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When the syntactic bootstrap breaks: Some children think *any* means *no*

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Children can use distributional information about where words occur to figure out their meanings. But what happens when two very different words not only have most of their distribution in common, but also compose to form indistinguishable sentential meanings in those common cases? As a negative polarity item (NPI), *any* is selectively licensed by certain linguistic environments, the most common of which is negation. This is the context in which children hear *any* in around 80% of their input. However, under negation, the meaning of *any* looks just like a negative quantifier in concord with the higher negation (a negative concord item; NCI). While studies of children's production indicate that they hardly ever produce *any* without a licensing negation, suggesting competence with its distribution, we hypothesize that some children may have misanalysed its meaning. To investigate what children think *any* means, we tested 106 monolingual English-speaking children between 2 and 6 years of age, as well as 20 adults, in two picture-choice comprehension tasks. These tasks assessed their interpretation of *any* without a preceding negation, both in a licensed (free choice) and an unlicensed context. While most children interpreted *any* the same way adults did, we also found a group of children who systematically responded to *any* as if it meant *no*, consistent with a negative concord (mis) analysis. In addition to illustrating how much children rely on distributional information to learn such abstract words, this finding bears on several debates. It raises the question of whether it is possible to represent the licensing conditions of NPIs prior to knowing their meanings. And it suggests that children may be biased to assume that their language uses negative concord constructions even when it does not.

Better to be occasionally cheated than perpetually suspicious.

– B.C. Forbes

1 Introduction

Some words are easy for children to learn, some words are hard, and a small group are so hard that they make the other hard words look easy. This paper is about how children learn one of those – the word *any*.

For children learning their first language, the easiest words are those they witness in frequent, time-locked, reliable correlation with what they can observe – their mommy, their ball, or a recurring social interaction (*hi* and *up*!; Swingley & Humphrey, 2017; Bergelson et al. 2019; Frank et al. 2021). Learning these words may only require mapping them to the right part of the world. Representing that part is still no small thing, of course, but children might be able to get away with not understanding accompanying words, or the syntax in which they are embedded, or much of the speaker's intent (Gleitman & Trueswell, 2020; Meylan & Bergelson, 2022).

In contrast, learning the vast majority of words is a lot harder (Gleitman et al. 2005; Gleitman & Trueswell, 2020). Some hard words are hard because they refer to unobservables (*planning*, *tomorrow*). Others refer to observables, but observables that are consistently consistent with multiple different words (e.g. *give* and *get, chase* and *flee*; Gleitman & Gleitman, 1992). The meanings of these words cannot be learned by word-to-world pairings, because they are not differentiated by different states of the world, but rather by how a speaker is conceptualizing a given state. The very same observable can be an instance of *chasing,* or *fleeing,* or (god help the child) *planning, conceptualizing,* and much more. Luckily, where word-to-world mappings underdetermine the meanings of words, sentence-to-world mappings can often do the trick (Gleitman, 1990; Fisher et al. 1991). *Chasing* and *fleeing* can both be used to describe the same event, but *mommy is chasing the ball* and *mommy is fleeing the ball* cannot. A child who has already learned the easier words, *mommy* and *ball*, and who knows how English orders who does what to whom is now in a position not only to differentiate *chase* and *flee*, but also to start identifying these words' distinct grammatical roles and making sense of the corresponding observables to narrow down each of their meanings (Bernal et al. 2007; Babineau et al. 2021). This is how syntactic bootstrapping can help children learn some of the harder words.

If only all hard words were so easy. Unfortunately for the child, for some hard words, not only word-to-world but even sentence-to-world pairings systematically underdetermine the meaning. What is a learner to do in these cases? Quine (1960) argued that the only thing anyone could do is not fix the meaning any further, and speak in a manner consistent with all available hypotheses – forever. But there is another learning strategy, more prone to error, but surely more efficient: just pick one hypothesis and stick with it, at least until you get clear evidence one way or another.

In this paper, we investigate whether this is how children learn the meaning of an especially hard class of words – negative polarity items with existential force. To study that, we look at English *any*. There are two reasons that *any,* and similar words across languages, should be especially hard to learn. First, *any* appears in a restricted class of environments, some of which are exactly the same linguistic environments in which a very different class of words – Negative Concord Items (NCIs) – also appear, but express a very different meaning. Second and more critically, in these shared environments, both NCIs and *any* systematically produce largely indistinguishable sentential meanings. That is, they could actually mean the same thing in most of the sentences in which they appear. The consequence is that even sentence-to-world pairings systematically under-determine what *any* means. In this paper, we test whether this malevolent state of affairs sometimes leads children to make the wrong guess. We use two experimental tasks to test whether children ever confuse the meaning of *any* with a quantifier that expresses negation, like the meaning of the English determiner *no*. We administer both tasks to the same children to test whether a given child has a stable (mis)interpretation of *any* across both.

1.1 How sentence-to-world pairings underdetermine what *any* means

What does *any* mean to an adult, and why might children misanalyze it? Like other polarity-sensitive words (like *yet* and *ever*), *any* leads two lives (Ladusaw, 1979). In one life, *any* behaves like a Negative Polarity Item (NPI). As an NPI, its appearance is limited to the scope of negation (e.g. *I don't have any cookies*), as well as a set of linguistic environments that share certain much-debated properties with negation. These include other 'downward-entailing' environments such as the antecedents of conditionals and the restrictors of universals, as well as questions, *only*, so-called 'adversative' predicates, markers of sarcasm, and more (Fauconnier, 1975; 1979; Ladusaw, 1979; Linebarger, 1987; Horn, 1989; 2015; Kadmon & Landman, 1993; Krifka, 1995; Giannakidou, 1998; von Fintel, 1999; Crnič, 2014; *i.a.*). The meaning of *any* in all of these contexts corresponds to a kind of indefinite existential quantifier, similar to (and maybe derived from) the meaning of *even one* (Lahiri, 1998; Chierchia, 2013; 2019). In its other life, *any* can appear in a restricted set of positive contexts, generally under the scope of modal operators (e.g. *Any cookie you want can be yours*). In that life, *any* acts as a Free Choice Item (FCI), and its meaning is generally of a wide-scoping universal (Vendler, 1967; Horn, 1972; Carlson, 1981), though examples of FCI uses with an existential force (Horn, 2000) contribute to a further debate about how best to characterize this second life (Crnič, 2019; van der Auwera, 2024). Outside of either of these two contexts in which *any* can live, its use is unacceptable to English speakers (e.g. **I have any cookies*) and correspondingly virtually unattested in children's input.

Due to these two lives, linguists have long debated whether *any* has one meaning or two (Linebarger, 1980; Carlson, 1981; Homma, 1990; Kadmon & Landman, 1993; Dayal, 1998; Giannakidou, 2001, *i.a.*). Behind this debate is the fact that many uses of *any* are consistent with multiple different analyses of its meaning. For example, in a negated main clause, *any* could be

interpreted either as a narrow-scoping existential or as a wide-scoping universal. Both would produce the same sentential meaning.

(1) I don't have any cookies
  a. $\sim\exists x$ [x is a cookie $\wedge$ I have x]
     There does not exist an x such that x is a cookie and I have x
  b. $\forall x$ [x is a cookie $\rightarrow \sim$(I have x)]
     For all x, if x is a cookie, then it is not the case that I have x

As for the linguist, so too for the child. To analyze *any* as a narrow-scoping NPI, children may need to notice that it never appears in corresponding affirmative sentences. Indeed, some researchers have suggested that this interpretive ambiguity might explain why *any* would have a wide-scoping universal FCI meaning in the first place (Ladusaw, 1979; Herburger, 2001; 2023; Kuhn & Maldonado, 2022; 2025). Here, however, we merely highlight this ambiguity as one example of how sentential meanings can underdetermine the lexical meaning of *any*. We home in on a further interpretive ambiguity, which children must face even if they understand that *any* cannot appear in an affirmative context.

The ambiguity we focus on is between NPI *any* and Negative Concord Items (NCIs). NCIs are a class of words that share much of their distribution – but not their meaning – with the NPI life of *any* (see Herburger, 2001; 2023). They are negative quantifiers (typically meaning 'nothing', 'no one', or 'never') which, when within the scope of another negation, can effectively appear inert; the meaning of the utterance in which they appear is negated just once, not twice. While standard American English does not generally permit negative concord constructions (though see, Blanchette, 2013; 2015), NCIs are common in many varieties of both British and American English (Smith, 2001; Anderwald, 2005), as well as across languages, including Greek, Japanese, Korean, and the Romance family (in French, Spanish, Catalan, Italian, and Romanian; see Robinson & Thoms, 2021, for review). For example, in Romanian, a negative sentence can have two negative operators (a sentential negator and an NCI) that are interpreted as one logical sentential negation (Fălăuş & Nicolae, 2016):

(2) Romanian
  Nu am văzut **nimic.**
  Not have seen **nothing**
  'I **didn't** see anything.' (not interpreted as a double negation, i.e. I saw something)

NCI-permitting languages vary with respect to how strictly they require a prior negator to license the occurrence of an NCI. In strict concord languages such as Romanian, NCIs are unlicensed in the absence of negation (Fălăuş & Nicolae, 2016), whereas in non-strict negative concord languages, such as most other Romance languages, NCIs can also occur in the absence of a prior negator pre-verbally. In that case, they contribute a negation themselves (see Giannakidou & Zeijlstra, 2017, for review).

The crux of the learning problem facing children is that under negation, *any* may look indistinguishable from a negative quantifier in concord with that negation (an NCI; see **Figure 1**). It is not that *any* necessarily has the exact same meaning. Rather, its distinctive contribution to a sentence – for instance, as a domain-widener (Kadmon & Landman, 1993) – may not be noticeable in most contexts in which it appears. (3a) and (3b) may not mean exactly the same thing, but they would be hard for a child to tell apart.

(3) a. I don't have any cookies
b. I don't have no_{NCI} cookies
c. *I have any cookies.

Since children cannot know a priori whether their variety of English has NCIs, they must be prepared to consider the possibility. And being so prepared, children could mistake the meaning of *any* under negation for the meaning of an NCI *no*. To make matters worse, noticing that *any* does not appear in corresponding affirmative constructions like (3c) would not disabuse the child of their misanalysis, because that distribution is still consistent with *any* being an NCI. In a strict NC language, an NCI would never appear without a negation either, but even in a non-strict NC language, NCIs would not appear postverbally in constructions like (3c) without some other negative element to license them (see Giannakidou & Zeijlstra, 2017).

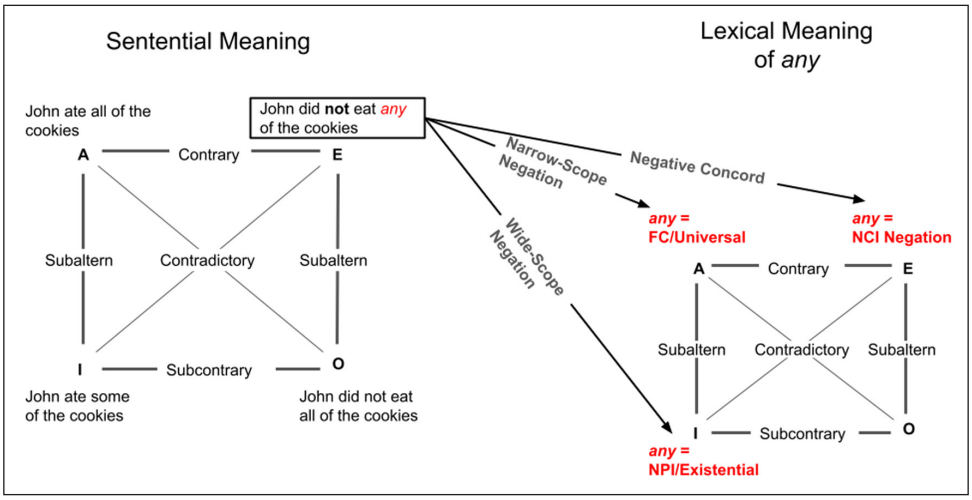

Figure 1: Two Aristotelean squares of opposition illustrate three possible mappings from sentential meaning (left) to the lexical meaning of *any* (right). If a sentence containing *any* under a negator is correctly understood to have a universal negative meaning (the E corner of the left square), there are three consistent analyses of the lexical meaning of *any* (three arrows). If the sentence is analyzed as a negative concord construction, the lexical meaning of *any* would be analyzed as a negator (the E corner of the right square). If the sentence is analyzed with inverse scope (*any* taking wide scope over *not*), *any* would be a universal quantifier or free-choice operator (the A corner of the right square). If the sentence is analyzed with linear scope (*not* taking wide scope over *any*), *any* would be an existential quantifier (the I corner of the right square). Note that two of these analyses yield contradictory lexical meanings (I and E).

To make matters even worse for the child, in at least some non-strict NC languages, the licensor for a postverbal NCI need not be a negation. Other downward-entailing and non-veridical environments – including questions, the antecedents of conditionals, and the restrictors of universals – can license NCIs just like they do NPIs (Giannakidou, 1998; Herburger, 2001). For instance, in Italian, postverbal NCIs are unlicensed in an affirmative assertion as in (4a), but can be used in a corresponding polar question as in (4b) without any other negative element. Again, this is just the same environment that would license an NPI with the meaning of *any*, and again it produces an indistinguishable sentential meaning.[1] Strikingly, in non-veridical contexts like these, the NCI itself is also bleached of its negative meaning; the question is a positively – not a negatively framed – polar question (Zanuttini, 1991; Giannakidou, 1998). Indeed, this is one reason Herburger (2001) suggests that NCIs themselves are systematically ambiguous between an existential and a negative meaning.

(4) Italian

a. *Hai visto **nessuno**.

b. Hai visto **nessuno**?
Have seen **nobody**?
'Did you see anybody?'

If children are open to the possibility of a word like *nessuno* appearing in their language, then figuring out what *any* means becomes that much harder. Questions, conditionals, and universals are just the sort of contexts that would be expected to distinguish an NPI from an NCI – only the NCI might start acting like an NPI! Although, to our knowledge, there is no one language in which questions, conditionals, and universals all license NCIs, each of these environments is a licensor in some language. That means that children, who have yet to learn which licensors are exclusive to NPIs in their particular language, cannot be sure that a word that is dependent on either one or more of these licensors is an NPI and not an NCI. The learner's situation is not just malevolent, it's absolutely devilish.

To be sure, there do exist contexts that distinguish *any* from an NCI. The same evidence that convinces linguists that *any* is not actually a negative quantifier could, if it were available, also convince the child. First, in its other life as an FCI, *any* appears without a wider-scoping negation, in which case it does not act as a negation itself but rather as either a universal or an existential (Horn, 2000; Crnič, 2019; van der Auwera, 2024). Maybe children, like some linguists, posit that *any* is ambiguous between its free choice meaning(s) and its meaning under negation. But at least prima facie, FCI uses of *any* should count for the child as evidence against the NCI hypothesis. (4a) and (4b) do not have the same sentential meanings.

[1] We are grateful to an anonymous reviewer for raising this point.

(5) a. You can have any cookie.
b. You can have no_{NCI} cookie.

Even in its life as an NPI, there are cases where understanding the sentential meaning should be sufficient to distinguish *any* from an NCI. An NCI in the same environment would either be unacceptable in a strict-NC language, or else would contribute a semantic negation to the meaning of the sentence in a non-strict one, which would yield the wrong sentential meaning; compare (5a) and (5b).

(6) a. Only cookies with any chocolate are worth eating.
b. Only cookies with no_{NCI} chocolate are worth eating.

Moreover, in both strict and non-strict concord languages, NCIs can be used as single-word fragment answers to questions, in which case they clearly express a negative quantifier. In English, *any* in the same position (i.e. *What do you want? Anything / When can we go? Anytime*) would never have a negative meaning. Finally, although both NPI *any* and certain NCIs can appear in the antecedents of conditionals, in the restrictors of universals, and in questions – as well as under negation – their distributions are not entirely the same. The licensing of NCIs by negation appears to be subject to a locality constraint, while NPI *any* can be licensed at longer distances and within islands (see Giannakidou & Zeijlstra, 2017 for a review).

The problem for English-learning children is that all of this disambiguating evidence is rare. In a corpus analysis of child-directed speech, Tieu (2013; 2015) found that sentential negation is by far the most common licensor of *any,* appearing in approximately 80% of utterances in which *any* is used. That is, at least about 80% of the uses of *any* that children hear are ambiguous between an NPI and an NCI interpretation. In contrast, Tieu found that *any* was only used as an FCI in 1–4% of its appearances, varying across the children whose input she examined. The remainder of cases are NPI uses with other licensors than negation, some of which might in principle disambiguate *any* from an NCI, as in (6) above. But consider that children also have to be open to the possibility that there really is an NCI in their language. For example, consider Japanese, a strict NC language, which has the NCI *nanimo* (meaning 'nothing'). Sano et al. (2009) found that in over 160,000 tokens of child-directed Japanese, which included 56 tokens of *nanimo,* children did not hear a single piece of evidence that could distinguish *nanimo* from an NPI.

In sum, children face the dual challenge of differentiating between these two classes of words – NCIs and NPIs – even as they simultaneously have to work out whether their language uses negative concord constructions at all. And they must do this with evidence that ranges from rare to nonexistent in their early input.

1.2 What do children think *any* means?

If much of the distribution of *any* in children's input underdetermines its meaning, then children might learn to expect and reproduce this distribution – only producing NPI *any* where it is licensed – before they have figured out whether *any* has the meaning of an existential or of a negation. Consistent with this possibility, Tieu's (2013; 2015) corpus analysis of 26 British and American children found that by age 3, they produced very few unlicensed instances of NPI *any* (< 3%). Sentential negation was the most frequently produced licensor (around 95%). At the same time, most of these children did not produce FCI *any* at all, and those who did produced it as an NPI significantly earlier. Thus, even as young children overwhelmingly used *any* within the scope of negation – more often, even, than they heard it used that way in their input – it is unclear if they were treating *any* as an NPI or an NCI.

Evidence from children's own production suggests that at least some children really may have misanalysed *any* as an NCI. Davidson (2020) points out that in Tieu's (2013) analysis of child speech, most of children's errors in using *any* were in utterances that the children intended to have a negative meaning.

> Sarah (Brown corpus, age 2;10)
> *MOT: that's to make orange juice (.) squeeze the oranges for orange juice for babies.
> *CHI: me?
> *MOT: yeah .
> ***CHI: I want any.**
> %com: negative meaning
> *MOT: you don't want any !
> (Transcript 33, Line 410)

Maybe this child intended to include a higher negator, but made a speech error and omitted it. Or maybe this child misanalysed *any* as a negative quantifier, and thought they could use it to convey a negative meaning without a higher negator.

Evidence from comprehension studies is likewise inconclusive, but consistent with the possibility that different children commit to different analyses of what *any* means (Xiang et al. 2006; Tieu & Lidz, 2016). Tieu and Lidz (2016) used a truth-value-judgement task in which children and adults saw a character searching for and finding different kinds of stars in a scene, but failing to find one particular kind, the fuzzy stars. A puppet then described the scene by saying the character "can't find *any* stars". All adults – and most children – rejected this description, interpreting NPI *any* as quantifying over a wider domain of stars, and so the puppet as saying, in effect, that the character did not find *even one* kind of star (which was false). But a third of children accepted the puppet's description. Tieu and Lidz quote some

of these children's justifications for their responses, and argue that they are consistent with treating *any* as quantifying over the same domain as a plain indefinite; that is, with treating *any* as an NCI, in concord with the wider-scoping negation. For instance, one child who agreed with the puppet that the character "can't find *any* stars" justified this response by pointing to the still-lost fuzzy stars in the image and saying, "Cause they're all the way up there". Tieu and Lidz report that this subset of children gave both the same truth-value judgments and similar justifications for their responses to "can't find *any* stars" as both they and adults gave to "can't find stars" – or as both might have given to "can't find *no* stars" in a negative concord language. Still, a negative concord language was not tested here, nor was children's understanding of *any* in an affirmative context, which could disambiguate the meaning of an existential from a negation. It is possible either that these children analyzed *any* as an NCI, or that they analyzed it as an NPI but did not understand its domain-widening, *even-one*-like, property.

What about children's comprehension and production of *any* in questions? Tieu (2013) reports that questions are the second most frequent licensor of NPI *any* in children's input after negation, making up 16–30% of NPI *any* tokens, depending on the child. This should give children good evidence that *any* is licensed in questions. Indeed, Tieu (2010) found that there is a high correlation and no evidence of lag between when children start producing *any* under negation and in questions. But as we have been emphasizing, adult-like production of an NPI does not entail adult-like comprehension. Moreover, as the case of *nessuno* shows, NCIs may act NPI-like in questions too. Establishing that children distinguish *any* from an NCI in a question requires testing their comprehension in a way that specifically distinguishes *any* from some masquerading NCI, which is no easy feat. While there is, to our knowledge, one study of how children understand questions containing *any*, it does not quite address this issue. Thornton (1995), tested 10 children (3;06–4;11) on questions in which a negation was either higher or lower than *any*:

(7) a. Did any of the turtles not buy an apple?
b. Didn't any of the turtles buy an apple?

Thornton found that children pointed to the turtle that hadn't bought an apple in response to (7a) 93% of the time, and to the turtle(s) that had bought an apple in response to (7b) 85% of the time. Note, however, that a child who thought *any* means no_{NCI} might respond exactly the same way. Consider again the case of *nessuno*. Consider moreover what the questions are about. The question in (7a) asks about those turtles that did not buy an apple, and those are the turtles children point to. The question in (7b) asks about turtles who did buy an apple, and children point to those. Children might respond the same way no matter what they think *any* means, as long as they independently understand which turtles are under discussion.

1.3 Negative concord and double negation

A closely related set of studies show that English-speaking children prefer a negative concord interpretation of sentences containing two negations (Thornton et al. 2016). When presented with a sentence as in (5), three to five-year-old English-speaking children overwhelmingly preferred the negative concord interpretation in (5a), whereas adults from the same speech community preferred the double negative interpretation in (5b) (Thornton et al. 2016).

(8) The girl who skipped didn't buy nothing.
   a. 'The girl who skipped bought nothing.' (Negative Concord reading)
   b. 'The girl who skipped bought something.' (Double Negative reading)

These results have been replicated in German-speaking, Italian-speaking, Japanese-speaking, and Afrikaans-speaking children, with studies finding that children prefer negative concord interpretations of sentences containing two negations more than adults do, across both languages that have negative concord constructions, and those that do not (Sano et al. 2009; Nicolae & Yatsushiro, 2020; Moscati, 2020; White et al. 2023). Artificial language learning tasks have also shown that English-speaking adults find it significantly harder to learn a double negation language compared to a negative concord language (Maldonado & Culbertson, 2021).

One interpretation of this pattern is that NCI analyses of unfamiliar function words that appear under a negator may be cross-linguistically preferred, not just by young children, but also by adults. An alternative explanation is that the preference for a negative concord interpretation reflects the processing difficulty and higher cognitive demands imposed by double negation (Corblin, 1996), especially in children (Jou, 1988), and especially given that negative quantifiers may pose additional interpretive challenges for children relative to positive quantifiers (Katsos et al. 2016; Moscati 2024).

How children interpret *any* bears on whether the negative concord interpretation of double negation is more likely to be a processing failure or a lasting linguistic analysis. If children treat *any* as equivalent to no_{NCI} in affirmative contexts, that would indicate that they have analyzed it as part of a negative concord construction in its more typical appearances under a wider-scoping negation. If this NCI analysis is available for *any* under a negation, it may likewise be available for an actual negator in the same position. This would raise the possibility that children may initially be biased to assume that they are in a negative concord language. We will return to this possibility in the discussion.

1.4 The present study

In this study, we investigate directly what children think *any* means. Given that children almost never produce unlicensed *any,* do they also assign *any* the same meaning as adults by the age at which they begin saying it? If not, do they sometimes confuse *any* with a negator, consistent

with the majority of its distribution in their input and the meanings of the sentences in which it appears on a negative concord analysis?

To answer these questions, we test how children interpret *any* in an affirmative context, in the absence of a wider-scoping negation. We use two picture-choice comprehension tasks to do this. In one task, we investigate how children interpret *any* in a free choice context, in which it is licensed in adult speech. In the other, we test how the same children interpret *any* in an affirmative sentence, where it is unlicensed. We look for correspondence in children's interpretation across tasks as a way of identifying a potential sub-group of children who might consistently interpret *any* as a negator.

In using an ungrammatical sentence as a probe of what children think *any* means, we do not assume that children think this sentence is acceptable. Rather, based on Tieu's (2013; 2015) finding that children almost never produce *any* in such sentences themselves, we think these children probably know that these sentences are unacceptable – no matter what they think *any* means. Nevertheless, their interpretation of *any* in such sentences may differ from adults and between younger and older children. In that case, comparison to appropriate controls can inform whether different interpretations stem from different reactions to ungrammaticality or from differences in what these children think *any* means.

In each task, in order to probe what children think *any* means, we compare children's and adults' interpretation of *any* to their interpretation of three other target words: *some, no*, and a nonce word. We also present each of these words in both an affirmative and a negative context. Prior research has found that 2-year-olds interpret *some* as an existential quantifier both in affirmative sentences (Barner et al. 2009) and under negation (Feiman et al. 2019). Comparing children's responses to *any* and their response to *some* tests whether they interpret *any* the same way as an existential. Similarly, children interpret *no* as a negative quantifier at least by age 3 (Nordmeyer & Frank, 2014), so that children's responses to *no* provide a reference for how children would respond if they interpret *any* the same way as a negator. Our central hypothesis is that some children – unlike adults – may interpret *any* like *no* and unlike *some* in affirmative contexts. Trials in which *no* is itself within the scope of another negator test participants' interpretation of double-negated sentences, allowing us to replicate prior findings that English-learning children tend to interpret the second negation as semantically null negative concord (Thornton et al. 2016).

Finally, nonce words, such as *dax* or *blick,* probe how children respond to a word appearing in the same position as *any* when they don't know what the word means. Although it is common to assume that children who are confused will choose randomly between all available options, it is possible that children have baseline preferences, priors, or biases that favor certain choices, or that the process of trying to make sense of an unknown word would itself lead them to pick certain options more often than others, possibly in a context-sensitive manner. Children's

responses to a nonce word in the same position as *any* should provide an empirical estimate of these factors both generally and at different ages, serving as an improved baseline measure that plays a similar function to a "chance" rate of responding.

2 Method

2.1 Ethics and consent

Ethical approval was obtained from the Institutional Review Board at Brown University (1809002208).

2.2 Participants

We tested 20 adults and 106 children across five age groups: 2-year-olds (N = 20, M_{age} = 2;5, *SD* = 6.8 months, 5 boys), 3-year-olds (N = 22, M_{age} = 3;6, *SD* = 2.9 months, 7 boys), 4-year-olds (N = 23, M_{age} = 4;4, *SD* = 3.3 months, 7 boys), 5-year-olds (N = 20, M_{age} = 5;4, *SD* = 3.1 months, 14 boys), 6-year-olds (N = 21, M_{age} = 6;6 months, *SD* = 4.2 months, 7 boys). We had planned to test 20 children per age group, but scheduled a few additional participants and included all the data. All children were reported by their caregivers to be typically developing monolingual English speakers who were exposed to fewer than ten hours of another language per week. Caregivers received a $5 online gift card as compensation. Sixteen additional children were tested but excluded for failing to complete all tasks. Adults were recruited through Amazon Mechanical Turk and children were recruited from the Brown University Developmental Labs' participant database. Written consent to participate was obtained from all children's caregivers, as well as verbal assent from children over 6 years of age.

2.3 Design

All participants took part in two picture-choice comprehension tasks, the 'Crayon Task' and then the 'Liquid Task', always in that order. These tasks assessed participants' interpretation of *any* outside of the scope of a preceding negation. In the Crayon Task, the use of *any* was meant to be acceptable on a Free Choice interpretation. In the Liquid Task, *any* was used postverbally in an upward entailing context where a Free Choice reading is unavailable, and where it is unlicensed for adult speakers. So that responses on the Crayon Task could not be affected by any confusion on unlicensed Liquid Task trials, the Crayon Task was always administered first.

In both tasks, participants heard different target words in determiner position within the critical utterance (*some, dax/blick, any, no*), both with and without a preceding negation to create a downward- or upward-entailing environment, respectively. This produced a 4 (Target Word) X 2 (Environment) design. Trials were blocked into upward-entailing and downward-entailing environments, with the order of the blocks and the order in which target words appeared within-block counterbalanced between participants within each age group.

2.4 Materials

2.4.1 Crayon Task

The Crayon Task consisted of 8 trials. In each trial, participants saw two boxes of crayons on opposite sides of the screen (see **Figure 2**). Elmo always appeared in the top left of the screen, and a different Sesame Street character ("Elmo's friend") appeared centered above the two boxes on each trial. The researcher introduced Elmo's friend by name, after which Elmo would say what his friend wants. Participants were asked to give each friend the crayon box they want by pointing to the box that Elmo describes. Then the experimenter (or the adult participant themselves) clicked on Elmo, causing his mouth to animate and produce a pre-recorded sentence in a voice different from the experimenter's:

"[Name] [wants/doesn't want] a box with [some/any/dax/no] [color] crayons"

Participants were asked, "Which crayon box should we give to *[Name]?* Can you point to it?" To record children's responses, the caregiver was asked to report which side of the screen the child pointed to (indicating *left* or *right* without re-describing the crayon box) and the experimenter clicked on the corresponding box.

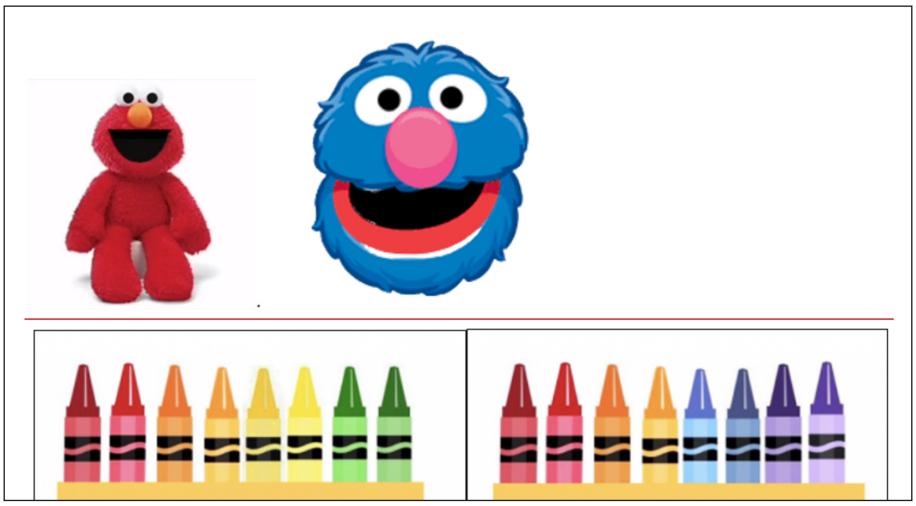

Figure 2: An example display of one trial in the Crayon Task. In this trial, participants would be introduced to Elmo's friend Grover, and then see a video of Elmo saying, "Grover wants a box with any green crayons."

Critically, one of the crayon boxes contained multiple crayons of the color that Elmo mentioned, varying along a spectrum (e.g. light green and dark green). In the upward-entailing sentences, in which Elmo says what color his friend "wants", this box matched a Free Choice interpretation of *any,* with the variation in colors supporting the use of *any* to include potentially non-prototypical cases.

Trials were grouped into blocks by upward- and downward-entailing environment (i.e. *wants* vs *doesn't want*), to avoid alternating between affirmative and negative sentences and ease the processing load of negation for younger children (see Reuter et al. 2018). For counterbalancing between participants, trials were ordered into four lists. One pair of lists had the UE sentences first, and the other pair had the DE sentences first. Crossed with these pairs, three target words (*some/any/no*) appeared in two different pseudo-random orders, always in the same order for both blocks within a list. *Dax* was always the final target word within each block, to avoid any confusion that might be caused by a nonce quantifier on preceding trials. Within each block, each color (*red, green, blue, purple*) was mentioned once.

Across all lists, each character always made the same request. For example, Grover always 'wants *any* green crayon'. The box containing the mentioned color was always presented on the same side for a given experimental item. Each character and item appeared once per list. Across items, each side (left or right) was the 'correct' response for 50% of trials (excluding *dax* trials, for which there is no 'correct' response). This resulted in the mentioned color appearing on the right-hand side on one out of the four trials within each block. The lists were assigned to participants in ascending order within each age group. Appendix A shows the lists.

2.4.2 Liquid Task

At the start of this task, participants were told that they would help Elmo find his friends. The task consisted of 8 trials. On each trial, participants were presented with three images of identical characters with different volumes of liquid: an empty container, a small volume, or a large volume (see **Figure 3**). The researcher then introduced the characters: "Let's see which one of these [girls/boys] is Elmo's friend. Look at what all these [girls/boys] have." and pointed to each container with the cursor, in order from left to right. "All of these [girls/boys] look the same, but only one of these [girls/boys] is Elmo's friend, [Name]." Elmo would then animate and describe his friend, with a pre-recorded voice different from the experimenter's:

Elmo: *[Name] [has/doesn't have] [any/dax/no/some] [liquid].*

The experimenter then asked the participant, "Which one of these [boys/girls] is Elmo's friend [Name]?" and invited them to point. As in the Crayon Task, the child's caregiver reported where the child pointed, and the researcher recorded the caregiver's report (*left*, *middle*, or *right*). For adults, no experimenter was present and the instructions were written out. Adults were asked to click on the character themselves.

As in the Crayon Task, trials in the Liquid Task were grouped into block by entailment environment (UE vs. DE; i.e. *has* vs. *doesn't have*). Each trial showed a new character, who was given a new name. There were four different kinds of liquids (water, juice, tea, milk), each of

which was used twice during the task, once per block. Each character's name, appearance, and the kind of liquid they had was held constant across lists (e.g. John was always the boy with the green shirt, and always had water).

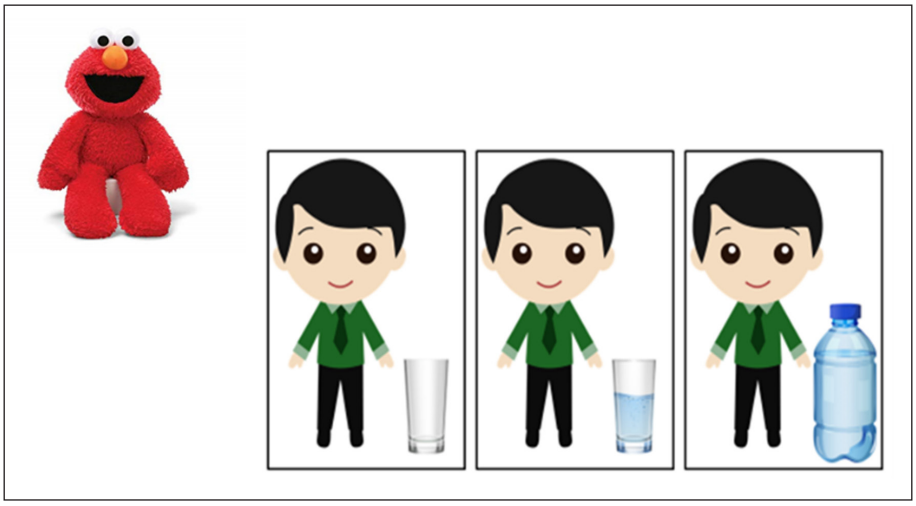

Figure 3: An example display of one trial in the Liquid Task. Participants would be told that while all these boys look the same, only one of them is Elmo's friend John. Elmo would then say, "John has any water," and participants would be asked, "Which one of these boys is Elmo's friend John?" Unlike in the Crayon Task, the appearance of any was unlicensed in the affirmative trials.

For counterbalancing between participants, trials were ordered into four lists. As in the Crayon Task, one pair of lists had the UE sentences first, and the other pair of lists had the DE sentences first. Crossed with these pairs, three target words (*some/any/no*) appeared in two different pseudo-random orders, with the same order for both blocks within a list. *Blick* was always the final target word within each block. We used *blick* instead of *dax* so that children would not assume that the nonce word had the same meaning in both the Crayon and the Liquid Task. The lists were assigned to participants in ascending order within each age group. Appendix B shows the lists.

2.5 Procedure

Children took part in the study online over Zoom video-call with their caregiver and an experimenter present. The experimenter shared their own screen with the participant, and advanced through a Qualtrics survey that displayed the experiment.

Adults completed both tasks on Qualtrics on their own, using a modified version of the same survey form. Adults were told the truth – that they were responding to questions designed for children in order to compare children's language comprehension to theirs. Before starting the

study, adults completed three additional sound-check trials, in which they pressed an on-screen button to play audio of one spoken word and were asked to write that word into a textbox in order to advance. For adults, all of the instructions that the experimenter would give verbally were written on the screen instead, and audio/video recordings of Elmo automatically played when advancing to a new trial. Adults were instructed that they could replay the audio and video of Elmo within each trial by clicking on him.

3 Results

3.1 Crayon Task

3.1.1 Analysis strategy

Except where otherwise mentioned, all subsequent analyses report on logistic mixed effects regressions. Whenever repeated measures from the same participant were being analyzed, the model included a random intercept of Participant. Estimates of the significance of fixed effects were derived from likelihood ratio tests, comparing models with and without those effects. Comparisons of performance to chance were derived from Wald II tests of significance of the intercept coefficient in a model including only the relevant group of participants.

In each model, the binary DV was whether the participant chose the box with the mentioned color. The fixed effects differed across models. We did not test an omnibus model with all fixed effects (entailment environment, quantifier, age) and interactions, which would have produced many non-hypothesis-driven tests and comparisons and led to a loss of statistical power to detect effects for the hypotheses of interest. To focus on these hypotheses, we compared specific types of trials instead. For the test trials, our analyses focused on comparing children's interpretations of *no* and of *any,* both to adults' interpretations and to children's interpretation of other words within the same environment. We treat the effect of age in different ways in different analyses, depending on the question being addressed. When analyzing control trials to test when children begin to understand the task, we grouped children into year-long age groups, matching our stratified sampling of equal numbers in each year-long group. This led us to exclude the youngest age groups from subsequent analyses. In the rest of the analyses, we treat age as a binary variable (child or adult) when comparing these two groups to each other. Only where children and adults differed, we further examined the children's responses in a separate model, testing the effect of age in months (across all age groups) as a continuous predictor.

3.1.2 Control trials: *dax* and *some*

Figure 4 shows participants' responses on the Crayon Task, broken down by age group and trial type. To check whether children at different ages could understand and perform the task, we tested whether each year-long age group responded differently to DE than UE trials on *some* and

on *dax* trials (that is, whether they differentiated *wants some* from *doesn't want some* and *wants dax* from *doesn't want dax*). We tested for an effect of Entailment (UE or DE) for each of these target words separately, and found that two-year-olds were the only group whose responses did not significantly differ between UE and DE environments in response either to *some* ($\chi^2(1) = 1.13$, $p = .29$) or to *dax* ($\chi^2(1) = 0.59$, $p = .44$). Given this lack of sensitivity to the difference between positive and negative requests for *some* and *dax*, we concluded that two-year-olds' responses on the critical *any* and *no* trials would be uninformative and excluded these children from further analysis on the test trials.

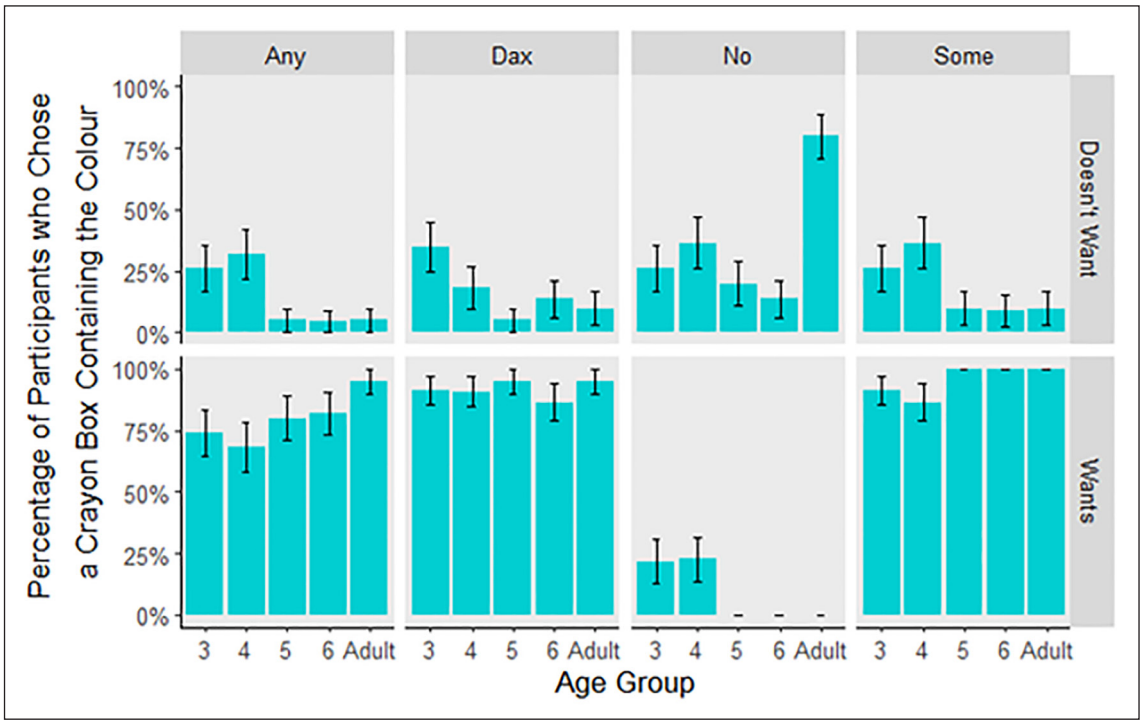

Figure 4: Results of the Crayon Task. The percentage of participants in each age group who chose the Crayon Box with the color mentioned by Elmo for each trial type. Rows correspond to entailment environment: DE (Elmo doesn't want…) on top and UE (Elmo wants…) on bottom. Facets correspond to the determiner [any/dax/no/some]. Error bars denote one standard error from the mean.

3.1.3 Test trials: *no*

How did 3- to 6-year-old children interpret single negations (*wants no [color] crayons*, i.e. UE *no* trials) and double negations (*doesn't want no [color] crayons*, i.e. DE *no* trials)? First, we examine whether children understood a single negation in an adult-like way. In UE *no* trials, we found that children chose the box with the mentioned color on fewer than half of the trials (11.5%,

$\beta = -2.04$, $p < .001$), but still significantly more often than adults ($\chi^2(1) = 4.37$, $p = .037$), who never chose that box (0%). To test for change across development, a separate model of just children's responses found a significant effect of Age, showing that younger children chose the box with the mentioned color more often than older children ($\chi^2(1) = 8.17$, $p = .004$). As **Figure 4** shows, starting at 5 years of age, all children interpreted a single negation in an adult-like way, never choosing the box with the mentioned color when Elmo said his friend "*wants a box with no [color] crayons*".

In contrast, children did not interpret double negation constructions in an adult-like way even by age 6. While adults interpreted double negations as affirmatives more often than chance, choosing the box that did contain the mentioned color on 80% of these trials ($\beta = 1.39$, $p = .013$), children systematically had the opposite interpretation, choosing the same box less often than chance, on only 24% of trials ($\beta = -1.15$, $p < .001$), thus interpreting double negation more often as a single negation. Here, there was a large and highly significant difference between children and adults ($\chi^2(1) = 21.81$, $p < .001$). Strikingly, there was also no age effect across children ($\chi^2(1) = 2.1$, $p = .15$). Even 6-year-olds interpreted a double negation as a single negation 86% of the time.

3.1.4 Test trials: *any*

Did children interpret *any* differently than adults? In UE environments where *any* has a free choice interpretation (i.e. *wants any* trials), we found that children chose the crayon box with the color Elmo mentioned more often than chance (76%; $\beta = 1.15$, $p < .001$) but significantly less than adults (95%; $\chi^2(1) = 4.62$, $p = .03$). There was no effect of age across children on these trials ($\chi^2(1) = 1.8$, $p = .18$).

In DE environments, in which Elmo said his friend *doesn't want any [color]* and *any* is an NPI, children chose the crayon box with the mentioned color significantly less than chance (17.2%; $\beta = -1.57$, $p < .001$), and not significantly differently from adults (5%; $\chi^2(1) = 2.3$, $p = .12$). Unlike in UE *any* trials, there was a significant effect of Age on children's choice in DE *any* trials, with older children choosing the box with the mentioned color less often than younger children ($\chi^2(1) = 7.41$, $p = .006$).

To test how much children differentiated *any* from a word they do not know, we compared children's and adults' responses on *any* trials to their responses on *dax* trials. Starting with DE contexts (i.e. *doesn't want any vs. doesn't want dax),* we modeled Age Group (children vs. adults), Target Word (*any* vs. *dax*), and their interaction. We found no main effect of Target Word ($\chi^2(1) = 0.30$, $p = .59$), no main effect of Age Group ($\chi^2(1) = 0.45$, $p = .50$), and no significant interaction ($\chi^2(1) = 0.48$, $p = .49$) on these trials. This is consistent with children and adults interpreting both *not any* and the negation of a nonce word, *not dax,* with a similar negative existential force.

Next, we compared *any* and *dax* in UE contexts using the same approach. Here, we again found no main effect of Age Group ($\chi^2(1) = 2.58$, $p = .11$). However, there was a significant main effect of Target word, with participants choosing the box with the mentioned color less in *wants any* trials than in *wants dax* trials ($\chi^2(1) = 6.0$, $p = .014$). There was no significant interaction between Age Group and Target Word ($\chi^2(1) = 0.67$, $p = .41$). This suggests that in a UE context, *wants any* had a weaker existential force than the nonce *wants dax*. Because our main interest was in whether children treat *any* as more negative than *dax*, we conducted an exploratory analysis of the simple effect of Target Word within children. This revealed that children responded by giving Elmo's friend the crayon box without the color significantly more on *any* trials than on *dax* trials ($\beta = 1.26$, $p = .01$). Hence, some children appear to interpret UE *any* as more like *no,* compared to how they interpret a nonsense word that they do not know.

Finally, we asked whether children interpreted *any* differently from the existential quantifier, *some*. Starting with DE contexts, we again modeled Age Group, Target Word (*any* vs. *some*) and their interaction. We found no main effect of Age Group ($\chi^2(1) = .26$, $p = .60$), no main effect of Target Word ($\chi^2(1) = 1.5$, $p = .21$), and no significant interaction ($\chi^2(1) = 1.10$, $p = .30$). Importantly, however, we found a different pattern of results in UE environments. Here, unlike in a DE context, we found a main effect of *any* vs. *some* ($\chi^2(1) = 9.93$, $p = .002$), reflecting participants choosing the box with the mentioned color less in response to *wants any* than to *wants some*. There was no main effect of age group ($\chi^2(1) = 2.90$, $p = .088$), and no significant interaction ($\chi^2(1) = 0.04$, $p = .86$). Again, because we were interested in whether children specifically treat *any* as more negative, we conducted an exploratory analysis of the simple effect of Target Word within children. This revealed that children gave Elmo's friend the crayon box without the color significantly more on *any* trials than on *some* trials ($\beta = 1.65$, $p = .002$). Hence, some children appear to interpret *any* as more like *no* and less like an existential quantifier in an affirmative free choice context. Here, there was an effect of age across children ($\chi^2(1) = 4.22$, $p = .04$), with older children more likely to choose the crayon box with the color that Elmo's friend wants *some* or *any* of, though as **Figure 4** shows, this may be due more to their increasingly adult-like interpretation of *some* than an increasingly adult-like non-negative interpretation of *any*.

In sum, we find that although both children and adults interpreted *any* as an existential quantifier less consistently than *some,* or even than the nonce word *dax,* children ranging from 3 to 6 years of age were less likely to interpret *any* as an existential compared to adults. The non-adult-like nature of this behavior is most striking in UE contexts. When told, for example, that Elmo's friend "wants the box with any green crayons", a quarter of the children (but only one out of twenty adults) picked the box that had no green crayons whatsoever. Additionally, most children were not adultlike in their interpretation of double negation even through to age six, with many interpreting two negations as one, as in a negative concord interpretation. The

adults, in contrast strongly preferred a double-negation interpretation, confirming that although they were recruited from a wider online population, most of them accessed English dialects that did not have negative concord.

3.2 Liquid Task

The analysis strategy for the Liquid Task was identical to the Crayon Task. In the Liquid Task, the binary DV was whether the participant chose the character with the empty container or not, collapsing "small volume" and "large volume" responses together.

3.2.1 Control trials: *blick* and *some*

Figure 5 shows participants' responses on the Liquid Task, broken down by age group and trial type. As we did for the Crayon Task, we tested whether each year-long age group responded differently to DE than to UE trials when asked *who has/doesn't have some* and *dax*. As in the Crayon Task, we again found that two-year-olds were the only group whose responses did not significantly differ between UE and DE environments in response either to *some* ($\chi^2(1) = 0.64$, $p = .42$) or to *dax* ($\chi^2(1) = 0, p = 1$). Given their lack of sensitivity to a single negation, we again concluded that two-year-olds' responses on the critical *any* and *no* trials would not be informative, and excluded these children from further analysis.

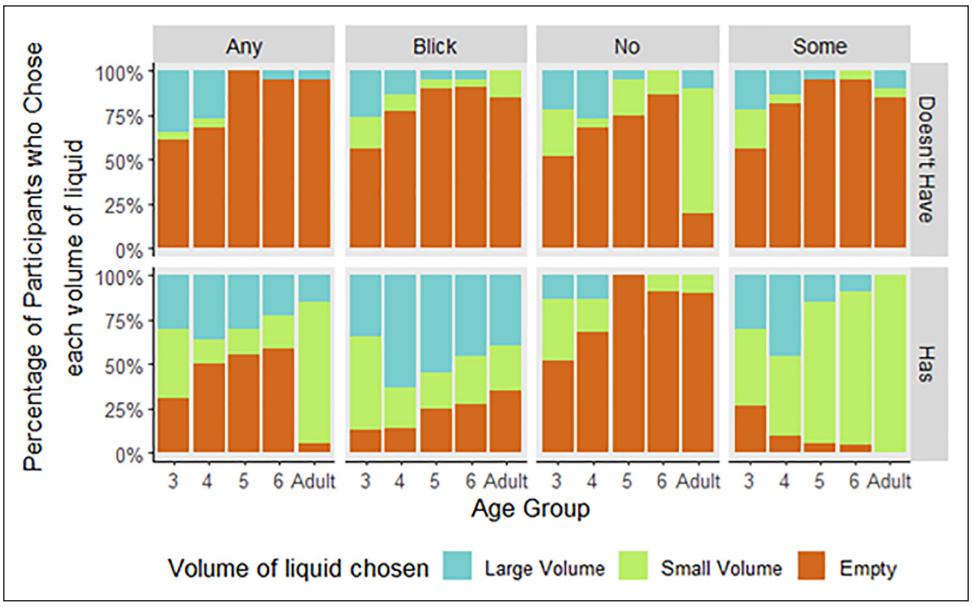

Figure 5: Results of the Liquid Task. The percentage of each response option (large volume, small volume, or empty) chosen by participants, broken down by age group, target word, and linguistic environment. Rows indicate whether there was negation in the prompt: [doesn't have] (top), [has](bottom). Facets indicate the target word [any/nonce word/no/some].

To check whether children at different ages could understand and perform the task, we tested whether each year-long age group responded differently to DE than UE trials on *some* and on *dax* trials (that is, whether they differentiated *wants some* from *doesn't want some* and *wants dax* from *doesn't want dax*). We tested for an effect of Entailment (UE or DE) for each of these target words separately, and found that two-year-olds were the only group whose responses did not significantly differ between UE and DE environments in response either to *some* ($\chi^2(1) = 1.13, p = .29$) or to *dax* ($\chi^2(1) = 0.59, p = .44$). Given this lack of sensitivity to the difference between positive and negative requests for *some* and *dax*, we concluded that two-year-olds' responses on the critical *any* and *no* trials would be uninformative and excluded these children from further analysis on the test trials.

3.2.2 Test trials: *no*

We investigated how children understood single negations (*has no [liquid]*) and double negations (*doesn't have no [liquid]*). First, we examined whether children understood a single negation in an adult-like way. In UE *no* trials, we found that children chose the character with the empty container more than half of the time (77%, $\beta = –1.2, p < .001$), no different from adults (90%; $\chi^2(1) = 1.92, p = .17$), but that younger children did so significantly less than older children ($\chi^2(1) = 16.2, p < .001$).

In contrast, children did not interpret double negation constructions in an adult-like way even by age 6. While adults treated double negations as affirmative more often than chance, choosing the character with a not empty container 80% of the time ($\beta = 1.38, p = .013$), children systematically had the opposite interpretation, choosing the character with the empty container more often than chance (70.1% of trials; $\beta = –0.85, p < .001$), treating double negation as a single negation. Here, there was a large and highly significant difference between children and adults ($\chi^2(1) = 17.21, p < .001$), and unlike in the Crayon Task, there was a significant age effect within children, with older children choosing the character with the empty container (i.e. the non-adult-like response) even more than younger children ($\chi^2(1) = 7.68, p = .006$).

3.2.3 Test trials: *any*

Did children interpret *any* differently than adults? In UE environments where *any* did not have a free choice interpretation (i.e. *has any* trials), we found that children chose the character with the empty container almost half of the time (48.3%: $\beta = 0.07, p = .75$). This was much more often than adults, who almost never did so (5%: $\chi^2(1) = 15.74, p < .001$). We further found that across children, there was no significant effect of age ($\chi^2(1) = 2.42, p = .12$); children's strikingly non-adult-like responses did not become more adult-like from age 3 through age 6.

In contrast, in DE environments, in which Elmo said his friend *doesn't have any [liquid],* children chose the character with the empty container significantly more often than chance

(80.5%; $\beta = -1.42$, $p < .001$), as did adults (95%; $\chi^2(1) = 3.06$, $p = .08$). Unlike on UE *any* trials, there was a significant effect of age on children's responses, with older children choosing the character with the empty container significantly more often than younger children ($\chi^2(1) = 17.1$, $p < .001$), concordant with the age effect observed for responses to negations, above.

To test whether children interpreted *any* differently from an unknown word, we compared how they responded to *any* and to *blick*. Starting with DE contexts *(i.e. doesn't have any vs. doesn't have blick),* we modeled Age Group (Children vs Adults), Target Word (*any* vs. *blick*), and their interaction. We found no main effect of Target Word ($\chi^2(1) = 1.96$, $p = .16$), no main effect of Age Group ($\chi^2(1) = 0.11$, $p = .74$), and no significant interaction ($\chi^2(1) = 1.82$, $p = .18$). In this case, consistent with the interpretation of *any* as either an NPI or an NCI, it was effectively semantically inert for both children and adults.

Next, we constructed the same models in UE contexts. Here, we found a main effect of Target Word ($\chi^2(1) = 6.0$, $p = .014$), no main effect of Age Group ($\chi^2(1) = 0.009$, $p = .93$), and a significant interaction ($\chi^2(1) = 10.60$, $p = .001$). Exploring this interaction, simple effects analyses revealed that while adults chose the empty container less often when asked *who has any* than *who has blick* ($\beta = -2.84$, $z = -2.23$, $p = 0.03$), children actually chose the empty container *more* often ($\beta = 1.84$, $z = 3.72$, $p < 0.001$). That is, children differentiated *any* from *blick* in affirmative contexts, but in the opposite direction from adults.

Finally, we investigated whether children interpreted *any* differently from the existential quantifier, *some*. Starting with DE contexts, we again modeled Age Group, target word (*any* vs. *some*) and their interactions. We found no main effect of Age Group ($\chi^2(1) = 0.035$, $p = .85$) and no main effect of Target Word ($\chi^2(1) = 0.035$, $p = .85$), but a significant interaction ($\chi^2(1) = 4.89$, $p = .027$). The interaction reflects the finding that children's responses to DE *any* and DE *some* were more similar than those of adults, but examining the simple effects revealed that neither children ($\chi^2(1) = 0.15$, $p = .70$) nor adults ($\chi^2(1) = 2.49$, $p = .11$) responded significantly differently to DE *any* than to DE *some*.

In contrast, we found a different pattern of results when comparing *any* to *some* in a UE environment (i.e. *has any* vs *has some*). Here we found a main effect of *any* vs *some* ($\chi^2(1) = 24.6$, $p < .001$) and a main effect of age group ($\chi^2(1) = 7.48$, $p = .0062$), but no significant interaction ($\chi^2(1) = 0$, $p = .99$). When they were asked *who has any [liquid]*, children more than adults chose the character with an empty container, even as each group rarely did so when told that Elmo's friend had *some* of that liquid. While adults interpreted *any* similarly to the existential *some*, children did not, with some children treating *any* more like a negation. There was no effect of age across children ($\chi^2(1) = 0$, $p = .99$).

Overall, children from 3 through to 6 years old were rarely adult-like in their responses to affirmative *any* in this task. In a UE context, children treated *any* as an existential quantifier less than *some,* and less than the nonce word *blick*. While adults interpreted *any* similarly to the

existential *some*, children did not. Almost half of the children chose the character with the empty container when hearing, "John has *any* water", treating *any* more like a negator. Only one adult did the same. Children's interpretation of an unlicensed NPI *any* was thus not at all adult-like in a context in which no free choice reading was available.

3.3 The interpretation of *any* across both tasks

The two tasks we used probed what children thought *any* means when it is not preceded by a negation. The Crayon Task probed children's interpretation of *any* in a licensed, free choice context, while the Liquid Task probed their interpretation of *any* in an unlicensed, affirmative context. Because the same participants completed both tasks, we can ask whether it was the same participants who interpreted *any* in a non-adult-like way in both cases. Recall that on the Crayon Task, when told that "Elmo wants the box with any [color] crayons", the non-adult-like response is choosing the crayon box without the mentioned color. On the Liquid Task, the non-adult-like response is choosing the character with the empty container when told that "John has any water". In both cases, these responses suggest that *any* was interpreted as a negator. If a child has mis-analyzed *any* as a negator, that child should give the non-adult-like response on both tasks, not just one of them.

Figure 6 shows the crosstabulation of participants' responses to affirmative (UE) trials on the Crayon Task and the Liquid Task. A majority (15 out of 21) of the children who interpreted *any* as a negator in Crayon Task also interpreted it as a negator in the Liquid Task. Conversely, of the children who did not interpret *any* as a negator in the Crayon Task, only a minority (27 out of 66) interpreted it as a negator in the Liquid Task. This pattern was consistent across ages. It did not hold among 3-year-olds: only 2 of the 6 who treated *any* as *no* in the Crayon Task went on to do the same in the Liquid Task. However, 6 out of 7 4-year-olds, 3 out of 4 5-year-olds, and 4 out of 4 6-year-olds did so. Conversely, 5 out of 19 3-year-olds who did not treat *any* as *no* in the Crayon Task went on to treat it as *no* in the Liquid Task. This was true of 5/15 4-year-olds, 8/16 5-year-olds and 9/18 6-year-olds

To assess the reliability of this pattern – whether certain children consistently interpreted *any* as a negator in both tasks – we tested whether children who gave the non-adult-like response on one task were more likely to give the non-adult-like response on the other. We restricted the data to 3- to 6-year-old children's responses to UE *any* trials, and used a logistic mixed effects regression, with their probability of choosing the empty container on the Liquid Task as the DV, and that child's choice of the crayon box (with vs without the mentioned color) in the Crayon Task, the child's age, and the interaction between them as fixed effects. This revealed a significant association between children's response to UE *any* trials across tasks ($\chi^2(1) = 7.82$, $p = .005$), a marginal effect of age ($\chi^2(1) = 3.54$, $p = 0.06$), and no significant interaction ($\chi^2(1) = 2.12$, $p = 0.15$).

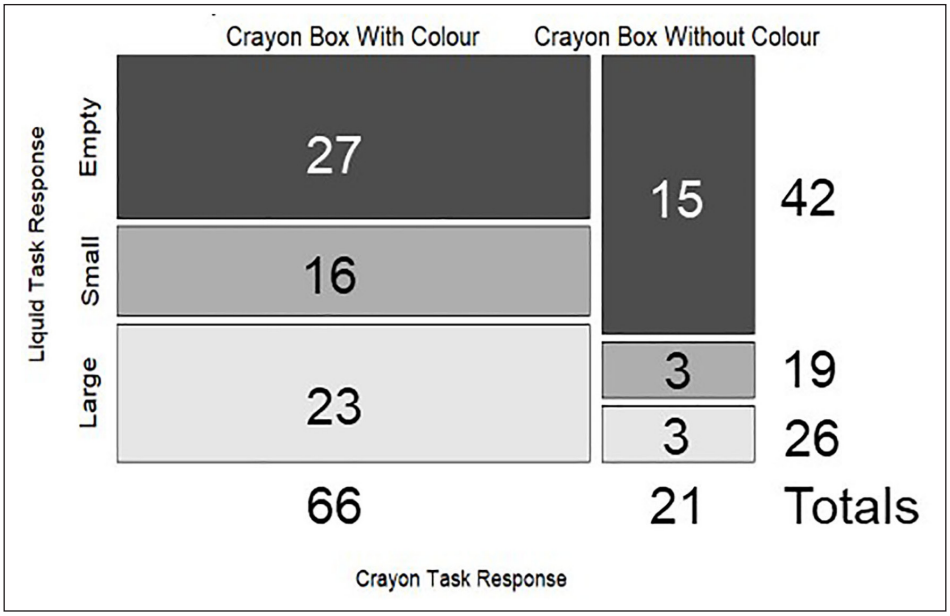

Figure 6: A mosaic plot, showing the numbers of children across all ages who gave specific combinations of responses to affirmative (UE) "any" trials across both comprehension tasks. Each tile corresponds to a cell in the crosstabulation between the two tasks, and the area of each tile is proportional to the number of children in that cell. Two-year-olds and adults are excluded. Columns indicate the choice of crayon box (with-vs-without the mentioned color); rows and shading indicate choice of character (empty container, small volume, or large volume of liquid). Sum frequencies of each response type for both tasks are printed outside the cells, in the margins.

Was this association specific to *any*? It is possible, for example, that some children systematically either chose or avoided choosing whatever was mentioned (the mentioned crayon color, the mentioned kind of liquid) in both tasks, perhaps in cases where they didn't understand what the target word meant. To investigate this possibility, we also tested whether children's responses to UE nonce word trials (*dax* and *blick*) on one Task similarly predicted their responses to UE *any* trials in the other Task. We used the same logistic regression as above, only with the data restricted to UE *dax* Crayon trials and UE *any* Liquid trials. This revealed no significant association in the *has any* trial in the Liquid Task and the *wants dax* trial on the Crayon Task ($\chi^2(1) = 0.43$, $p = .51$), and no significant effect of age ($\chi^2(1) = 0.01$, $p = .92$), or interaction ($\chi^2(1) = 0.02$, $p = .89$). We repeated the same procedure with UE *any* trials as the prediction and UE *blick* trials as the DV, and again found no association between the "wants *any*" trial in the Crayon Task and the "has *blick*" trial in the Liquid Task ($\chi^2(1) = 1.93$, $p = .16$), and no significant effect of age ($\chi^2(1) = 2.38$, $p = .12$) or interaction ($\chi^2(1) = 0.31$, $p = .58$).

In sum, a subset of children appeared to persistently respond to affirmative statements with *any* as if it meant *no*. The same children did not respond the same way to a word they did not

know, suggesting that their responses were not the result of confusion or uncertainty, but a genuine misanalysis.

4 Discussion

Across two tasks, we found a subgroup of children between 3 and 6 years of age who, in the absence of a higher negator, systematically interpreted *any* as if it had an inherently negative meaning, like the negative quantifier *no*. In the Crayon Task we presented children with an affirmative construction in which a grammatical free choice reading of *any* was available. In this context, we found that although most children interpreted *any* similarly to adults, about a quarter interpreted *any* the same way they interpreted *no*. In the subsequent Liquid Task, in which an unlicensed *any* appeared in an ungrammatical affirmative construction, we found that most three-to-six-year-olds treated *any* as if it meant *no*. Moreover, we found that of the children who interpreted *any* as a negator in the first task, a majority interpreted *any* as a negator in the second task as well. Conversely, of those who did not interpret *any* as a negator in the first task, only a minority interpreted it as a negator in the second task. We also found that this correspondence between tasks was specific to *any*; children who treated *any* as *no* in one task did not tend to treat a nonce word as *no* in the other task.

The association of non-adult-like responses between tasks argues against two deflationary possibilities. First, it suggests that the quarter of children who treated *any* as if it were *no* in the Crayon Task were responding systematically, since most of them (but few of the other children) proceeded to respond the same way on the subsequent Liquid Task. Second, it weighs against the possibility that when children encountered unlicensed uses of *any* in the Liquid Task (*John has any water*), they were repairing the sentence to make *any* licensed, perhaps by assuming that the speaker meant to include an earlier negation. That these same children also tended to respond as if *any* meant *no* in the Crayon Task, where *any* is acceptable to adults without a higher negator, suggests that they really misanalysed its meaning. This finding validates our use of ungrammatical sentences to probe children's understanding of *any:* children's non-adult-like responses on the ungrammatical sentences converge with their responses on the grammatical ones. Independently, we also know of no evidence that 3- to 6-year-olds are capable of the relevant kind of repair in these ungrammatical sentences. Rather, many studies have shown that at least through age 5, children do not revise early parsing commitments even when evidence later in the sentence contradicts them (Trueswell et al. 1999; Hurewitz et al. 2000; Weighall, 2008; Choi & Trueswell, 2010). And those are all cases where children would only have to reanalyze content they actually heard, not posit unheard elements. Those findings make it unlikely that children could posit a negator after they had begun parsing the sentence as an affirmative. Finally, note that adults demonstrably did not engage in the same kind of repair – they did not interpret *John has any water* as a negative, but rather as an existential statement, consistent with the analysis of

any as a weak existential (see Chierchia, 2013). This makes it unlikely that children would repair the sentence by positing a covert negator even if they had adult-like repair capabilities.

Consistent with prior work, we also found evidence that, in both tasks, younger children struggled with *no* itself (Nordmeyer & Frank, 2014; Katsos et al. 2016; Moscati, 2024). They struggled similarly with *doesn't want/doesn't have*, so that 3- and 4-year-olds mistakenly treated a sentence with a single negation as an affirmative on around a quarter of trials. Previous studies have found that negation words can themselves be difficult to process, especially in a context in which there are only two choices, and neither of them has been explicitly described in negative terms (De Villiers & Tager-Flusberg, 1975; Nordmeyer & Frank, 2018; Reuter et al. 2018). This, however, makes it even more striking that some children interpreted *any* as a negator. If some of the children who have misanalyzed *any* as a negator also struggled to process negation words in this task, then the number of children who responded as if *any* meant *no* would actually underestimate the number of children who misanalyzed *any* as meaning *no*.

While we find that some children have misanalysed the meaning of *any,* prior research has shown that by age two, children hardly ever produce *any* where it is not licensed to appear in adult speech (Tieu; 2013; 2016). Combining these two results suggests that children's production is more adult-like than their comprehension. That virtually all children produce *any* only where it is licensed in adult usage belies some children's persistent misanalysis of its meaning.

These findings are consistent with the observation that from a child's perspective, most of the distribution of *any* is ambiguous between a negative polarity item and a negative concord negator. This complements previous comprehension studies, which found that a significant minority of children do not appear to interpret *any* as a domain-widener (Xiang et al. 2006; Tieu & Lidz, 2016). In those studies, that minority effectively ignored the presence of *any* within the scope of a higher negator – just as would be expected if they understood *any* as a negative concord negator, redundant with the higher negation that licensed it. On the other hand, those studies had not assessed children's understanding of *any* in an affirmative context. Doing so here, we find a minority subgroup of children who interpret *any* as a negative quantifier. Although NCIs cannot be used postverbally in any language, it is possible that this is a restriction that children only learn later. In that case, children's misanalysis here could be consistent with their treating *any* as an NCI that lacks this restriction.

4.1 Does representing the licensing conditions of an NPI depend on representing its meaning?

Our findings indicate that not all children comprehend the existential meaning of *any* by the age at which they produce *any* only in grammatically licensed utterances. At the same time, Tieu (2015) found that children do not produce *any* with all of its possible licensors. While *any* is

licensed by a negator around 80% of the time children hear it in their input, children themselves use a negator 95% of the time they say *any*. This is consistent with some children assigning *any* an adult-like meaning, but others analyzing *any* as a strict negative concord item, which – unlike NPI *any* – can be licensed only by a negation and not by other downward entailing environments. This means that the finding that children almost never produce unlicensed *any* may not actually indicate that they have mastered the licensing conditions of its life as an NPI.

This raises an important further question about the link between the licensing conditions and the meanings of NPIs. Most theories derive the licensing requirements of *any* from the combination of its semantics – for example, as a domain-widener (Kadmon & Landman, 1993) or as equivalent to 'even one' (Lahiri, 1998; Chierchia, 2013; 2019) – and the semantics of downward-entailing environments (Fauconnier, 1975; Ladusaw, 1979; von Fintel, 1999). A natural interpretation of all accounts of this kind is that speakers should know the licensing requirements of *any* by virtue of knowing its meaning. A natural extension is that children should learn the licensing requirements of *any* by virtue of learning its meaning (Tieu & Lidz, 2016).

Our findings suggest an alternative possibility: that children learn what *any* means by first observing and reproducing its distribution, and then hypothesizing candidate lexical meanings that would be consistent with the meanings of sentences in which *any* has appeared. In the case of *any*, some children may (correctly) generalize across the distribution and hypothesize that *any* is an NPI, while others may (incorrectly) generalize across the same distribution and hypothesize that *any* is an NCI, and it may be surprisingly late until they encounter data that can arbitrate between these possibilities. If children can only acquire the adult-like meaning of *any* from hypotheses about its distribution, that would entail that children represent at least part of the distribution and licensing conditions of *any* prior to – indeed, as a prerequisite to – representing its meaning. Could it be possible to represent *all* of the licensing requirements of *any* without representing its meaning?

The answer may turn on an empirical point that future studies may test. Do all children who make the right generalization about the full range of licensors do so only after they have homed in on the adult-like meaning for *any* (or on whatever component of that meaning actually drives the licensing requirements)? Such a pattern would be expected under an account in which the grammatical distribution and the semantic properties are part of the same system (e.g. Chierchia, 2013). Alternatively, are there some children who master the full range of licensors for *any* – beyond just negation – prior to mastering its meaning? For example, these children could conceivably continue to posit a negative meaning for *any* while learning it is licensed in the scope of *only*, the antecedents of conditionals, and so on. Such a pattern would suggest that children's acquisition of well-formedness is independent from mastery of the meaning, and specifically that representing the full grammatical distribution of an NPI does not depend on knowing what it means.

It is important to note that even if it turns out that children can learn the full range of licensing requirements of NPI *any* without knowing its meaning, that would not mean that there is no principled link from the meaning to the distribution. One possibility might be that the distribution is dependent on the semantics diachronically through language change, driven by the semantic knowledge of adult speakers. For example, Herburger (2023) argues for a compatible view, on which the semantic contribution of NPIs to the conditions of NPI-licensing is strictly diachronic. On her account, speakers for whom *any* is a weak existential use it to convey strong meanings in downward-entailing contexts. The more adult speakers use *any* in this way to the exclusion of others, the more likely child learners are to infer that *any* is restricted to these environments. At the same time, the same learners would be free to infer different lexical meanings for *any* – from a semantically null and redundant negator, to a narrow-scoping existential, to a wide-scoping universal. This may explain why *any,* along with many other NPIs, appear to lead multiple lives, with systematically different meanings in downward-entailing contexts versus in restricted classes of upward-entailing ones (see also, Kuhn & Maldonado, 2022; 2025).

4.2 Do children assume their language uses negative concord?

That some children misanalyse *any* as a negative concord negator offers a unique insight into a long-standing puzzle: why it is that, across languages, children tend to interpret double-negated constructions as if they only had one negation, including in languages that use both concord and double negation constructions, and even in languages that do not have negative concord at all (Sano et al. 2009; Thornton et al. 2016; Moscati, 2020; Nicolae & Yatsushiro, 2020; White et al. 2023). One proposal is that processing double negation is too hard for children, either because the operation is too cognitively demanding or too confusing pragmatically (Jou, 1988). Another proposal is that independent of any difficulty understanding double negation, children may be predisposed to analyze a second negator as being in semantic concord with the first (Nicolae & Yatsushiro, 2020).

Our results support the latter possibility, that children tend to assume their language has negative concord by default. The fact that *any* is not a negator, and yet some children misanalyse it as such, suggests that children's tendency to interpret two negation words as a single negation does not actually depend on the second word being a negator. If children interpret a polarity sensitive word as an NCI when it is not actually a negator, then that interpretation cannot depend on any difficulty they might have with processing double negation. Consistent with this, we find that children's tendency to interpret two negation words as one sentential negation actually increases with age, even as the difficulty of a single negator declines. While 3- and 4-year-olds struggle with a single negation, 5- and 6-year-olds interpret single negations just like adults do, but interpret double negation in an even less adult-like way. The processing difficulty of negation appears to dissociate, across development, from the tendency to interpret two negation words as

one logical negation, again suggesting that the former is the result of a learning bias that favors an NC grammar and only strengthens with age.

Such a bias may well be functional. After all, children who are learning languages with negative concord need to learn the NCIs they encounter, and to analyze them as NCIs rather than NPIs. Although NPIs and NCIs share licensors beyond negation, there are other environments (e.g. the scope of *only*) which license NPIs, but not NCIs. This means that the distribution of NCIs – especially in strict-NC languages – is close to a subset of the distribution of NPIs. As with other cases of learning problems that have this structure, a bias to assume the narrower hypothesis may allow learning both hypotheses given the evidence. If all the evidence is consistent with two hypotheses, a learner should pick whichever hypothesis does not predict additional unobserved evidence (a kind of 'size principle'; e.g. Xu & Tenenbaum, 2007).

Of course, in the case of *any*, the available evidence is not entirely consistent with both hypotheses. Recall Tieu's (2013; 2016) finding that in about 20% of its appearances in the input of the children she studied, *any* was either used as an NPI licensed by something other than a negation (∼15%), or had a free choice interpretation. This distribution should prevent children from analyzing *any* as a strict negative concord item, which would always require a licensing negator (though maybe it does not prevent all children; see the example from Davidson, 2020, in the introduction). On the other hand, distinguishing *any* from a *non-strict* NCI may not be possible on syntactic grounds, given this input. It may require further understanding that the speaker does not intend to be negating anything. For example, in a context in which children are being offered cookies, they might need to figure out that, "You can have any cookie you like" is not intended as a prohibition. Or in a context in which they are asked, "Which vegetables do you want?", they may need to figure out that answering with *any* will not get the same response as saying *none*. Maybe it is by trying to use or interpret *any* in these sorts of cases that children figure out that it is not a negator. A further speculation is that the difference between the majority of children in our study who interpreted *any* as an existential and that minority who interpreted it as a negator is just whether they have heard (or paid attention to) some sufficient amount of these sorts of cases. This is just what we would expect if children learn the meanings of non-referential, hard words like *any* by making inferences about their meanings from their distributions, as in syntactic bootstrapping. Indeed, *any* may be just one example of a much more general phenomenon – the difficulty of pinning down the meaning of an abstract word when its distribution is consistent with multiple candidate meanings. The reason some children may confuse *any* for an NCI may not be far from the reason many adults think that *ambivalent* means *indifferent,* that *penultimate* means *ultimate,* and so on.

All this is currently just speculation. As our study did not collect data regarding our participants' linguistic input, we cannot know what exposure children in our study had to actual negative concord constructions. While negative concord constructions are absent from

standard English, it is possible that some of the children in our sample may have been exposed to NCIs in their input from adult English speakers, especially in less formal and highly emphatic contexts (e.g. *He doesn't want nothing to do with you!*). Nor can we know what specific distribution of *any* these children had actually heard, and specifically how much they had heard *any* in non-negated environments, such as in conditionals, questions, and universals. Studies of how individual differences in the linguistic input that children hear match up with changes in their comprehension may help to uncover how children attain the adult semantics of *any* and why some children misanalyse the meaning of *any* through to age 6 while others do not.

Additionally, while we focused on how English-speaking children learn the meaning of *any,* children in NCI-permitting languages have to learn both NPIs like *any* and actual NCIs, and keep them separate. Given our results, an open question is whether the presence of actual NCIs in the input helps to learn the meaning of NPIs by providing a contrast, or whether it hinders, by providing another similarly distributed, potentially ambiguous word to learn. A clear direction for future research is to investigate how our findings relate to both strict and non-strict NC languages.

5 Conclusion

We investigated how children learn the meaning of an abstract word with a complicated distribution: *any*. We hypothesized that even compared to other words that do not have observable correlates, *any* should be especially hard for children to learn because the meanings of most sentences in which children hear it are consistent with it having different contradictory lexical meanings, including both an existential and a negative concord negator. This malevolent setup should make syntactic bootstrapping – the process of figuring out the meaning of a word from its distribution – difficult. We found that between 3 and 6 years of age, when children already produce *any* exclusively in adult-like ways, a subpopulation of children have nevertheless systematically misanalysed *any* as meaning *no*, an analysis that is consistent with most of the distribution of *any* in their input.

By highlighting a case where syntactic bootstrapping can fail, these results illustrate how much children rely on it. They also suggest that when faced with ambiguous evidence, children have highly specific biases to hypothesize certain meanings for words. In this case of words that consistently appear under a higher negation, children may tend to assume that they are negative concord negators in the absence of evidence to the contrary. This sheds light on how children learn about negative concord in languages where, unlike English, it is widespread. It also suggests that children's well-documented cross-linguistic tendency to interpret double negation as single negation is the result of a learning bias that favors negative concord analyses of sentences with two negators, independent of any difficulty children might have processing double negation. All this opens up new questions for future research: how children acquire NPIs and NCIs in languages that have both, and whether learning the meaning of an NPI follows or precedes learning the exact conditions under which it is licensed to appear.

Appendices

Appendix A – Crayon Task conditions

Side with the box containing the mentioned color: Left (lighter shade) OR Right (darker shade)

TTrial #	List 1	List 2	List 3	List 4
1	"Grover wants a box with **any** green crayons"	"Big Bird doesn't want a box with **any** red crayons"	"Ernie wants a box with **some** red crayons"	"Cookie Monster doesn't want a box with some blue crayons"
2	"Bert wants a box with **no** blue crayons"	"Oscar doesn't want a box with **no** green crayons"	"Grover wants a box with **any** green crayons"	"Big Bird doesn't want a box with **any** red crayons"
3	"Ernie wants a box with **some** red crayons"	"Cookie Monster doesn't want a box with **some** blue crayons"	"Bert wants a box with **no** blue crayons"	"Oscar doesn't want a box with **no** green crayons"
4	"Kermit wants a box with **dax** purple crayons"	"Zoe doesn't want a box with **dax** purple crayons"	"Kermit wants a box with **dax** purple crayons"	"Zoe doesn't want a box with **dax** purple crayons"
5	"Big Bird doesn't want a box with **any** red crayons"	"Grover wants a box with **any** green crayons"	"Cookie Monster doesn't want a box with **some** blue crayons"	"Ernie wants a box with **some** red crayons"
6	"Oscar doesn't want a box with **no** green crayons"	"Bert wants a box with **no** blue crayons"	"Big Bird doesn't want a box with **any** red crayons"	"Grover wants a box with **any** green crayons"
7	"Cookie Monster doesn't want a box with **some** blue crayons"	"Ernie wants a box with **some** red crayons"	"Oscar doesn't want a box with **no** green crayons"	"Bert wants a box with **no** blue crayons"
8	"Zoe doesn't want a box with **dax** purple crayons"	"Kermit wants a box with **dax** purple crayons"	"Zoe doesn't want a box with **dax** purple crayons"	"Kermit wants a box with **dax** purple crayons"

Appendix B – Liquid Task conditions

Trial #	Character	Item	Condition 1	Condition 3
1	John	Water	: “John has **any** water!”	“John has **some** water!”
2	Adam	Juice	“Adam has **no** juice!”	“Adam has **any** juice!”
3	Emma	Tea	“Emma has **some** tea!”	“Emma has **no** tea!”
4	Noah	Milk	“Noah has blick milk!”	“Noah has blick milk!”
5	Jenny	Water	“Jenny **does not** have **any** water!”	“Jenny **does not** have **some** water!”
6	Olivia	Milk	“Olivia **does not** have **no** milk!”	“Olivia **does not** have **any** milk!”
7	Brian	Tea	“Brian **does not** have **some** tea!”	“Brian **does not** have **no** tea!”
8	Ana	Juice	“Ana does not have blick juice”	“Ana does not have blick juice”
Trial #	**Character**	**Item**	**Condition 2**	**Condition 4**
1	Jenny	Water	“Jenny **does not** have **any** water!”	“Jenny **does not** have **some** water!”
2	Olivia	Milk	“Olivia **does not** have **no** milk!”	“Olivia **does not** have **any** milk!”
3	Brian	Tea	“Brian **does not** have **some** tea!”	“Brian **does not** have **no** tea!”
4	Ana	Juice	“Ana does not have blick juice”	“Ana does not have blick juice”
5	John	Water	“John has **any** water!”	“John has **some** water!”
6	Adam	Juice	“Adam has **no** juice!”	“Adam has **any** juice!”
7	Emma	Tea	“Emma has **some** tea!”	“Emma has **no** tea!”
8	Noah	Milk	“Noah has blick milk!”	“Noah has blick milk!”

Data availability

All data and reproducible analysis code (in R Markdown) are available at: https://osf.io/9z3ct/

Data: 2022-05-16_ANC_data.csv

Analysis code: 2025_01_05_Analysis-Script.Rmd

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