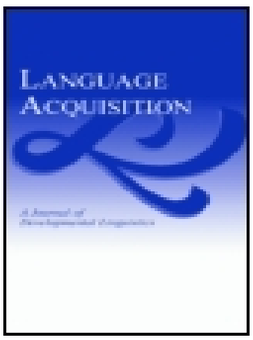

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NPI licensing and beyond: Children's knowledge of the semantics of any

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Abstract

This paper presents a study of preschool-aged children's knowledge of the semantics of the negative polarity item (NPI) *any*. NPIs like *any* differ in distribution from non-polarity-sensitive indefinites like *a*: *any* is restricted to downward-entailing linguistic environments (Fauconnier 1975, 1979; Ladusaw 1979). But *any* also differs from plain indefinites in its semantic contribution; *any* can quantify over *wider* domains of quantification than plain indefinites. In fact, on certain accounts of NPI licensing, it is precisely the semantics of *any* that derives its restricted distribution (Kadmon & Landman 1993; Krifka 1995; Chierchia 2006, 2013). While previous acquisition studies have investigated children's knowledge of the distributional constraints on *any* (O'Leary & Crain 1994; Thornton 1995; Xiang, Conroy, Lidz & Zukowski 2006; Tieu 2010), no previous study has targeted children's knowledge of the semantics of the NPI. To address this gap in the existing literature, we present an experiment conducted with English-speaking adults and 4–5-year-old children, in which we compare their interpretation of sentences containing *any* with their interpretation of sentences containing the plain indefinite *a* and the bare plural. When presented with multiple domain alternatives, one of which was made more salient than the others, both adults and children restricted the domain of quantification for the plain indefinites to the salient subdomain. In the case of *any*, however, the adults and most of the children that we tested interpreted *any* as quantifying over the largest domain in the context. We discuss our findings in light of theories of NPI licensing that posit a connection between the distribution of NPIs and their underlying semantics, and conclude by raising further questions about the learnability of NPIs.

1 Introduction

Across languages we find a class of items that are sensitive to the monotonicity of the environment in which they appear. Negative polarity items (NPIs) such as *any*, for example, are licensed in the scope of negation as in (1), but are ill-formed in affirmative declarative sentences such as (2).

(1) Jack did not pick any mushrooms.

(2) *Jack picked any mushrooms.

NPIs are expressions that are restricted to *negative* environments; without an appropriate licenser they are ungrammatical. A great deal of the extensive literature on NPI licensing has been devoted to characterizing the environments that license NPIs (see among others, Fauconnier 1975, 1979; Ladusaw 1979; Heim 1984; Linebarger 1987; Horn 1989; Kadmon & Landman 1993; Krifka 1995; Giannakidou 1998; von Fintel 1999; Chierchia 2013). One very productive line of research is built upon the Fauconnier-Ladusaw hypothesis, according to which NPIs are licensed in the scope of downward-entailing (DE) operators, i.e. operators that license subset inferences (3)-(4) (Ladusaw 1979, among others).[1]

(3) A function of type $<\sigma,\tau>$ is downward entailing iff for all *x*, *y* of type σ such that $x \Rightarrow y : f(y) \Rightarrow f(x)$.

(4) An NPI is only grammatical if it is in the scope of an α such that $[\![\alpha]\!]$ is downward-entailing. (von Fintel 1999:100)

[1]For example, the negative quantifier *no*-NP is DE (i) and licenses *any* (ii), while the existential quantifier *some*-NP is not DE (iii) and fails to license *any* (iv).

(i) No children played games ⇒ No children played board games

(ii) No children played any games at the cottage.

(iii) Some children played games ⇏ Some children played board games

(iv) *Some children played any games at the cottage.

Another observation about *any* is that it is a *domain widener*. It widens previously restricted domains of quantification along contextually given dimensions, giving rise to a reduced tolerance of exceptions (Kadmon & Landman 1993). This is best illustrated with an example. Consider (5).

(5) A_1: Do you have a camera?

B_1: No.

A_2: Nothing too fancy, even a plain old disposable camera will do.

B_2: No, I don't have ANY cameras.

Imagine that one takes the initial domain of quantification starting with A's query to be contextually restricted to digital cameras of a decent grade, excluding one-time-use disposable cameras. The domain of quantification of *any* in B_2 is *wider* than the initial restriction introduced in A_1. This larger domain includes even basic disposable cameras, which were initially treated as exceptions to the domain.[2] In this sense, *any* is less tolerant of exceptions to the domain. Notice also that domain widening does not arise if we reverse the order of the indefinites, as in (6), even if the indefinite *a* is focused (see Chierchia 2013 for details).

(6) A_1: Do you have any cameras?

B_1: No.

A_2: Nothing too fancy, even a plain old disposable camera will do.

B_2: #No, I don't have A camera.

[2]Notice that B could also reply with: *In that case, yes, I have some*. This suggests that the initially restricted domain did not include disposable cameras (hence B's initial negative response), but was subsequently expanded to include disposable cameras (hence B's changing his response to *yes*).

In the present study, we are interested in when and how young children acquire an adult-like representation of *any* – not just of its restricted distribution, but also of its meaning. A small handful of previous acquisition studies have reported that children are sensitive to the *licensing condition* of the NPI from as early as we can test them. In particular, children restrict *any* to the scope of licensers such as negation from as early as 2;00 by measures of production, and from as early as 3;06 by experimental measures (O'Leary & Crain 1994; Thornton 1995; Xiang, Conroy, Lidz & Zukowski 2006; Tieu 2010). No previous study, however, has targeted children's knowledge of domain widening. We designed an experiment to address this gap in the existing developmental literature. Before we turn to the experiment, however, we would first like to sketch one formal proposal of the semantics of *any*.

2 The semantics of any

Moving beyond a descriptive characterization of the DE licensing condition, Kadmon & Landman (1993) attempted to explain why NPIs ought to be sensitive to a logical notion such as downward entailment.[3] According to their influential thesis, the restricted distribution of *any* can be derived as a consequence of the fact that *any* widens the domain of quantification, as was demonstrated in (5).

According to Kadmon and Landman's analysis, the key to licensing *any* is the following: widening must yield a stronger assertion. That is, the statement on the *widened* interpretation (i.e. after domain widening) must entail the statement on the narrower interpretation. This proposal provides an explanation for why *any* is restricted to DE

[3]We assume the DE account for the purposes of our discussion, and do not seek to tease apart alternative accounts of licensing. The focus of our study is the domain widening property of *any*, which can be discussed independently of the particular view of licensing that one chooses to adopt. The experiment that we present in Section 4 does not hinge on a particular account of NPI licensing.

environments: *any* widens the domain of quantification, and it is precisely in DE environments that widening results in a stronger assertion. A clear example of this is when *any* appears in the scope of negation. Negatively quantifying over a larger domain yields a stronger assertion than the same negative assertion quantifying over a narrower domain. We can illustrate this with the examples in (7) and (8).

In the upward-entailing (7), the strongest assertion one can make, given the three alternatives, is the one quantifying over the narrowest domain (D, containing the students in the Harvard linguistics lounge). But negation, like other DE operators, reverses the direction of entailment in (8), such that the strongest assertion of the three alternatives is the one that quantifies over the largest domain (D", containing the students on the Harvard campus):

(7) a. I saw a student [D: in the Harvard linguistics lounge]

b. I saw a student [D': in the Harvard linguistics building]

c. I saw a student [D": on the Harvard campus]

(8) a. I didn't see a student [D": on the Harvard campus]

b. I didn't see a student [D': in the Harvard linguistics building]

c. I didn't see a student [D: in the Harvard linguistics lounge]

(where $D \subset D' \subset D''$)

For Kadmon and Landman, the domain widening property of *any* was rooted in its lexical semantics; the authors did not develop a compositional analysis.

In more recent work building on these insights and on a proposal in Krifka (1995), Chierchia (2006, 2013) provides a compositional implementation of the semantics of *any*. Under Chierchia's analysis, *any* is truth-conditionally equivalent to a plain indefinite such as *some* or *a* (9).

(9) $[\![\text{any}]\!] = [\![\text{some}]\!] = \lambda P \lambda Q \exists x \in D[P_w(x) \wedge Q_w(x)]$

A sentence like (10a) would correspond to the same literal meaning as the sentence *Jack has some cameras*, represented as in (10b). *Any* is different from plain indefinites, however, in that it activates a set of domain alternatives, i.e. alternative domains of quantification. In our example, *any* invokes alternative subtypes of cameras, let's say disposable one-time use cameras, digital point-and-shoot cameras, and high-end single lens reflex cameras, represented schematically as in (10c). Given these (sub)domain alternatives, (10b) essentially amounts to saying that Jack has one or more cameras in D (i.e. one or more disposable, point-and-shoot, or SLR cameras), represented as in (10d).

(10) a. *Jack has any cameras

b. $\exists x \in D[camera_w(x) \wedge have_w(j, x)]$

c. $\{d, p, s\}$
$\{d, p\}$ $\{p, s\}$ $\{d, s\}$
$\{d\}$ $\{p\}$ $\{s\}$

d. $[camera_w(d) \wedge has_w(j, d)] \vee [camera_w(p) \wedge has_w(j, p)] \vee [camera_w(s) \wedge has_w(j, s)]$

(adapted from Chierchia (2013):166, Ex. 45)

Once alternatives are activated, they must be factored into meaning, and this is carried out via the process of exhaustification. In the case of NPIs like *any*, alternatives are exhaustified via a covert 'only'-like operator (11), which eliminates alternatives that are not entailed by the assertion. As a consequence, the assertion is stronger than all of the activated alternatives.

(11) $O_c(p) = p \wedge \forall q \in C[q \rightarrow p \subseteq_C q]$, where $C = ALT$

But we run into a problem when we attempt to exhaustify the alternatives in (10), as shown in (12). Negating the stronger alternatives amounts to saying that Jack doesn't have any of the specific kinds of cameras, which is in contradiction to the assertion that he does have one or more of these cameras. In fact, this problem generalizes to all upward-entailing environments, in which none of the alternatives will be entailed by the assertion and will have to be eliminated, thus yielding a logical contradiction.[4]

(12) a. $O(\exists x \in D[camera_w(x) \wedge have_w(j,x)])$

b. $[camera_w(d) \wedge has_w(j, d)] \vee [camera_w(p) \wedge has_w(j, p)] \vee [camera_w(s) \wedge has_w(j, s)] \wedge \neg([camera_w(d) \wedge has_w(j, d)]) \wedge \neg([camera_w(p) \wedge has_w(j, p)]) \wedge \neg([camera_w(s) \wedge has_w(j, s)])$

(adapted from Chierchia (2013):166, Ex. 45)

Exhaustification is consistent however, in a DE environment such as (13a,b). Again, the set of subdomain alternatives corresponds to the more restricted domains of quantification in the context, yielding the assertion in (13c). In this case, as in any DE environment, the relevant alternatives are all entailed, so exhaustification does not yield a logical contradiction (13d). If Jack doesn't have any cameras, it follows that he doesn't have any specific kinds of cameras. In other words, (13a) has the effect of a plain negated existential statement.

(13) a. Jack doesn't have any cameras

b. $\neg\exists x \in D[camera_w(x) \wedge have_w(j,x)]$

[4] Note that Chierchia's analysis includes both a syntactic and semantic component of licensing. Obligatory exhaustification is syntactically encoded via a [+D (omain)] feature on *any*, which must be checked by an exhaustifying operator that bears the same feature. In an upward-entailing environment, the [+D] feature on *any* can still be checked by the O operator, i.e. satisfying the syntactic requirement. However, exhaustification will fail to yield a consistent semantics, i.e. failing to satisfy the semantic requirement of NPI licensing. It is the latter that renders *any* ungrammatical in upward-entailing environments.

c. $\neg([camera_w(d) \wedge have_w(j, d)] \vee [camera_w(p) \wedge have_w(j, p)] \vee [camera_w(s) \wedge have_w(j, s)])$

d. $O(\neg\exists x \in D[camera_w(x) \wedge have_w(j, x)]) = \neg\exists x \in D[camera_w(x) \wedge have_w(j, x)]$

(adapted from Chierchia (2013):166, Ex. 47)

We have thus derived the distribution of the NPI. *Any* activates subdomain alternatives that must be exhaustified. Given this exhaustification succeeds only in DE environments, we can explain why *any* is restricted to such environments.

Finally, Chierchia's proposal also provides an explanation for the observed contrast in (5) and (6), repeated below:

(14) A_1: Do you have a camera?

B_1: No.

A_2: Nothing too fancy, even a plain old disposable camera will do.

B_2: No, I don't have ANY cameras.

(15) A_1: Do you have any cameras?

B_1: No.

A_2: Nothing too fancy, even a plain old disposable camera will do.

B_2: #No, I don't have A camera.

Recall that in (14), the domain of *any* in B_2 is *wider* than the initial restriction in A_1. Yet when we reverse the order of *a* and *any*, as in (15), no domain widening is observed. Under Chierchia's proposal, this difference falls out rather naturally from the nature of the alternatives of the respective indefinites. The widening effect in (14)-B_2 arises from contrastively focusing *any*. Since the focal alternatives of *any* are its domain alternatives, the

discourse in (14) satisfies conditions on contrastive focus by providing an appropriate antecedent (Rooth 1992); in other words, the wider domain of *any* in B_2's assertion is contrasted with the more restricted domain of *a* in A_1's assertion. In contrast, focusing *a* fails to widen the domain in (15); it is ineffective here because the focal alternatives of plain indefinites are not domain alternatives, but rather functions of the same type (e.g., giving rise to alternatives such as *I don't have two cameras, I don't have every camera*, etc.).

To summarize, *any* activates domain alternatives. The requirement that these alternatives be exhaustified offers an explanation of the NPI's restricted distribution, as exhaustification succeeds only in DE environments. The particular nature of the NPI's alternatives, on the other hand, offers an explanation of why *any*, but not plain indefinites, exhibits *domain widening* in situations of contrastive focus.

3 The acquisition of *any*

3.1 Previous studies

There have been a small handful of studies that have examined children's knowledge of *any*. All of these studies targeted children's knowledge of the distributional constraints on the NPI. We briefly summarize the findings of these studies below.

3.1.1 Spontaneous production of *any*

Tieu (2010, 2013) presented an analysis of the spontaneous production of 40 children acquiring American and British English as a first language, whose transcripts are available on the CHILDES database (MacWhinney 2000). In determining whether children were target-like in their knowledge of *any* from the point at which they began to produce it spontaneously and productively, two aspects of the children's spontaneous production data were examined: (i) their rates of licensed vs. unlicensed *any*, which provided an indication of, among other

things, whether the children were target-like in their knowledge of the licensing condition on *any*; (ii) the environments in which *any* appeared, and in particular, the diversity of licensers, which provided an indication of whether children had productive knowledge of a general DE licensing condition on *any*. Consider the results for the 26 children who produced a minimum of 15 instances of NPI *any* over the entirety of their transcripts (with *any* emerging as young as 2;00). The main finding was that both the American and British groups of children made very few grammatical or licensing errors with respect to *any*. The NPI was correctly produced as a determiner (sometimes appearing with an elided NP) (16), as part of complex indefinites such as *anything* and *anybody* (17), and as part of the adverbial *anymore* (18):

(16) a. Adam (Brown corpus), Transcript 34 (age 3;07,07), Line 80

CHI: I don't have <u>any</u> toys in here .

b. Naomi (Sachs corpus), Transcript 91 (age 4;07,28), Line 1070

CHI: he didn't want <u>any</u> .

(17) a. Adam (Brown corpus), Transcript 34 (age 3;07,07), Line 45

CHI: I didn't see <u>anything</u> .

b. Sarah (Brown corpus), Transcript 67 (age 3;06,30), Line 466

CHI: I don't hear <u>anybody</u> there .

(18) a. Adam (Brown corpus), Transcript 54 (age 4;10,02), Line 579

CHI: I can't make it go <u>anymore</u> .

b. Nina (Suppes corpus), Transcript 44 (age 3;00,16), Line 1962

CHI: I'm gonna close it (be)cause it's not raining outside <u>any more</u> .

Importantly, children made very few NPI licensing errors; moreover, those licensing errors that did occur were interspersed among adult-like usage of the NPI. Of the 1724 total instances of NPI *any* across the 26 children, under 3% were categorized as licensing errors.[5] The children were therefore generally quite target-like with respect to licensing; no child appeared to exhibit a developmental stage characterized by lack of a licensing condition on *any*.

Some children also appeared to generalize beyond sentential negation, although sentential negation was by far the most frequent licenser in both the children's and caregivers' production. Abe (Kuczaj corpus, Kuczaj 1977), for example, produced *any* in the scope of sentential negation, negative quantifiers, *never* (which in addition to being DE, also has the logical property of anti-additivity), *without* (also anti-additive and DE), in *if* -conditionals, *in case*-conditionals, and in comparative constructions.

In sum, young children's spontaneous production reveals a target-like distribution of *any*. Wherever the children produced *any* spontaneously, they produced it in a target-like manner. Moreover, some children were able to use *any* with DE operators beyond sentential negation. The surface distribution of *any* suggests productive knowledge that *any* must be licensed in the scope of a DE operator.

3.1.2 Elicited production of *any*

Conclusions from the single reported elicited production study of *any* converge with the conclusions that can be drawn from the spontaneous production data: children know how to restrict *any* to the scope of licensers in their production. O'Leary & Crain's (1994) study

[5]The error rate was calculated based on instances of NPI *any* that appeared in plausibly positive/upward- entailing environments, as well as those that appeared in unclear contexts (where it was impossible to determine based on context whether the child had intended a negative meaning).

(reported in Gualmini 2004) used an elicited production paradigm to elicit DE and non-DE environments from 11 children (4;04–5;04). In the condition shown in (19), the authors found that children never produced *any* outside the scope of negation, i.e. in a positive declarative, even when *any* appeared in the prompt. In contrast, children had no problem producing *any* when it could appear in the scope of negation, as in (20).

(19) *Situation:* Some dogs were hungry, and every dog eventually ate some food.

a. *Test sentence:* Only one dog got any food.

b. *Experimenter prompt:* What really happened?

Children's responses: No every dog got **some** food! / *No, every dog got **any** food!

(20) *Situation:* Some dogs are hungry; only one dog decides not to eat.

a. *Test sentence:* Every dog got some food.

b. *Experimenter prompt:* What really happened?

Children's responses: No, this dog did not get **any** food! / No, this dog did not get **some** food!

(Gualmini 2004:960)

In sum, children have been shown to restrict *any* to the scope of a licenser in both spontaneous and elicited production.

3.1.3 Comprehension of *any*

Other experimental evidence of children's target-like knowledge of licensing comes from studies of children's comprehension of *any*. Thornton (1995) tested children's comprehension of questions containing NPI *any* and negation such as the following:

(21) a. Did **any** of the turtles not buy an apple?

b. Didn't **any** of the turtles buy an apple?

Thornton conducted the test with 10 children (3;06–4;11) and found that these children had no problem interpreting *any* with respect to negation, pointing 93% of the time to the turtle that hadn't bought an apple in response to (21a), and pointing 85% of the time to the turtle(s) that had bought an apple in response to (21b). Such findings suggest that by 3;06, children can correctly interpret *any* as an existential in questions and under negation.

Finally, Xiang, Conroy, Lidz & Zukowski (2006) used a Truth Value Judgment Task (TVJT) (Crain & Thornton 1998, 2000) to compare children's comprehension of negative declaratives containing *a*, *some*, and *any*. These three existential indefinites differ in their possible scope interactions with negation. In particular, *any*, as an NPI, must take scope under negation. Using contexts that biased towards wide scope readings of the indefinites, Xiang et al. tested whether children would interpret each of the indefinites as scoping above negation. An example item is provided in (22).

(22) "Hi, my name is Joe. I am eating dinner. My mom said I have to eat all my dinner before I can have dessert. I really don't like peas. But I guess they are healthy. Ok, I will try and eat them. There, I did a pretty good job. There are only a few peas left, and those are mushy. I don't think I am supposed to eat the mushy peas. I will probably get my dessert!"

PUPPET: I was listening to the story, and I know what happened!

a. A-condition: Joe didn't eat a pea.

b. SOME-condition: Joe didn't eat some peas.

c. ANY-condition: Joe didn't eat any peas.

Given that the character in the story ate all but a single pea (*a*-condition) or all but a few peas (*some*/*any* conditions), participants were expected to accept the test sentences if the indefinites were allowed to take wide scope with respect to negation (i.e. *There is a pea that Joe didn't eat* / *There are peas that Joe didn't eat*), and to reject the test sentences if the indefinites took narrow scope (i.e. *It is not the case that Joe ate a pea* / *It is not the case that Joe ate (some) peas*). The test was conducted with 17 children $(4;05-5;05, M = 4;10)$. The main finding was that children accessed a wide scope interpretation of *a* and *some* between 60–70% of the time, but did so for *any* less than 10% of the time. The authors thus concluded that the children understood the NPI status of *any*.

To summarize, measures of elicited production and comprehension suggest that by three to four years of age, children correctly restrict *any* to the scope of negation in both production and comprehension.

3.2 Targeting the semantics of *any*

In light of these previous studies of the acquisition of NPI licensing, let us briefly consider what the target of acquisition is. To have knowledge of the DE licensing condition, the child must have knowledge of the logical property of DEness, such that licensing can be generalized beyond any single operator. Unless the child could generalize to the set of DE operators, she would have to learn each individual licenser on a case-by-case basis. While we will not specifically examine the acquisition of DEness independently of its role in licensing NPIs, we briefly mention here one line of research in this area, and direct the interested reader to these relevant works.

Gualmini & Crain (2002) have argued that data indicating relevant entailment relations are unlikely to be available in sufficient quantity; instead, they propose that entailment relations displayed by certain DE quantifier determiners follow from their

meaning, and given a restricted hypothesis space, children only have to entertain a small number of the logically possible hypotheses about determiner meanings. According to these authors, children can be shown to be adult-like in classifying expressions as either DE or non-DE, because natural languages do not differ in their classifications of DE vs. non-DE expressions. In contrast, children may not necessarily be fully adult-like in classifying NPIs, because what constitutes an NPI can differ from language to language.[6] Crain & Thornton (2006) provide further discussion motivating the innate specification of downward entailment as part of Universal Grammar, discussing the universality of key properties of DE expressions as well as a substantial body of experimental evidence showing that 4-year-olds are sensitive to the properties of DE operators.[7] Since the main focus of our investigation will be on the semantic/quantificational properties of *any*, we refer the reader to the existing literature on the acquisition and learnability of DEness without taking a particular stance on how it is acquired.

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[6]In fact, NPIs also exhibit variation within a single language; see, for example, Israel (2011) for a sub-categorization of NPIs in English.

[7]One of the properties of DE expressions is that they give rise to so-called 'conjunctive entailments' of disjunction (Chierchia 2004), as shown in (i)–(iii).

(i) The runner did not receive a medal or a cash prize.

⇒ The runner did not receive a medal and the runner did not receive a cash prize.

(ii) Every runner who received a medal or a cash prize did an interview.

⇒ Every runner who received a medal did an interview and every runner who received a cash prize did an interview.

(iii) If the runner received a medal or a cash prize, he was obliged to give an interview.

⇒ If the runner received a medal, he was obliged to give an interview and if the runner received a cash prize, he was obliged to give an interview.

A number of studies have shown that 4–5-year-olds are sensitive to these conjunctive entailments (Chierchia, Crain, Guasti & Thornton 2001; Gualmini, Crain, Meroni, Chierchia & Guasti 2001; Gualmini & Crain 2002, 2004); for example, children compute the conjunctive entailment in the restrictor but not the scope of the universal quantifier *every*, suggesting they know that the restrictor is DE but the scope is not.

According to semantic analyses of *any*, the restricted distribution of the NPI has a principled source; it derives from the NPI's semantics. Given this, one could posit the following hypothesis. Strictly speaking, what the child has to acquire is not the licensing condition on *any*, i.e. its restricted distribution. Rather, what the child has to acquire is its lexical semantics, and this in turn should lead to its restricted distribution. In other words, if the restricted distribution (i.e. the licensing condition) of *any* derives from its semantics (i.e. obligatory activation and exhaustification of domain alternatives, etc.), then once the child acquires the semantics, the licensing condition should follow. If we find that children are target-like with respect to the licensing condition, we might also be compelled to conclude that they have target-like knowledge of the semantics of *any*.

But we would like to point out that this latter conclusion should not be taken for granted. Even if we presuppose a connection between the NPI's semantics and its surface distribution, sensitivity to the licensing condition is at best indirect evidence for knowledge of the underlying semantics; the former does not necessarily entail the latter. In particular, it is conceivable that young children might treat *any* as simply a "negative counterpart" of existential indefinites like *some*. In other words, children who look target-like may simply have caught on to the superficial restricted distribution of *any* without making any deeper generalizations about its meaning. A possible scenario that must be ruled out, for example, is one in which the child, perhaps in an initial stage of development, hypothesizes a single categorial representation of an existential indefinite that must be realized as *some* in positive environments and as *any* in negative environments.[8] On the surface, the child would appear to

[8]See, among others, Klima (1964) and Lakoff (1969) for original discussion of the idea (and subsequent arguments against the idea) that *any* and *some* are alternative forms, the former of which surfaces in so-called "affective" contexts. Our point is not to endorse or argue against this kind of theoretical proposal concerning the state of the *any*/*some* dichotomy in the adult grammar; rather, we wish to point out that if a child learner hypothesized a superficial relationship of complementary distribution between the two,

have adult-like knowledge of *any*, passing all of the tests that were described in the previous section. Such a scenario, however, would involve a substantive gap in the child's knowledge; such a child would have yet to acquire the target semantics of *any*.

Finally, considerations of the caregiver input provide a further reason not to make the assumption that a child who adheres to the licensing condition on *any* automatically has an adult-like representation of its semantics. In particular, Tieu (2013, 2015) provides an analysis of samples of caregiver input, which reveals rather consistent positive evidence for the grammatical status of *any* in the scope of licensers such as negation, but very little, if any, evidence for the semantics of *any*. Tieu reports that of 577 instances of NPI *any* produced by a caregiver in the Lara, Kuczaj, and Warren corpora from the CHILDES database (Rowland & Fletcher 2006; Kuczaj 1977; Warren-Leubecker 1982; Warren-Leubecker & Bohannon 1984), 75% involved *any* occurring in the scope of sentential negation, such as (23a,b). In contrast, there was only one potential case of domain widening out of the 577 instances, provided below in (24).

(23) a. FAT: we don't have any hot chocolate. (Kuczaj, Transcript 118, Line 19)

b. MOT: Lara hasn't got any shoes on. (Lara, Transcript 100, Line 252)

(24) MOT: no, the rabbit is silent.

CHI: only they can make rabbit noise.

MOT: well, what kind of rabbit noise?

CHI: oo!

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without postulating any deeper semantic differences, s/he would appear target-like on the existing spontaneous and experimental measures. See also Musolino (1998) and Gualmini (2004) for further relevant discussion.

MOT: no, I don't think the rabbit makes **any** noise. (Warren, George transcript, Line 456)

In other words, children clearly receive more evidence for the restricted distribution of the NPI than they do for the semantics of the NPI. This provides yet another reason to more precisely target children's knowledge of the semantics of *any*, before concluding that they have an adult-like representation of the NPI.

In summary, previous production and comprehension studies indicate that children as young as 2;00 have knowledge of the licensing condition on *any*. But none of these previous studies specifically targeted children's sensitivity to the semantic differences between *any* and plain indefinites that we discussed in Section 2. In particular, no study has examined whether children can associate *any* with a wider domain of quantification than that of plain indefinites. Children's target-like performance involving *any* might reflect target-like knowledge of its distributional requirements, but it does not directly tell us anything about their knowledge of the semantics of *any*. In the next section, we present experimental results that address this gap in empirical coverage.

4 Experiment

4.1 Method

4.1.1 Participants

We tested 92 English-speaking children $(3;05-5;08,\ M=4;03)$ in Connecticut and Maryland preschools. Twenty of the children were excluded from the analysis, as they failed

to answer correctly on at least 75% of control trials.[9] We present here the results from the remaining 72 children (35 female) $(3;06-5;08,\ M=4;04)$. Children were randomly assigned to one of three target conditions or to one of three control conditions. In all, 42 children were tested across the three target conditions and 30 children were tested across the three control conditions. The mean age for both test and control groups was 4;04.

We also tested 145 adult native speakers of English, who were likewise randomly assigned to one of the three target conditions or to one of the three control conditions. Of the 145 participants, 72 adults participated in the target conditions, and 73 participated in the control conditions. All adult participants were undergraduate linguistics and/or psychology students at the University of Connecticut or the University of Maryland. Participants were paid $10 or received course credit for participating.

4.1.2 Procedure

Children and adults were tested using the same procedure. We used a TVJT to assess participants' interpretations of negatively quantified sentences containing different indefinites. The task was carried out by a single experimenter using a laptop computer. The experimenter presented stories using cartoon pictures and animations created and displayed in PowerPoint. Pre-recorded video clips of a puppet created the pretense that the puppet was participating in the task live via webcam. Participants were told that the puppet was not very good at paying attention to stories, and were given a scorecard to fill out, with the goal of helping the puppet to learn how to pay better attention. At the end of each story, the puppet was asked a question about the story. The participant's task was to determine whether the puppet's statement was 'right', in which case s/he was instructed to put a stamp in the 'happy

[9]Twelve of the 20 excluded children were younger than four years of age; some of these children were inattentive and did not complete the experiment.

face' column of the scorecard. If the puppet was 'wrong', the participant was instructed to put a stamp in the 'sad face' column of the report card. We also elicited follow-up justifications to ascertain the participant's reasons for providing *yes*- or *no*-responses.

Children were tested individually, usually in a quiet room away from their classmates. Adult participants were tested individually in the lab. Sessions were videorecorded for subsequent coding and analysis.

4.1.3 Materials

4.1.3.1 Target conditions

The stories used in the experiment made negatively quantified statements felicitous. Each context clearly provided different possible (sub)domains of quantification. On the critical test trials, the context would also make one of these subdomains highly salient; importantly, the relevant subdomain was not the largest of the possible domain alternatives but rather a smaller subdomain. Depending on whether participants accepted the negatively quantified test sentence, we could infer whether they were associating the relevant indefinite with the more restricted subdomain, or whether it had to quantify over a larger domain alternative. *Yes*- and *no*-responses, along with appropriate follow-up justifications, were taken as a measure of the participant's ability to restrict the domain of quantification to one of the domain alternatives.

Each participant received two training items, followed by four test and four control items, which were presented in one of two pre-randomized, counterbalanced orders. The four target trials varied in the dimension along which widening could be expected (colour, pattern, size, and texture). We varied the dimension in order to keep the trials from becoming too repetitive for children, making sure to pick shapes and dimensions that young children could easily

identify and were very familiar with. An example test story is provided in (25). Figure 1 presents the final image that accompanied the presentation of the test sentence.

(25) *Example critical test trial*[10]

"[1] This story is about Donald and Daisy. They're doing some puzzles. See, they have to put a wooden star here, a metal star here, and a fuzzy star here. Oh no! The puzzle box is empty! Where all the pieces? [2] Silly Goofy! He's taken all the puzzle pieces and hidden them all over the attic! If Donald and Daisy want to finish their puzzles, they're going to have to find some stars! [3] Can you find all the wooden stars? Can you find all the metal stars? What about the fuzzy stars? They're all the way up on the clock! Good job. Let's see if Donald and Daisy can find them. [4] Donald and Daisy find all the wooden stars and all the metal stars! [5] They can fit their wooden stars and their metal stars perfectly! What they each need to finish their puzzle is a fuzzy star. [6] But Goofy did a really good job hiding the fuzzy stars up on the clock. Donald and Daisy look and look but they can't find the fuzzy stars! So they can't finish their puzzles. Let's ask Froggy why."

EXPERIMENTER: Hey Froggy, why can't Donald and Daisy finish their puzzles?

a. ANY-condition

   PUPPET: Hmm... Donald and Daisy both can't find **any stars**!

b. A-condition

   PUPPET: Hmm... Donald and Daisy both can't find **a star**!

c. BARE PLURAL condition

   PUPPET: Hmm... Donald and Daisy both can't find **stars**!

[10]Numbers in square brackets indicate slide changes.

In this test story, the domain of quantification consists of a set of nine stars which vary along the contextually determined dimension of texture, i.e. there are three wooden stars, three metal stars, and three fuzzy stars. The largest domain of quantification in this context is the one containing all nine stars. Possible subdomain alternatives in this context include: {wooden stars}, {wooden stars, metal stars}, {metal stars, fuzzy stars}, {fuzzy stars}, etc. In the story, Donald and Daisy have to find the stars in order to finish a puzzle; at a critical juncture of the story, it is established that though they have been successful in finding the wooden stars and the metal stars, they cannot finish their puzzles because they cannot find the fuzzy stars. Thus what is at issue revolves around just one particular subdomain alternative (e.g., the fuzzy stars). At this point, a puppet appears on the screen to answer a question about the story: *Why can't they finish their puzzles?* with a negatively quantified sentence containing one of the indefinites. The participant's task was to decide if the puppet's statement was correct (*Did he say the right thing?*). If the participant restricted the domain of the relevant indefinite to a smaller subdomain alternative (i.e. the fuzzy stars), s/he was expected to accept the statement; if the indefinite had to quantify over a larger domain, s/he was expected to reject the statement.[11]

The primary comparison of interest is that between *any* and plain indefinites, as *any* is argued to quantify more widely. Claims that *any* widens the domain rely on it doing so in contrast to plain indefinites like *a* or *some*. We chose to compare *any* to *a* for the following reason: we chose to use negative test sentences, as negation is the most frequent licenser of *any*. The test sentences were then designed to be identical across conditions except for the indefinite; since *some* resists the scope of negation, and *any* is most frequently licensed in the

[11]An anonymous reviewer questions whether the present design differs substantially from the design used in Xiang et al. (2006). In Appendix 1, we provide a more thorough explanation of how the two designs differ. In particular, the stories that were used in the two experiments differed in their contextually determined domains of quantification.

scope of negation, we chose to use *a*, which allows a narrow scope reading. But the use of *a* gives rise to a potential confound: a wide-scope, specific reading of *a* above negation yields the same response as a narrow scope reading of *a* with a restricted domain of quantification. Bare plurals, on the other hand, resist wide scope (Carlson 1977), and thus serve as a control for the scope confound.[12, 13]

We treated indefinite type as a between-subject factor to avoid contaminating effects on subsequent trials. If a participant happened to associate an indefinite with a more restricted domain of quantification, for example, we wanted to ensure that this domain restriction would not influence how they interpreted subsequent sentences containing other indefinites. Thus participants heard four repetitions of a single kind of indefinite.

The test sentences from the four target trials in each condition are presented in Appendix 2. All test sentences were pre-recorded with neutral intonation, and in particular

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[12]For example, the following examples from Carlson (1977) show that the wide scope reading that is available for *a* in (i) is unavailable for the bare plural in (ii).

(i) Minnie wishes to talk with a young psychiatrist

a. (∃sg x) (young psychiatrist(x) & Minnie wishes Minnie talk with x)

b. Minnie wishes (∃sg x) (young psychiatrist(x) & Minnie talk with x)

(ii) Minnie wishes to talk with young psychiatrists

a. #(∃pl x) (young psychiatrist(x) & Minnie wishes Minnie talk with x)

b. Minnie wishes (∃pl x) (young psychiatrist(x) & Minnie talk with x)

(Carlson 1977:417)

Carlson goes on to show that the unavailability of the wide scope reading cannot lie in the plurality marker, since other plurally quantified NPs (*many*/*all*/*twelve*/*a few*/*most psychiatrists*) exhibit a similar scope ambiguity as that displayed in (i).

[13]Initial piloting involved stories that had only one character completing a single puzzle; piloting with the addition of a bare plural condition revealed that the bare plural sentences were much more felicitous when there was more than one character searching for (multiple) puzzle pieces. Thus for consistency, and because it did not affect the felicity of the other two conditions, we had two characters searching for multiple copies of the three puzzle pieces across all three conditions. The floated *both* was then added based on pilot feedback suggesting that it made the use of the conjoined NP subject more natural.

without stress on the indefinite. Pre-recording the test sentences ensured consistency, as all participants heard the same auditory stimuli.

In addition to the four target items, each participant also received four control items. Two of the four control trials had test sentences containing negation without any indefinites (e.g., *Mickey and Minnie both didn't find the squares*), and the other two control trials involved sentences containing the relevant indefinite without negation (i.e. *some* in the ANY condition, e.g., *Mickey and Minnie both found some circles*, *a* in the A condition, e.g., *Mickey and Minnie both found a circle*, and the bare plural in the BARE PLURAL condition, e.g., *Mickey and Minnie both found circles*). These control items served as a basis for inclusion in the analysis. They ensured that adult participants were paying attention to the task, and ensured that children had no difficulties with the comprehension of negation or with the relevant indefinites. The control sentences could be associated with a *yes*- or a *no*-target; depending on how the participant was responding on the test trials, the experimenter selected the appropriate control sentences that would ensure a balance of *yes*- and *no*-responses overall. Any participant who did not answer correctly on at least three of the four control trials was excluded from the data analysis. The puppet's statements on the negation and indefinite control stories are provided in Appendix 2.

4.1.3.2 Control groups

In addition to the three target conditions described above, we also had three control groups (corresponding to *any*, *a*, and bare plurals).[14] Participants in these control groups saw test stories that were parallel to those seen by the target groups, except that the three types of puzzle pieces in each case did not vary along the relevant dimensions (colour, pattern, size, or

[14]Our study involves two notions of control conditions. One is at the group level, while one pertains to all participants. To avoid confusion, we refer to the former as *control groups*, and to the latter as *control items*.

texture); rather they were of three completely different shapes, thus eliminating potential widening of the domain as a factor. For example, Mickey and Minnie might find the stars and moons but fail to find the hearts. In such a case, the sentence *Mickey and Minnie both can't find any hearts* would be unambiguously true, regardless of how narrowly or widely a participant chose to set the domain of *any*. These three control conditions allowed us to control for participants' ability to interpret the literal meaning of negatively quantified existential statements.

The target truth values of these sentences were the opposite of the target values of the sentences that participants in the target groups saw, i.e. where we expected *yes*-responses from the plain indefinite target groups, we expected *no*-responses from the plain indefinite control groups, and where we expected *no*-responses from the *any* target group, we expected *yes*-responses from the *any* control group. The sentences used in these control conditions can be found in Appendix 2.

As in the target groups, participants in the control groups received two training items, followed by four test and four control items, which were presented in one of two pre-randomized and counterbalanced orders. The control items were the same as those in the target conditions (two negation controls and two indefinite controls), and were also dynamically selected to balance the total number of *yes*- and *no*-responses from any given participant.

4.2 Results

4.2.1 Control groups

Both children and adults performed well in the three control conditions, with accuracy above 98% in all conditions. Importantly, when domain widening was not at issue, children and adults had no difficulty interpreting sentences containing *any*, *a*, and bare plurals.

4.2.2 Target conditions

The dependent measure in the following analysis was the proportion of *yes*-responses to the puppet's statements, taken to indicate domain restriction to a salient subdomain. All participants passed the controls, and were therefore included in the analysis.

Figure 2 displays the results from the target indefinite conditions. Planned comparisons revealed a main effect of indefinite ($F(2,108) = 51.74, p < .001$), a main effect of group ($F(1,108) = 4.35, p < .05$), and a significant interaction between indefinite and group ($F(2,108) = 3.82, p < .05$). While children in the plain indefinite conditions were adult-like, children in the ANY condition provided more *yes*-responses than adults did (Tukey HSD, $p < .05$). This asymmetry was driven primarily by four children who accepted *any* on at least three of the four trials, providing justifications consistent with domain restriction to the salient subdomain.[15]

Although the two groups differed in the ANY condition, individual children's responses indicated that they were generally consistent in their responses across trials. Figure

[15] An anonymous reviewer questions whether the non-adult-like children could have been driven by a *yes*-bias. We think this is unlikely, for two reasons. First, when a child provided *yes*-responses to the target trials, we selected control trials that had *no*-targets, to make sure that the child was capable of appropriately rejecting unambiguously false descriptions. The second reason is that these children were able to provide meaningful justifications for their *yes*-responses. We systematically elicited justifications following both *no*-and *yes*-responses, in order to determine whether the responses were indeed driven by a narrow or widened interpretation. As can be seen in the sample justifications in (30)-(31), children who accepted the *any*-targets gave the same kinds of justifications as the children who accepted the plain indefinite targets: they referred to the salient subdomain alternative, e.g., the fuzzy stars. This suggests they were interpreting the sentences with the restricted domain.

3 presents the distribution of children in the ANY condition across five response patterns: those who rejected all four *any*-sentences, those who rejected at least three of four, those who accepted half, those who accepted at least three of four, and those who accepted all four *any*-sentences. With the exception of one child, the individual responses, along with appropriate follow-up justifications, reveal that the children were generally consistent in their responses, whether they interpreted *any* with a wider domain (75% + reject) or a more restricted domain (75% + accept).[16]

4.2.3 Follow-up justifications

We elicited follow-up justifications to ensure that participants were accepting or rejecting the test sentences for the expected reasons. For example, following a *yes*-response, participants were asked, "How do you know (Froggy's right)?" Following a *no*-response, they might hear, "How do you know (Froggy's wrong)?" or "What really happened in the story?" Justifications were elicited following both positive and negative responses, as these were expected to differentiate a widened domain (*no*-response) from a restricted domain (*yes*-response). Especially for children, requesting justifications after both kinds of responses served not to bias the participant to favour one response-type over the other. For example, we did not want the child to think that they would have to justify their answers only if they rejected the puppet's statement, potentially discouraging the child from providing *no*-

[16]Adult participants were also generally consistent in their responses, either accepting at least three of four target trials or rejecting at least three of four target trials. Of the 72 adults who participated across the three test conditions, only four displayed chance performance; moreover, these four adults were in the plain indefinite conditions, where the domain restriction associated with the indefinite is expected to be flexible.

responses. Consistent elicitation of justifications thus ensured that the experimenter was not responding differently to the children's *yes*- and *no*-responses.

Adults' justifications for accepting the plain indefinite statements usually made reference to the relevant restricted subdomain alternative (e.g., *Yes, because they can't find the fuzzy stars*). In contrast, justifications for rejecting *any*-statements also made reference to the other two subdomain alternatives, suggesting these could not count as exceptions to the domain of quantification (e.g., *No, because they found the wooden and metal stars – they just can't find the fuzzy stars*).

Children's follow-up justifications for their responses were generally adult-like. In accepting the plain indefinite statements, children made reference to the salient subdomains:

(26) *CHI-44, age 4;04,* A *condition*

PUPPET: Hmm… Donald and Daisy both can't find a heart.

CHILD: Donald and Daisy both can't find a heart.

EXPERIMENTER: Was he right?

CHILD: Yes!

EXPERIMENTER: Yes? How do you know?

CHILD: Because they can't find these hearts. [gesturing to the small hearts]

(27) *CHI-07, age 4;07,* BARE PLURAL *condition*

PUPPET: Hmm… Minnie and Mickey both can't find triangles.

EXPERIMENTER: Was he right?

CHILD: Yes! Striped ones.

Children who were adult-like in rejecting *any*-statements were also adult-like in their justifications. For example, some children made reference to the backgrounded subdomains, suggesting these could not count as exceptions to the domain of quantification.

(28) *CHI-03, age 4;05,* ANY *condition*

PUPPET: Hmm… Donald and Daisy both can't find any stars.

[…]

CHILD: No!

EXPERIMENTER: Okay. Why- what should he have said? Did he say the wrong thing?

CHILD: Yeah!

EXPERIMENTER: What should he have said? What do you think?

CHILD: They couldn't find the fuzzy stars, but he said they couldn't find ANY stars.

(29) *CHI-14, age 4;01,* ANY *condition*

PUPPET: Hmm… Donald and Daisy both can't find any stars.

EXPERIMENTER: Was he right?

CHILD: [shakes head]

EXPERIMENTER: No? What should he have said?

CHILD: They found two stars!

EXPERIMENTER: What did they find? They found …

CHILD: Two woodens and two of the …

EXPERIMENTER: Metal?

CHILD: Yeah, the metal ones.

The children who were non-adult-like in accepting *any*-statements provided follow-up justifications that were of the same kind as those provided by children who accepted the plain indefinite statements. These made reference to the salient subdomain, suggesting the domain of *any* could be restricted to that alternative.[17]

(30) *CHI-51, age 5;01,* ANY *condition*

PUPPET: Hmm… Donald and Daisy both can't find any stars.

EXPERIMENTER: Was he right?

CHILD: Mmhmm.

EXPERIMENTER: How do you know?

CHILD: 'Cause (.) they're all the way up here. [gesturing to set of fuzzy stars]

Note also that CHI-51 was able to repeat the test sentence containing *any*, ruling out the possibility that he had simply misheard or ignored the *any*:

(31) *CHI-51, age 5;01,* ANY *condition*

PUPPET: Hmm… Mickey and Minnie both can't find any diamonds.

CHILD: He was right.

EXPERIMENTER: He was right? How do you know?

CHILD: Because.

EXPERIMENTER: Because what. What did he say?

[17] As an anonymous reviewer points out, it is noteworthy that these (four) non-adult-like children were not responding purely at chance; rather, they were consistent in their responses, providing *yes*-responses on at least three of the four target trials. Moreover, their justifications clearly resemble those of children in the plain indefinite conditions, suggesting that they were interpreting the *any*-sentences as involving a restricted domain of quantification.

CHILD: He said Minnie and Minnie (.) Minnie and Mickey can't find any diamonds.

EXPERIMENTER: Is that what happened in the story?

CHILD: Mmhmm.

In sum, regardless of whether the children's responses were adult-like or not, the justifications were generally consistent either with an interpretation where the indefinite was associated with a restricted domain of a quantification, or with an interpretation where the indefinite was associated with a widened domain.

4.2.4 Summary

When provided with contextually salient subdomain alternatives, the adult English speakers and the majority of the children that we tested systematically interpreted *any* as quantifying over larger domains than the plain indefinites. Follow-up justifications from both groups indicated that *any*-statements were rejected for quantifying too widely to truthfully describe what had happened in the stories (i.e. *any* always quantified over the largest domain containing all the puzzle pieces), while the plain indefinites were free to restrict to a salient subdomain.

In sum, the results from the adult participants provide systematic evidence that *any* is distinct from plain indefinites in its preference for *wider* domains, and the results from the child participants indicate that the majority of the 4-year-olds we tested were sensitive to this difference.

5 Discussion

The main finding from our experiment was that both adults and children distinguished *any* from the plain indefinites *a* and the bare plural in terms of domain restriction. In this section, we would like to discuss two aspects related to this finding. First, we will make a connection between our findings and those of the developmental literature on scalar implicatures, particularly those recent studies that place the source of children's difficulties with implicatures in a difficulty in accessing the required *alternatives.* We will briefly discuss the role of domain alternatives in children's ability to access *widened* interpretations of *any*. In doing so, we will also offer a potential explanation for the four children who appeared to allow domain restriction for *any*. Second, we will return to the learnability question of how children acquire the semantics of *any*, in conjunction with its distributional constraints.

First, recall that on theoretical analyses such as Chierchia (2013), *any* activates domain alternatives that must be exhaustified. This mechanism of exhaustification, i.e. through a covert *only*-like operator, is also argued to underlie the derivation of scalar implicatures such as (32) (see Fox 2007; Chierchia, Fox & Spector 2011).

(32) a. Some of the horses jumped over the fence.

[icon] *Not all of the horses jumped over the fence*

b. Jack ate the ice cream or the cake.

[icon] *Jack didn't eat both the ice cream and the cake*

It has been widely reported in the developmental literature that children compute fewer scalar implicatures of the kind in (32) than adults do (Noveck 2001; Gualmini et al. 2001; Chierchia 2001; Papafragou & Musolino 2003; Barner et al. 2011, among many others). According to recent proposals, the problem lies in accessing the stronger lexical alternatives that are required to compute the implicature, e.g., *all* in (32a) and *and* in (32b). That is, children are

adult-like in their ability to exhaustify alternatives, but they encounter difficulty when the alternatives that are required for the computation are not readily accessible (see, among others, Chierchia 2001; Gualmini et al. 2001; Reinhart 2006; Barner et al. 2011; Singh et al. 2013; Lewis 2013, and Tieu et al. 2015 for relevant discussion).[18]

Now consider how access to alternatives would be relevant in our experiment. The exhaustification process in the present case involves identifying the relevant subdomain alternatives, retaining them in memory throughout the story (until the critical test sentence is presented), and then exhaustifying the alternatives at that point. For example, when Donald and Daisy have to find three different kinds of stars, participants need to identify the alternative do- mains, e.g., the wooden stars, the metal stars, the wooden and metal stars, the fuzzy stars, etc. They need to hold these alternatives in memory throughout the story. Finally, when the puppet utters the negative *any*-statement, they must exhaustify with respect to these domain alternatives. In principle then, non-adult-like performance could be attributed to difficulties in identifying, storing, or retrieving the relevant subdomain alternatives.

Consider first the possibility that restrictions on memory could prohibit the storage of the multiple subdomain alternatives. We think this is unlikely to have posed a problem for the

[18] For instance, children have been reported to accept underinformative 'A or B' descriptions of 'A and B' situations; however, when presented with two puppets, one of whom utters the 'A or B' description and one of whom utters an 'A and B' description, children reward the puppet who uttered the conjunctive description (Chierchia 2001; Gualmini et al. 2001). This suggests children are sensitive to the relative strength of two alternatives. As another example, children have been shown to compute free choice inferences from disjunction, such as the following:

(i) Jack may have ice cream or cake.

[icon] *Jack may have ice cream and Jack may have cake*

Such inferences have been argued to be derived as a kind of scalar implicature; crucially, the alternatives required to compute the free choice inference are the individual disjuncts *Jack may have ice cream* and *Jack may have cake*, which appear as substrings of the assertion. An explanation for children's success on free choice inferences is that children are able to access the alternatives in the sentence, rather than having to retrieve them from the mental lexicon (Zhou et al. 2013; Tieu et al. 2015).

child participants, given that participants could always 'see' the subdomain alternatives; the puzzle pieces were always on the screen, whether they had been found by the characters or not. If they were found, then participants saw that they were slotted into their respective stencils in the puzzle; if not, the puzzle pieces remained (visibly) in their hiding spots, where Goofy had put them.

We suspect the more likely challenge has to do with which alternatives children took to be salient. Imagine a child who only paid attention to a limited set of objects in the story at a time; such a child might dismiss the previously mentioned subdomains (e.g., the wooden and metal stars) as being irrelevant to the outcome of the story. After all, by the critical point in the story, Donald and Daisy have already found these puzzle pieces and slotted them into their places in the puzzle. These two subdomain alternatives are no longer the focus of the story; more important are the puzzle pieces that have yet to be found. If at the end of the story, one has only the single salient subdomain (e.g., the fuzzy stars) and no other alternatives to consider, exhaustification is vacuous. The *any*-statement essentially amounts to a plain negative existential statement quantifying over the salient subdomain; it would essentially be interpreted as *Donald and Daisy both can't find the fuzzy stars*.

On this explanation, the four children who allowed domain restriction for *any* may very well have had knowledge that *any* triggers obligatory exhaustification of subdomain alternatives, but they may have nonetheless failed to identify or retrieve the relevant alternatives, and thus would have appeared to fail to "widen" the domain. This is entirely parallel with the case of children who otherwise have the means to exhaustify a *some*-sentence or an *or*-sentence, but do not appear to compute implicatures because they cannot access the *all* and *and* alternatives. Briefly put, a child cannot exhaustify alternatives that she does not have access to. It is quite possible, then, that in the case of *any*, even the four children under question had adult-like knowledge of exhaustification, but performed in a non-

adult-like manner because they failed to access the less salient subdomain alternatives in the context. For this reason, they would appear to allow exceptions to the domain of quantification for *any*.[19]

Before concluding, let us step back and consider the contribution of our data to the larger question of how children acquire the syntax and semantics of the NPI *any*. In this paper, we reviewed evidence from both naturalistic and experimental data that children as young as 2–3 years of age exhibit what appears to be a target-like distribution of *any*, restricting their production and comprehension of *any* to the scope of appropriate licensers such as negation. The results of our experiment add to this, revealing that 4-year-olds as a group distinguish *any* semantically from plain indefinites like *a* and the bare plural. In particular, they generally interpret *any* as quantifying more widely than the plain indefinites. In other words, by 4 years of age, children appear to have mastered both the syntax and the

[19]An anonymous reviewer suggests manipulating the context such that it would not be so easy for a child to forget or dismiss the first two subdomain alternatives. For example, the reviewer suggests we highlight the salience of the other two subdomain alternatives by having the characters find these particular puzzle pieces *after* the characters have already failed to find the fuzzy stars. Note, however, that any domain alternative that is made sufficiently salient becomes a potential target for domain restriction (at least for a plain indefinite). If we made all three subdomain alternatives equally salient, for example, adults could quite naturally 'restrict' the domain of the indefinite to the largest domain containing all three subdomains. Similarly, if we made salient the two subdomains of stars that were found, by mentioning them at the end of the story, it would be quite natural to restrict the domain of a plain indefinite to the subdomain containing those two kinds of stars. We chose to make one of the domain alternatives more salient than the others, so that we could elicit domain restriction to that subdomain (in the plain indefinite conditions). We could just as easily have chosen to make the other two subdomains more salient through last mention, as the reviewer suggests; then the target domain restriction would have included the wooden and metal stars. But then we might very well encounter the same problem but in reverse: the same four children might remember or consider as relevant only the subdomain containing wooden and metal stars. In short, our goal was simply to make one domain alternative salient enough for a plain indefinite to restrict to it, while keeping the rest of the domain alternatives relevant enough for the domain of *any* to include them. To the extent that the adults and most of the children performed exactly as expected, it would appear that our manipulation was generally successful.

semantics of *any*.[20] Yet as we briefly discussed in Section 3.2, children do not receive a great deal of positive evidence for the semantics of *any*. It is far from clear what guides children to the conclusion that *any* activates domain alternatives, triggers obligatory exhaustification, and invokes domain widening. In contrast, children receive rather consistent positive evidence of the licensing of *any* by operators such as negation.

One suggestion we would like to put forth for future investigation is that children make use of the restricted distribution of the NPI in order to home in on the semantics of the NPI (see Tieu 2013 for a more elaborated discussion). Chierchia (2013) provides a cross-linguistic typology of polarity-sensitive indefinite types, of which *any* is but one example. He derives this finite set of polarity-sensitive types by allowing variation along two parameters: the kind of alternatives that the polarity-sensitive item activates, and the exhaustification mechanism that factors these alternatives into meaning. Each polarity-sensitive indefinite in this typology has a unique semantics, resulting from its values for the two parameters, and this in turn derives its unique distribution, i.e. the distribution that we observe on the surface. What we would like to suggest is that this cross-linguistic typology corresponds to the hypothesis space that the child learner must consider. In acquiring the syntax and semantics of *any*, the child figures out the distributional constraints on the NPI, and that in turn leads the child to the target semantics. In other words, the child uses what *is* clearly observable in the input, i.e. the NPI's distribution, in order to acquire what is not so easily observable, i.e. the NPI's semantics. We leave to future research a detailed investigation of such a learnability proposal. Our goal in this paper is simply to illustrate that we must consider both

[20]For the purposes of the present study, we have focused on NPI *any*, and set aside its free choice instantiation. See Tieu, Romoli, Zhou & Crain (2015), however, for experimental evidence that children are also adult-like in their comprehension of sentences containing free choice *any*, e.g., *Lucy is allowed to hold any rabbit*.

the syntax and the semantics of the NPI, if we are to understand how a child comes to acquire the target representation of the NPI.

6 Conclusion

The experimental findings of the present study reveal that *any* and plain indefinites differ in how widely they tend to quantify. We presented English-speaking adults and 4-year-old children with contexts that contained multiple domain alternatives. When one of these subdomain alternatives was made more salient than the others, both adults and children interpreted plain indefinites as quantifying over this particular subdomain; in other words, they restricted the domain to the salient subdomain. In contrast, *any* was interpreted as quantifying over the largest domain in the context, i.e. the one containing all three subdomains. Previous acquisition studies of *any* only targeted the distributional constraints on the NPI, and neglected children's knowledge of the underlying semantics of the NPI. Our experiment addresses this gap, and provides novel evidence that 4-year-olds are sensitive to the domain widening property of *any*.

It is our hope that providing a fuller picture of the target of acquisition, in particular targeting the semantics of the NPI, adds one further piece to the puzzle of how children arrive at the target representation of the NPI. What we have argued in this paper is that acquiring the complete target representation of the NPI must extend beyond the observation that the NPI has a restricted distribution.

Appendix 1

An anonymous reviewer questions whether the design of the present study differs substantially from the design in Xiang et al. (2006). In this appendix, we describe the critical differences between the two designs.

Let us first begin by stating that the goals of the two studies were different. While Xiang et al.'s study was designed to investigate the scope possibilities for different indefinites, the present study was designed to investigate the domain restriction possibilities for different indefinites. The challenge is that scope and domain restriction are easily confounded; let us attempt to tease them apart here.

First, there were four indefinites used across the two studies: *a*-NP, *any*-NP, *some*-NP, and the bare plural. Let us assume that all of these indefinites can in principle be interpreted as taking either wide or narrow scope.

Let us also assume for the moment that these indefinites can all associate with a domain of quantification that can be contextually restricted. Consider the domains of quantification that were made natural in the contexts in Xiang et al.'s study and in the present study. In Xiang et al.'s study, the most natural domain restriction contained the 'normal peas' that Billy was supposed to eat; 'mushy peas' were considered to be irrelevant, i.e. exceptions to the domain. In fact, it was made quite clear that the mushy peas didn't count, as Billy himself thought that he didn't have to eat them.

In our stories, the most natural domain restriction contained the subdomain of fuzzy stars that prevented Mickey and Minnie from being able to finish their puzzles; the irrelevant subdomains were the metal stars and the wooden stars that were found by the two characters, and set aside earlier in the story.

This means that across the two studies, there were three potential domain restrictions that the indefinites could reasonably be associated with:

- D": the largest domain in each context, e.g., both kinds of peas vs. all three kinds of stars
- D': the subdomain of things the characters acted upon: e.g., normal peas vs. metal and wooden stars
- D: the subdomain of things the character didn't act upon: e.g., mushy peas vs. fuzzy stars

These possible domain restrictions, along with the two scope possibilities for the indefinite, yield the six scenarios in Table 1; paraphrases for each reading are provided in (33) through (38).

(33) Wide scope reading of indefinite, Domain restricted to D"

a. *There are normal or mushy peas that the character didn't eat*

b. *There are wooden, metal, or fuzzy stars that the characters didn't find*

(34) Narrow scope reading of indefinite, Domain restricted to D"

a. *The character didn't eat any normal or mushy peas*

b. *The characters didn't find any wooden, metal, or fuzzy stars*

(35) Wide scope reading of indefinite, Domain restricted to D'

a. *There are normal peas that the character didn't eat*

b. *There are metal or wooden stars that the characters didn't find*

(36) Narrow scope reading of indefinite, Domain restricted to D'

a. *The character didn't eat any normal peas*

b. *The characters didn't find any metal or wooden stars*

(37) Wide scope reading of indefinite, Domain restricted to D

a. *There are mushy peas that the character didn't eat*

b. *There are fuzzy stars that the characters didn't find*

(38) Narrow scope reading of indefinite, Domain restricted to D

a. *The character didn't eat any mushy peas*

b. *The characters didn't find any fuzzy stars*

Participants in both experiments rejected the *any*-sentences. In Xiang et al.'s experiment, there are three possible explanations for these rejections. First, participants could have accessed a wide scope interpretation of the indefinite, while restricting the domain to the normal peas (35); this is plausible, given the naturalness of restricting the domain to the normal peas that Billy ate. Second, participants could have accessed a narrow scope interpretation of the indefinite, while restricting the domain to the normal peas (36); again, this is plausible because of the naturalness of restricting the domain to the normal peas. Finally, participants could have accessed a narrow scope reading of the indefinite, with *any* triggering widening of the domain to include both kinds of peas (33). Given the way the story was set up, it is difficult to decide among these three possibilities.

Since we were interested precisely in the different domain restriction possibilities, our stories made it so that the three possible explanations for *no*-responses would not be equally plausible. Consider again the three possible explanations for a *no*-response, this time in the context of the puzzle stories in our experiment. First, participants could have accessed a wide scope interpretation of the indefinite, while restricting the domain of the indefinite to the metal and/or wooden stars (35); this would be rather unlikely, because it was made clear that the metal and wooden stars were irrelevant by the time the test sentence was uttered (the

metal and wooden stars were not the reason that the characters failed to finish their puzzles). Second, participants could have accessed a narrow scope interpretation of the indefinite, while restricting the domain to the metal and wooden stars (36); again, this not very natural because the metal and wooden stars were no longer salient or relevant when the test sentence was uttered. Finally, participants could have accessed a narrow scope interpretation of the indefinite, with *any* triggering widening to include all three subdomains of stars (34); this was the target interpretation, and indeed our participants' justifications were consistent with them having accessed this interpretation.

One final difference between the two designs was the indefinite that was used as a control. The present study set out to assess domain restriction possibilities for the NPI, and it was therefore important to be able to compare the NPI with an indefinite that would also take narrow scope, but that might allow domain restriction where the NPI did not. Thus we included the bare plural, which can only take narrow scope under negation. This essentially allowed us to restrict our attention to the Narrow Scope column of Table 1. Bare plurals elicited *yes*-responses, suggesting domain restriction to the fuzzy stars; in contrast, *any* elicited *no*-responses, suggesting the domain had to include more than just the salient fuzzy stars. Xiang et al.'s study set out to assess scope possibilities, and therefore used the positive polarity item *some* as a wide scope control with which to compare the NPI. As we saw above, however, it's not clear that their design allows us to tease apart the different scope and domain restriction possibilities.

Appendix 2

Sentences presented in the target indefinite conditions

(39) ANY *target condition*

a. Mickey and Minnie both can't find any diamonds. (target: *no*)

b. Mickey and Minnie both can't find any triangles. (target: *no*)

c. Mickey and Minnie both can't find any hearts. (target: *no*)

d. Mickey and Minnie both can't find any stars. (target: *no*)

(40) A *target condition*

a. Mickey and Minnie both can't find a diamond. (target: *yes*)

b. Mickey and Minnie both can't find a triangle. (target: *yes*)

c. Mickey and Minnie both can't find a heart. (target: *yes*)

d. Mickey and Minnie both can't find a star. (target: *yes*)

(41) BARE PLURAL *target condition*

a. Mickey and Minnie both can't find diamonds. (target: *yes*)

b. Mickey and Minnie both can't find triangles. (target: *yes*)

c. Mickey and Minnie both can't find hearts. (target: *yes*)

d. Mickey and Minnie both can't find stars. (target: *yes*)

Sentences presented in the indefinite control conditions

(42) ANY *control condition*

a. Mickey and Minnie both can't find any diamonds. (target: *yes*)

b. Mickey and Minnie both can't find any triangles. (target: *yes*)

c. Donald and Daisy both can't find any hearts. (target: *yes*)

d. Donald and Daisy both can't find any stars. (target: *yes*)

(43) A *control condition*

a. Mickey and Minnie both can't find a diamond. (target: *no*)

b. Mickey and Minnie both can't find a triangle. (target: *no*)

c. Mickey and Minnie both can't find a heart. (target: *no*)

d. Mickey and Minnie both can't find a star. (target: *no*)

(44) BARE PLURAL *control condition*

a. Mickey and Minnie both can't find diamonds. (target: *no*)

b. Mickey and Minnie both can't find triangles. (target: *no*)

c. Mickey and Minnie both can't find hearts. (target: *no*)

d. Mickey and Minnie both can't find stars. (target: *no*)

Control trials that appeared in both test and control conditions

(45) *Negation controls*

a. Mickey and Minnie both didn't find the squares. (target: *yes*)

or: Mickey and Minnie both didn't find the moons. (target: *no*)

b. Mickey and Minnie both didn't find the circles. (target: *yes*)

or: Mickey and Minnie both didn't find the suns. (target: *no*)

(46) ANY *indefinite controls*

a. Mickey and Minnie both found some suns. (target: *yes*)

or: Mickey and Minnie both found some circles. (target: *no*)

b. Mickey and Minnie both found some squares. (target: *yes*)

or: Mickey and Minnie both found some clouds. (target: *no*)

(47) A *indefinite controls*

a. Mickey and Minnie both found a sun. (target: *yes*)

or: Mickey and Minnie both found a circle. (target: *no*)

b. Mickey and Minnie both found a square. (target: *yes*)

or: Mickey and Minnie both found a cloud. (target: *no*)

(48) BARE PLURAL *indefinite controls*

a. Mickey and Minnie both found suns. (target: *yes*)

or: Mickey and Minnie both found circles. (target: *no*)

b. Mickey and Minnie both found squares. (target: *yes*)

or: Mickey and Minnie both found clouds. (target: *no*)

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Table 1: Expected truth values for wide and narrow scope readings of the indefinite, with different domain restrictions.

Domain restriction	**Wide scope**	**Narrow scope**

D” (both kinds of peas / all kinds of stars)	True (33)	False (34)
D’ (normal peas / metal and wooden stars)	False (35)	False (36)
D (mushy peas / fuzzy stars)	True (37)	True (38)

Figure 1: Final image accompanying the test sentence *Donald and Daisy both can’t find any stars* / *Donald and Daisy both can’t find a star* / *Donald and Daisy both can’t find stars*. On this trial, Donald and Daisy found the wooden and metal stars, but could not find the fuzzy stars (left on top of the clock). On all trials, the last slide that participants saw always contained the same three components: the puppet always appeared in the top left corner of the frame, the last image from the story appeared on the right, and the two main characters, along with their incomplete puzzles, always appeared on the bottom left of the frame.

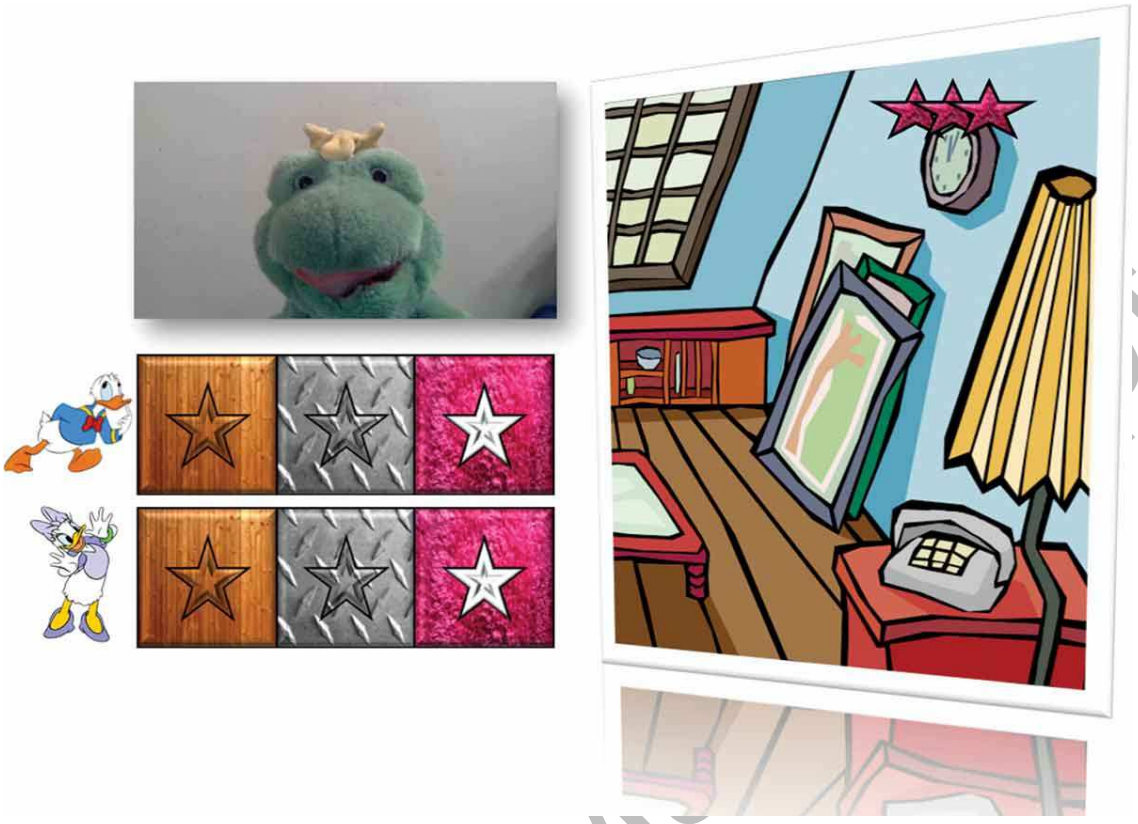

Figure 2: Children's and adults' percentage of *yes*-responses to the target indefinite conditions. *Yes*-responses were taken to indicate interpretations containing domain restriction to a salient subdomain alternative.

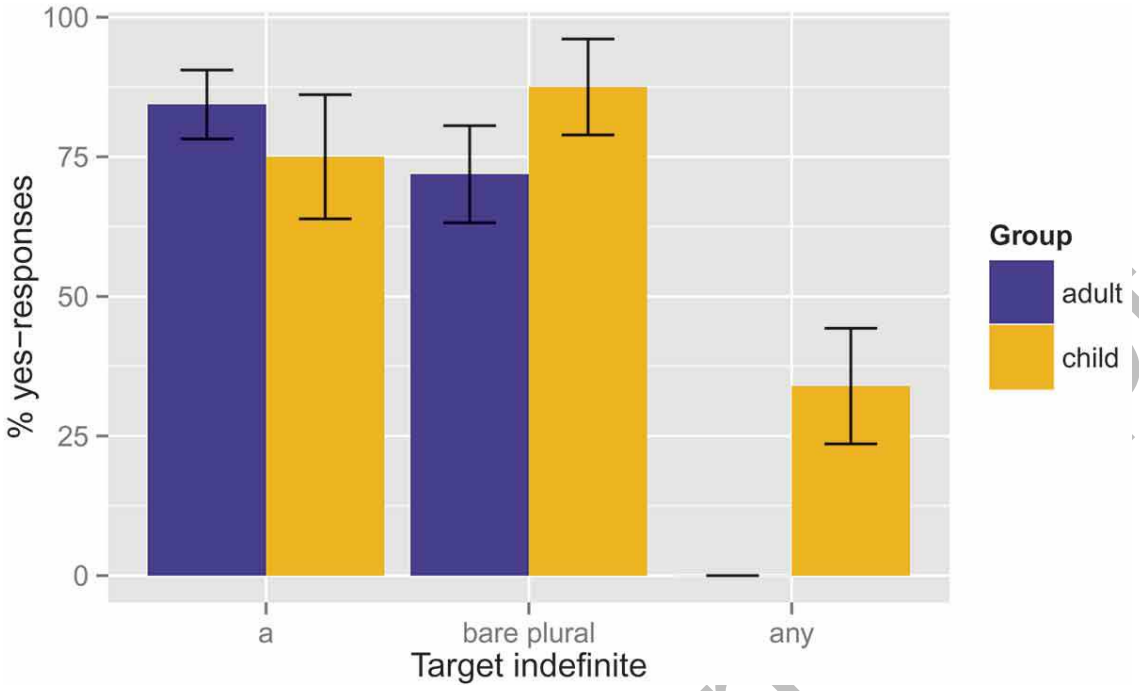

Figure 3: Observed response patterns from children in the ANY condition (n=14).