, and Dan took statistics.

17. Which president did every historian study for their thesis?

    Dr. Smith studied George Washington, Dr. Johnson studied John Adams, and Dr. Brown studied Thomas Jefferson.

18. Which flower did every botanist study last spring?

    Clara studied roses, Steven studied tulips, and Janet studied daffodils.

19. Which mode of transportation did every student take to school this morning?

    Robert took the bus, Gina took the train, and Jack drove a car.

20. Which dessert did every baker make for the event?

    Jim made the cake, Amy made the pie, and Victor made the cookies.

<u>Questions with an object quantifier</u>

21. Which child played every sports game last week?

    John played tennis, Bill played soccer, and Jenna played golf.

22. Which student read every book for school?

    John read War and Peace, Mary read Of Mice and Men, and Jill read The Catcher in Rye

23. Which boy toured every state during Spring Break?

    Louis toured Arizona, Rick toured California, and Tom toured Hawaii.

24. Which tourist visited every continent last summer?

    Sally visited Europe, Paula visited South America, and James visited Africa.

25. Which boy ate every fruit as a snack?

    Rich ate an apple, Tom ate an orange, and Paul ate a strawberry.

26. Which man bought every kitchen appliance for the apartment?

    Brian bought the blender, Frank bought the toaster, and Henry bought the can opener.

27. Which zookeeper fed every animal yesterday?

    Tom fed the bear, Anne fed the lion, and Jimmy fed the giraffe.

28. Which botanist studied every flower?

    Clara studied roses, Steven studied tulips, and Janet studied daffodils.

29. Which historian studied every president for their thesis?

    Dr. Smith studied George Washington, Dr. Johnson studied John Adams, and Dr. Brown studied Thomas Jefferson.

30. Which baker made every dessert for the event?

    Jim made the cake, Amy made the pie, and Victor made the cookies.

31. Which person ignored everybody at the meeting?

    Valerie ignored Melissa, Matt ignored Joe, and Irene ignored Nathan.

32. Which woman corrected everybody in class?

    Sally corrected Paula, Emma corrected Tracy, and Kathy corrected Tim.

33. Which girl called everybody last night?

    Jane called Serena, Caroline called Jamie, and Karen called Jeremy.

34. Which host met everybody at dinner yesterday?

    Laura met George, Harry met Betty, and Scott met Martin.

35. Which professor recommended everybody for the internship?

    Professor Collins recommended Justin, Professor Ortiz recommended Emily, and Professor Jacobs recommended Rosemary.

36. Which person ate everything this morning?

    Helen ate waffles, Bob ate pancakes, and Greg ate an omelette.

37. Which student read everything last semester?

    Anna read Introduction to Psychology, Carl read Syntax, and Dan read Statistical Modeling.

38. Which chef cooked everything last night?

    Robert cooked pasta, Gina cooked chicken, and Jack cooked risotto.

39. Which person packed everything this morning?

    Eric packed the tent, Martha packed the food, and Alice packed the clothes.

40. Which manager sold everything last week?

    Allie sold car insurance, Cynthia sold real estate property, and Ryan sold vacation packages.

Appendix D: Experiment 5, stimuli.

Practice trials, controls and fillers are the same as in Experiment 1.

Critical items

Single answers, questions with a subject quantifier

1. Which book did every student read?

   Introduction to General Psychology.

2. Which boy did every girl in class kiss?

   Justin.

3. Which professor did every applicant meet at dinner yesterday?

   Mr. Junaid.

4. Which famous landmark did every tourist see in Paris?

   The Eiffel Tower.

5. Which professor did each student meet at the conference?

   Professor Edwards.

6. Which problem set did each student finish yesterday?

   Problem set 3 on page 20.

7. Which holiday did each American celebrate in December?

   Christmas.

8. Which patient did each doctor help on Monday?

   Mr. Brown.

Single answers, questions with an object quantifier

9. Which applicant submitted every document before the deadline?

   Katherine Mitchel.

10. Which musician played every piece at last night's concert?

    Mark Weinstein.

11. Which woman met every guest at the entrance?

    Maria.

12. Which waiter served every patron yesterday?

    Sam.

13. Which librarian helped each student yesterday?

    Mr. Wilkins.

14. Which girl bought each toy at the mall?

    Kathy.

15. Which sales manager called each customer Friday night?

    Lauren.

16. Which boy broke each toy car yesterday morning?

    Max.

<u>Pair-list answers (PLAs), questions with a subject quantifier</u>

17. Which sports game did every child play last week?

    Mark and John played tennis, Bill and Angelica played soccer, and Jenna and Matilda played golf.

18. Which art project did every child make for the teacher?

    Harry made a paper dog, Cynthia made a vase, and Brian made a greeting card.

19. Which family member did every student visit during Spring Break?

    Jane visited her mom, Caroline visited her grandfather, and Peter visited his sister.

20. Which animal did every zookeeper feed?

Tom fed the bear, Anne fed the lion, and Jimmie fed the giraffe.

21. Which cat did each girl feed in the morning?

    Lauren fed Morris, Jenna fed Kitty, and Nicole fed Daisy.

22. Which report did each manager write last week?

    Samantha wrote the sales report, Adam wrote the debt report, and Madeline wrote the annual report.

23. Which company did each auditor inspect last year?

    Mr. Green inspected Ernst & Young, Ms. Davidson inspected Wachovia, and Mr. Wiesel inspected Coca-Cola.

24. Which advisor did each freshman choose for the first year?

    Max chose Dr. Greenstone, Larry chose Dr. McCoy, and Lindsey chose Dr. Shah.

<u>Pair-list answers (PLAs), questions with an object quantifier</u>

25. Which student recorded every speech on camera?

    Mat recorded the Dean's speech, Dan recorded the President's address, and Helen recorded the Committee talk.

26. Which woman brought every dish to the party?

    Ms. Simpson brought lasagna, Ms. Miller brought Caesar salad, and Ms. Park brought peach cobbler.

27. Which professor recommended every student?

    Professor Collins recommended Jane, Professor Ortiz recommended Emily, and Professor Jacobs recommended Rosemary.

28. Which driver took every visitor home last night?

    Tom took Ms. Franko, Bob took Ms. Dombovski, and Jack took Mr. Perkins.

29. Which doctor treated each patient last month?

Dr. White treated Helen, Dr. Paterson treated Sue, and Dr. Brown treated Anne.

30. Which woman took each item from the box?

Mary took the pineapple, Jennifer took the melon, and Kim took the big orange.

31. Which detective interviewed each suspect last week?

Detective Jones interviewed suspect A, Detective Smith interviewed suspect B, and Detective Wang interviewed suspect C.

32. Which actor played each part last night?

Bob played Romeo, Sam played Hamlet, and Jim played Macbeth.

Appendix E: Experiment 5, script.

Slide 1.
Big Bird *[click]*, Elmo *[click]*, and Cookie Monster *[click]* are waiting for snacks. Let's see what there is to choose from. *[click x6]* Yum! Our friends are hungry today. Let's see what they get *[click]*.
What did Big Bird, Elmo, and Cookie Monster get?

Slide 2.
Diego *[click]* , Boots *[click]* , and Dora *[click]* are winning prizes. There's a hat *[click]*, a balloon *[click]* , and a Teddy Bear *[click]*. I wonder what they'll win? *[click]* Wow!
What did Diego, Boots, and Dora win?

Slide 3.
Chuckie *[click]* , Suzie *[click]* , and Angelica *[click]* are picking prizes from the carnival. Wow! *[click x9]* There are so many prizes for them to choose from! Suzie picks an Oreo cookie *[click]*, a chocolate chip cookie *[click]*, and a chocolate fudge cookie *[click]*. Angelica picks a blue balloon *[click]*, popcorn *[click]*, and a chocolate chip cookie *[click]*. Chuckie picks a red balloon *[click]*, popcorn *[click]*, and a chocolate fudge cookie *[click]*.
EVERY: Which child picked <u>every</u> cookie?
EACH: Which child picked <u>each</u> cookie?

Slide 4.
Buzz *[click]*, Jessie *[click]*, and Woody *[click]* are playing board games. There's Candy Land *[click]*, Sorry *[click]*, and Monopoly *[click]*. I wonder what they'll play? Woody *[click]*, Jessie *[click]*, and Buzz *[click]* play Candy Land. Then, Buzz decides to play another game. He plays Monopoly *[click]*. Jessie wants to play another game too, so she plays Sorry *[click]*.
EVERY: Which game did <u>every</u> friend play?
EACH: Which game did <u>each</u> friend play?

Slide 5.
Its snack time for Jessie *[click]*, Buzz *[click]*, and Woody *[click]*! Let's see what they have to choose from. *[click x8]* YUM! Jessie chose an orange *[click]* and an apple *[click]*, Buzz chose and orange *[click]*, and Woody chose and orange *[click]* and an apple *[click]*.
EVERY: Did <u>every</u> friend choose an orange?
EACH: Did <u>each</u> friend choose an orange?

Slide 6.
Princess Belle *[click]*, Princess Jasmine *[click]*, and Princess Cinderella *[click]* are playing. Wow! *[click]* Princess Jasmine finds 3 goody bags *[click]*. She looks inside and finds, a Crunch candy bar *[click]*, a Snickers candy bar *[click]*, and a Kit kat candy bar *[click]*. She shares the Crunch candy bar with Cinderella *[click]*, and the Kit Kat candy bar with Belle *[click]*.
EVERY: **Which princess receives <u>every</u> candy bar?**
EACH: **Which princess receives <u>each</u> candy bar?**

Slide 7.
The lions are out to play! There's Nala *[click]*, Simba *[click]*, and Scar *[click]*! What toys will they play with? *[click x6]* Scar gets an apple *[click]* and a scratching post *[click]*, Simba gets the ball of yarn *[click]* and a carrot *[click]*, and Nala gets the toy mouse *[click]* and a bottle of water *[click]*.
Which toy did no lion pick?

Slide 8.
Clifford *[click]*, T. Bone *[click]*, and Cleo *[click]* are tasting ice cream! *[click x3]* Yum! Clifford *[click]*, T. Bone *[click]*, and Cleo *[click]* taste the vanilla ice cream. But T. Bone wants to find another flavor. Oh! *[click]* There's strawberry. Cleo wants to try the chocolate ice cream too! *[click]* Yum!
EVERY: **Which flavor ice cream did <u>every</u> dog try?**
EACH: **Which flavor ice cream did <u>each</u> dog try?**

Slide 9.
Diego *[click]*, Boots *[click]*, and Dora *[click]* are looking for pets! Wow! *[click x6]* There are so many pets for them to choose from! Let's see what pets the friends receive. Boots receives a parrot *[click]* and a dog *[click]*, Diego receives a dog *[click]* and a cat *[click]*, and Dora receives a cat *[click]* and fish *[click]*.
EVERY: **Did <u>every</u> friend receive a dog?**
EACH: **Did <u>each</u> friend receive a dog?**

Slide 10.
The friends are waiting for a surprise! *[click x3]* Wow! *[click]* There are the boxes. Big Bird gets 3 boxes to open *[click]*. He opens the boxes and finds a jump rope *[click]*, a bouncy ball *[click]*, and a toy tiger *[click]*. He shares the jump rope with Elmo *[click]*, and the bouncy ball to Cookie Monster *[click]*.
EVERY: **Which friend receives <u>every</u> toy?**
EACH: **Which friend receives <u>each</u> toy?**

Slide 11.
Mr. Fox *[click]*, Mr. Chicken *[click]*, and Mr. Horse *[click]* are going to have some snacks. Let's see what they have to choose from. *[click x8]* Yum! Mr. Fox chose a bottle of water *[click]* and a bagel *[click]*. Mr. Chicken chose a muffin *[click]* and a bottle of water *[click]*. Mr. Horse chose a bottle of water *[click]* and a bowl of cereal *[click]*.
EVERY: Which drink did <u>every</u> animal pick?
EACH: Which drink did <u>each</u> animal pick?

Slide 12.
Dori *[click]*, Nemo *[click]*, and Bruce *[click]* are about to go swimming! *[click x3]* But there are three pools for them to choose from! Dori *[click]*, Nemo *[click]*, and Bruce *[click]* swim in the red pool first. Then, Nemo *[click]* decides to swim in the blue pool, and Bruce *[click]* decides to swim in the yellow pool.
EVERY: Which pool did <u>every</u> fish use?
EACH: Which pool did <u>each</u> fish use?

Slide 13.
The animals are out to play! There's Mr. Cat *[click]*, Mr. Dog *[click]*, and Mr. Mouse *[click]*. I wonder if they'll pick any flowers? *[click x4]* Mr. Dog picks the red flower *[click].* Mr. Cat picks the blue flower *[click]*. Mr. Mouse wanted to look at flowers too! So he picks the yellow flower *[click]*.
Which flower did no animal pick?

Slide 14.
SpongeBob *[click]*, Patrick *[click]*, and Squidward *[click]* are feeding their pets. Aww! *[click]* What cute puppies! Patrick gets with white puppy *[click]*, the brown puppy *[click]*, and the black puppy *[click]* to feed. He feeds them all *[click x3]*. But the white puppy is still hungry, so he goes over to Squidward *[click]* who feeds him also *[click]*. The black puppy is still hungry too, so he goes over to SpongeBob *[click]*, who feeds him also *[click]*.
EVERY: Which character fed <u>every</u> dog?
EACH: Which character fed <u>each</u> dog?

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