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The Role of Syntactic Cues in Monolingual and Bilingual Two-year-olds' Novel Word  
Disambiguation

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## Abstract

Although linguistic and nonlinguistic cues help young children infer meaning when presented with unfamiliar words, little is known about how syntactic information and early bilingual experience shape word learning. This study examined how monolingual and bilingual 24- to 30-month-olds' disambiguation of novel words during a mutual exclusivity task differs as a function of syntactic cues, age, and productive vocabulary. English monolinguals and Spanish-English bilinguals were presented with familiar and novel objects within a syntactic context (e.g., "Give me the *blick!*") or in isolation (e.g., "*Blick!*"). Results showed that monolinguals and bilinguals adhered to mutual exclusivity more often when provided with syntactic cues than when those cues were absent. Furthermore, bilinguals' mutually exclusive disambiguation of novel words increased with age, but only when syntactic cues were available. These results provide insight into factors that influence children's disambiguation of novel words. The theoretical implications of these findings are discussed.

Keywords: *lexical development, disambiguation, mutual exclusivity*

# The Role of Syntactic Cues in Monolingual and Bilingual Two-year-olds' Novel Word Disambiguation

## 1.0 Introduction

The context in which information is presented impacts language learning in monolingual and bilingual children. For instance, in the domain of word learning, words can be presented in isolation (e.g., “Dog!”) or within a syntactic context (e.g., “Look at the dog!”). Although monolingual and bilingual infants can make word-object associations when novel words are presented in isolation (e.g., Byers-Heinlein et al., 2013), some evidence suggests that monolingual and bilingual infants may benefit from disambiguating novel words within a syntactic context (e.g., Fennell & Byers-Heinlein, 2014). However, little work to date has systematically examined how syntactic contexts and bilingualism may affect young children’s word learning (cf. Gathercole, 1997). Thus, this study examines how presenting novel words within a syntactic context or in isolation may affect monolinguals’ and bilinguals’ novel word disambiguation.

### 1.1 Mutual exclusivity word disambiguation tasks

In mutual exclusivity tasks, children are presented with two objects. One is a familiar object for which the child knows the label (e.g., cup), and one is an unfamiliar object for which the child does not have a label (e.g., avocado slicer)—and asked to identify whether the familiar object or the unfamiliar object is the referent of a novel label (e.g., “Give me the *blick*,” or “*Blick!*”). The manner in which children are asked to select an object varies across studies, with some studies using eye-tracking or looking-while-listening paradigms in which children look at the target object (e.g., Byers-Heinlein & Werker, 2009; Houston-Price et al., 2010; Kalashnikova et al., 2018) and others using behavioral paradigms in which children point to or hand the target

object to an experimenter (e.g., Byers-Heinlein et al., 2014; Davidson & Tell, 2005; Frank & Poulin-Dubois, 2002; Kalashnikova et al., 2015; Rocha-Hidalgo et al., 2021).

Mutual exclusivity tasks have frequently been used to examine the effects of early bilingualism on language development (e.g., Byers-Heinlein et al., 2014; Byers-Heinlein & Werker, 2009; Davidson & Tell, 2005; Frank & Poulin-Dubois, 2002; Kalashnikova et al., 2018; Kalashnikova et al., 2015). Evidence from such studies suggests that how novel words are presented may differentially shape monolingual and bilingual children's novel word disambiguation. For instance, in a study in which monolingual and bilingual two-year-olds were presented with novel words *in isolation* during a mutual exclusivity task, monolinguals and bilinguals showed *no difference* in their ability to disambiguate the meaning of those novel words (Byers-Heinlein et al., 2014). In contrast, other studies have found that young monolinguals and bilinguals may *differ* in their disambiguation of novel words during a mutual exclusivity task when presented with those words *within a syntactic context* (e.g., one-year-olds: Byers-Heinlein & Werker, 2009; Houston-Price et al., 2010; three-year-olds: Davidson & Tell, 2005; but also see Frank & Poulin-Dubois, 2002; Kalashnikova et al., 2015; Kalashnikova et al., 2018). Therefore, one possibility is that differences in syntactic contexts provided by experimental tasks across studies may be responsible for the inconsistent findings regarding bilinguals' adherence to mutual exclusivity in word disambiguation. Thus, the current study examined how syntax may shape novel word disambiguation in young word learners.

In addition to demonstrating the influence of syntax on children's ability to associate labels with objects, mutual exclusivity tasks have also provided insight into other relevant factors that impact children's vocabulary development. For instance, both young monolinguals' (Davidson & Tell, 2005; Frank & Poulin-Dubois, 2002; Kalashnikova et al., 2015) and

bilinguals' (Frank & Poulin-Dubois, 2002; cf. Davidson & Tell, 2005; Kalashnikova et al., 2015) disambiguation of novel words in mutual exclusivity tasks have been found to improve with age. Such findings suggest that young children's disambiguation of novel words may change as they gain more experience with language, develop language skills, and learn more words.

In mutual exclusivity tasks, monolingual children and adults are more likely to map novel labels (e.g., *blick*) to unfamiliar objects (e.g., an avocado slicer) for which they do not have a label than to map novel labels to familiar objects (e.g., cup) for which they already have a label (e.g., Au & Glusman, 1990; Landau et al., 1988; Markman & Wachtel, 1988). In contrast, bilingual children may be equally likely to map novel labels to unfamiliar objects as to familiar objects (e.g., Byers-Heinlein & Werker, 2009; Davidson & Tell, 2005; cf. Byers-Heinlein et al., 2014; Frank & Poulin-Dubois, 2002; Kalashnikova et al., 2015; Kalashnikova et al., 2018) because being bilingual provides natural cross-language violations of mutual exclusivity. Bilingual environments naturally afford opportunities for children to learn two different words for one concept (e.g., for an English-Spanish bilingual child, knowing the English word, *dog*, and the Spanish translation equivalent, *perro*, for the concept of dog). Thus, in the present study, we use a mutual exclusivity task to examine whether young monolingual and bilingual children's disambiguation of the meaning of novel words depends on whether novel words are presented within a syntactic context. See Table 1 for a summary of the methods and findings from the extant mutual exclusivity literature.

Table 1.

*Summary of Methods and Findings from Previous Studies on Mutual Exclusivity*

Study	Sample Size	Participants' Age	Label Presentation	Response Type	Difference Between Monolinguals & Bilinguals
Byers-Heinlein & Werker, 2009	Study 1: 48 Study 2: 16	17- to 18-month-olds	Syntax	Looking while listening	Yes
Houston-Price et al., 2010	54	17- to 22-month-olds	Syntax	Looking while listening	Yes
Kalashnikova et al., 2018	Study 1: 58 Study 2: 32	18- and 24-month-olds	Syntax	Looking while listening	No
Byers-Heinlein et al., 2014	48	24-month-olds	No syntax	Target item selection	No
Rocha-Hidalgo et al., 2021	146	24-month-olds	Syntax	Target item selection	No
Frank & Poulin-Dubois, 2002	121	27- and 35-month-olds	Syntax	Target item selection	No
Davidson & Tell, 2005	80	3- to 4- and 5- to 6-year-olds	Syntax	Target item selection	Yes

Kalashnikova et al., 2015	76	39- to 67-month-olds	Syntax	Target item selection	No
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## 1.2 Syntactic context and word learning

A number of word learning studies have examined children's sensitivity to syntactic cues in inferring word meaning by varying the syntactic context in which novel words are presented. Syntactic information has been found to be helpful for children as young as two years of age in distinguishing a speaker's reference to novel nouns, verbs, and adjectives (e.g., Diesendruck et al., 2006; Echols & Marti, 2004; Naigles, 1990; Waxman et al., 2009; cf. Keren-Portnoy et al., 2018). For instance, the presence or absence of a determiner (e.g., in English, *a[n]* and *the*) can help children infer whether novel words refer to an object or substance (e.g., Colunga & Smith, 2005; Gathercole, 1997; Samuelson & Smith, 1999). Moreover, English-speaking two-year-olds have been found to infer the meaning of novel verbs by using syntactic information (e.g., Fisher, 2002), and similar findings have been reported with Chinese-speaking two-year-olds learning verbs as well (e.g., Lee & Naigles, 2005). Such findings suggest that for young language learners, syntactic context is a meaningful linguistic cue that helps young children disambiguate the meaning of a new word.

For bilingual children, syntactic context may provide cues about which of their two languages are being used. Although bilingual children's speech processing and spoken word recognition have been reported to be similar across their two languages (e.g., Marchman et al., 2010), syntactic cues specific to each language may provide bilingual children with information about the greater linguistic context of their environment. Indeed, bilingual children are sensitive to the linguistic context of their environment (e.g., Comeau et al., 2007) and have greater



syntactic awareness than their monolingual counterparts (e.g., Bialystok, 1988; Cromdal, 1999; Davidson et al., 2010). Moreover, recent research has found that the language being used modulates Spanish-English bilingual toddlers' attention during a novel noun generalization task (Schonberg et al., 2020), such that bilingual children showed a shape bias in an English language context (the language that has a larger proportion of shape-based nouns) but not during a Spanish language context (the language that has a smaller proportion of shape-based nouns). These results suggest that bilingual children's experience with syntax that differentially draws their attention to shape influences the strength of this language learning bias across the two languages. Given this evidence that syntax plays a role in bilinguals' novel noun generalization, there is reason to believe that syntax may also guide bilingual children's disambiguation of the meaning of words. Specifically, syntax may cue the larger linguistic context, which in turn may facilitate disambiguation.

### **1.3 The present study**

The goal of the present study was to understand how syntactic context affects young monolinguals' and bilinguals' disambiguation of new words, how children's extant productive language skills influence their novel word disambiguation, and how their strategies for disambiguation change over development. Specifically, we examined how 24- to 30-month-old English monolingual and Spanish-English bilingual children's performance on a mutual exclusivity task differs (1) in the presence or absence of syntactic context, (2) as a function of children's extant vocabulary knowledge, and (3) as a function of age. We focused on the 24- to 30-month age range because this age range reflects a time of immense productive language development, particularly at the lexical and syntactic levels (e.g., Fenson et al., 1994; Frank et al., 2017; Pearson et al., 1993).

To examine whether monolingual and bilingual children’s task performance differed by syntactic context, we used a mutual exclusivity task (Markman & Wachtel, 1988) in which we manipulated the presence or absence of syntactic cues (e.g., “Where is the *blick*?” vs. “*Blick!*”). First, we did not have clear predictions about whether monolingual and bilingual children would differ in their overall adherence to mutual exclusivity, regardless of the effect of syntactic cues. Given previous work, it is possible that bilinguals may adhere to mutual exclusivity less than monolinguals (e.g., Byers-Heinlein & Werker, 2009; Davidson & Tell, 2005) or may not differ from monolinguals in their adherence to mutual exclusivity (e.g., Byers-Heinlein et al. 2014; Frank & Poulin-Dubois, 2002; Kalashnikova et al., 2015; Kalashnikova et al., 2018).

We did, however, expect the presence of syntactic cues to lead all children—regardless of language background—to more consistently adhere to mutual exclusivity (e.g., Fennell & Byers-Heinlein, 2014). The syntactic context provided by the English phrase may cue form class, highlighting that the novel word is a noun rather than a verb or an adjective. Understanding that the novel word is a noun should help all children map the novel word onto an object more readily than they would without syntactic context.

Lastly, we expected an interaction in which the magnitude of the effect of syntactic cues would be greater for bilinguals than monolinguals (Davidson & Tell, 2005; Kalashnikova et al., 2015)—that is, that bilinguals’ adherence to mutual exclusivity would be affected by the presence or absence of syntactic cues more so than that of monolinguals. Because bilingual children are sensitive to the linguistic context of their environment (e.g., Comeau et al., 2007; Nicoladis, 1998; Petitto et al., 2001; Schonberg et al., 2020), we expected syntactic cues in the present study to provide bilingual children with stronger cues to the English context of the study (e.g., Byers-Heinlein et al., 2014; Byers-Heinlein & Werker, 2009; Davidson & Tell, 2005).

Additionally, understanding the English phrasal context may allow bilingual children to infer that the novel word being presented is an English noun and thus lead them to attribute labels in mutually exclusive ways. In contrast, in the absence of syntactic cues, bilingual children are not cued to a Spanish or English language context and are not provided cues regarding word class. Therefore, the absence of syntactic cues deprives monolingual children of information about word class, whereas bilingual children are deprived of information about both word class *and* the language being used. Thus, we expected bilingual children to adhere less to mutual exclusivity in the absence of syntactic cues than monolinguals (cf. Byers-Heinlein et al., 2014). Because children's existing vocabulary may influence how they learn new words, we also examined whether monolingual and bilingual children's performance on a mutual exclusivity task differed as a function of productive language skills (e.g., Frank & Poulin-Dubois, 2002). We measured monolingual and bilingual children's total productive conceptual vocabularies, as well as bilingual children's knowledge of translation equivalents. We expected monolingual and bilingual children with larger conceptual vocabularies to exhibit more consistent adherence to mutual exclusivity (e.g., Frank & Poulin-Dubois, 2002). However, because translation equivalents are a natural cross-language violation of mutual exclusivity (i.e., two words are mapped onto one concept, as opposed to one word for one concept), we expected bilingual children's adherence to mutual exclusivity to differ as a function of their knowledge of translation equivalents (e.g., Byers-Heinlein & Werker, 2013). In line with the lexicon structure hypothesis (Byers-Heinlein & Werker, 2009; Byers-Heinlein & Werker, 2013), we predicted that bilingual children who knew a smaller proportion of translation equivalents—that is, children whose vocabularies had *fewer* examples of cross-language violations of mutual exclusivity—would adhere to mutual exclusivity *more often* than bilingual children who knew a greater

proportion of translation equivalents (cf. Frank & Poulin-Dubois, 2002; Kalashnikova et al., 2019).

Age has also been shown to influence children's performance on mutual exclusivity tasks, although findings across monolingual and bilingual children are mixed (Davidson & Tell, 2005; Frank & Poulin-Dubois, 2002; Kalashnikova et al., 2015). Even less is known about how the potential influence of syntactic information on adherence to mutual exclusivity may change over development for children from varying language backgrounds. Thus, in the present study, we systematically investigated whether monolingual and bilingual children differed in their adherence to mutual exclusivity when disambiguating novel words as a function of both age and syntactic cues. In the presence of syntactic cues, we expected that age would be positively correlated with both monolingual (Davidson & Tell, 2005; Frank & Poulin-Dubois, 2002; Kalashnikova et al., 2015) and bilingual (Frank & Poulin-Dubois, 2002; cf. Davidson & Tell, 2005; Kalashnikova et al., 2015) children's adherence to mutual exclusivity. When no syntactic information was available, we predicted that there would be no relation between age and adherence to mutual exclusivity in either group of children.

## **2.0 Material and methods**

### **2.1 Participants**

Sixty-four children between the ages of 24 and 30 months ( $M_{age}=26.87$  months,  $SD=2.00$ ; 34 girls) were included in this study. Half the children were monolingual speakers of English and were exposed to English at least 90% of the day; these monolingual children had no systematic exposure to any non-English language. The other half of the children were bilingual in Spanish and English. Based on a criterion commonly cited in the literature (Pearson et al., 1997), children were classified as bilingual in this study if they were exposed to English 25% to 75% of the day.

The monolingual and bilingual children did not statistically differ in age or maternal education. Table 2 provides the monolingual and bilingual children's language and demographic information with corresponding tests of between-group differences. All children were recruited through the UCLA Infant and Young Child Database. An additional 19 children participated in the study, but their data were not included in analyses for the following reasons: their parents did not complete the necessary questionnaires ( $n=5$ ) or the child did not complete the study ( $n=14$ ). Of these 14 children who did not complete the study, 12 were bilingual children in the No Syntax condition—3 of whom did not complete training trials and 9 of whom completed training trials but did not complete test trials; in contrast, only one monolingual in the No Syntax condition and only one bilingual in the Syntax condition were excluded for failure to complete the study. This will be further discussed in the Discussion.

Table 2.

*Demographic and Vocabulary Characteristics of Monolingual and Bilingual Children*

	Monolinguals (n=32, 16 girls)	Bilinguals (n=32, 18 girls)	Statistic
Age (in months)	27.11 (2.08)	26.63 (1.92)	$t(62)=0.955, p=.343$
English exposure	99.89% (0.42%)	59.31% (17.71%)	$t(28.034)=12.332, p<.0001$
English MCDI	461.25 (162.63)	296.16 (153.18)	$t(61.78)=4.18, p<.0001$
Spanish MCDI	--	176.84 (154.09)	$t(31)=4.307, p<.001^a$
Total conceptual vocab.	461.25 (162.63)	424.75 (217.11)	$t(62)=0.761, p=.449$
Maternal education <sup>b</sup>	10.19 (1.11)	10.40 (1.00)	$U=422.50, Z=-0.683, p=.495$

*Note.* Standard deviations appear in parentheses.

<sup>a</sup> This statistic compares bilingual children's English MCDI versus Spanish MCDI scores.

<sup>b</sup> Maternal education was measured on an 11-point scale, ranging from 1=*Some Elementary School* to 11=*Master's or Doctoral degrees*. The average maternal education of approximately 10 in this sample represents a Bachelor's degree.

## 2.2 Materials and procedure

Experimental protocols were concordant with the Declaration of Helsinki. Informed consent was obtained from caregivers, and verbal assent was obtained from child participants. All children participated in a mutual exclusivity word disambiguation task conducted in English. Children were tested in an experiment room with a child-sized table and chairs in the center of the room. The experimenter sat across the table from the child. While children completed the

task, parents completed questionnaires regarding their children's language development and demographic background. Parents completed these questionnaires either in the corner of the experiment room behind the child's line of sight or right outside the experiment room, whichever made the parent and child more comfortable. If parents chose to stay in the experiment room, they were asked not to interact with the child or experimenter while the child completed the disambiguation task.

**2.2.1 Disambiguation task.** Children completed a mutual exclusivity task to measure their disambiguation of novel words. In this task, children were randomly assigned to a Syntax or No Syntax condition and participated in five training trials, followed by 10 test trials. For both conditions and both the training and test phases of the task, children were presented with two objects simultaneously and asked to hand one object to the experimenter.

The familiar words were selected for both the training and test trials using the MacArthur-Bates Communicative Development Inventory: Words and Sentences (MCDI; Fenson et al., 1994). The 20 English nouns known by the highest percentage of English monolingual 16-month-olds were chosen to ensure that the 24- to 30-month-old participating children would know the target items in the training trials and the familiar items in the test trials. Additionally, to control for the length of each word used in the training and test phases of the task, only familiar monosyllabic words were chosen, and only monosyllabic novel words were created. All novel words followed English phonology, and a native Spanish speaker confirmed that the novel words were not phonologically typical in Spanish. Moreover, all objects (familiar and novel) were similar in size. For each trial, the placement of the objects—whether the target objects were placed on the left or right of the table—was counterbalanced across children.

During the training trials, children were presented with two familiar objects (e.g., a shoe and a bottle) and asked to hand a target object to the experimenter. Children were told, “We’re going to play a word game! I’m going to show you some toys, and I’m going to name one of the toys. When I name the toy, I want you to give me that toy. Okay?” For children in the Syntax condition, the experimenter named the target object within a sentence context (e.g., “Can you give me the shoe? Where’s the shoe?”) to request the target object from the children (e.g., Byers-Heinlein & Werker, 2009). For children in the No Syntax condition, the experimenter simply named the target object (e.g., “Shoe! Shoe!”) to request the target object from the children (e.g., Byers-Heinlein et al., 2014). All children received feedback on their responses and were trained until they provided the correct target object on all five training trials. The 10 familiar objects used in the training trials were all early-learned English words and are listed in Table 3. Figure S1 in the Supplementary Materials shows a picture of the objects used during the training phase. For each trial in the training phase, the following characteristics were randomized for each child: the pairings of the two familiar objects, the order in which the two familiar objects were presented, and the familiar object the child was requested to give to the experimenter.

Table 3.

*Familiar Target and Distractor Objects Used During Training Phase*

Target	Distractor
Shoe	Sock
Dog	Hat
Cookie	Duck
Bottle	Car



Ball

Book

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After the training trials, children were presented with 10 test trials. During these test trials, children were shown one familiar object and one novel object and asked to hand an object to the experimenter; in contrast to the training trials, these requests for an object used a novel word (e.g., Syntax condition: “Can you give me the *blick*? Where’s the *blick*?”; No Syntax condition: “*Blick! Blick!*”). When children handed an object to the experimenter—regardless of which object they chose—they were praised, and the experimenter proceeded to the next trial. If children handed the novel object to the experimenter, the trial was coded as exhibiting mutual exclusivity; conversely, if children gave the experimenter the familiar object, this was coded as a violation of mutual exclusivity. The 10 familiar objects and 10 novel words used in the test trials are listed in Table 4. Figure S2 in the Supplementary Materials shows a picture of the objects used during the test phase. During the test phase, the following characteristics were randomized for each child: the pairings of the novel and familiar objects, the order in which objects were presented, and the novel label used with each familiar-novel object pair.

Table 4.

*Novel Target and Familiar Distractor Objects Used During Test Phase*

Target	Distractor
Pok	Spoon
Kloop	Plane
Wug	Pig
Neem	Boat

Dax	Tree
Tog	Bear
Fep	Cat
Yim	Fish
Bep	Cup
Blick	Truck

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**2.2.2 Parent questionnaires.** Children’s exposure to English and/or Spanish was measured using a language background questionnaire, which asked parents about their child’s exposure to each language spoken at home. Parents also completed a questionnaire about their child’s demographics and socioeconomic background.

To measure children’s productive vocabulary in each language, parents completed the American English version of the MCDI (Fenson et al., 1994; Frank et al., 2017) and its Mexican-Spanish adaptation, the MacArthur-Bates Inventario del Desarrollo de Habilidades Comunicativas (Mexican-Spanish MCDI; Jackson-Maldonado et al., 2003). Parents of monolingual children completed only the American English MCDI, whereas parents of bilingual children completed both the American English and Mexican-Spanish MCDIs. Both the American English and Mexican-Spanish MCDIs are parent-completed checklists that are commonly used to measure typically developing monolingual children’s productive language abilities (e.g., Samuelson & Smith, 1999; Waxman, 1999; Yoshida et al., 2009), as well as bilingual children’s knowledge of translation equivalents and total conceptual vocabulary (e.g., De Houwer et al., 2006; Frank & Poulin-Dubois, 2002; Pearson et al., 1993; Yoshida et al., 2011). In line with previous studies using MCDIs to measure bilingual children’s knowledge of translation

equivalents (e.g., De Houwer et al., 2006; Frank & Poulin-Dubois, 2002), the present study only considered translation equivalents to be concepts that bilingual children produced labels for in both languages (e.g., apple/manzana). Total conceptual vocabulary was defined as the total number of concepts children knew a label for. Thus, for monolinguals, total conceptual vocabulary was equivalent to the total number of words known on the English MCDI. For bilinguals, total conceptual vocabulary was the number of translation equivalents known subtracted from the sum of words known on the English MCDI and Spanish MCDI (i.e., English MCDI + Spanish MCDI - translation equivalents).

### 3.0 Results

The present study examined how syntactic context may influence 24- to 30-month-old monolinguals' and bilinguals' adherence to mutual exclusivity to disambiguate the meaning of new words and how this adherence to mutual exclusivity may change over development. For each of the ten test trials, selecting the novel object as the novel word's referent was considered adherence to mutual exclusivity. Although children were randomly assigned to each condition, preliminary analyses revealed that children in the Syntax condition ( $M=26.23$  months,  $SD=1.98$  months) were younger than those in the No Syntax condition ( $M=27.52$  months,  $SD=1.83$  months),  $F(1,60)=7.574$ ,  $p=.008$ , partial  $\eta^2=.112$ . As such, all group analyses included age as a covariate. However, children in the two conditions did not differ in their total conceptual vocabulary (Syntax:  $M=435.03$ ,  $SD=204.87$ ; No Syntax:  $M=450.97$ ,  $SD=179.35$ ),  $t(60.934)=0.331$ ,  $p=.742$ , Cohen's  $d=.083$ .

We analyzed trial response data (*adherence* or *no adherence* to mutual exclusivity) with a mixed-effects logistic regression using the *lme4* package (Bates et al., 2015) in *R* (R Core Team, 2021). The initial model included both *participant* and *item* (i.e., the label used in each trial) as

random intercepts and age as a covariate in addition to the primary predictors of interest, condition (Syntax/No Syntax), language background (monolingual/bilingual), and the interaction term (condition x language background). However, this model converged with a singular fit due to the fact that the variance of the random effect for *item* was essentially 0. Given that there were no item effects (see Table S1 in the Supplementary Materials for the results of full item analysis), we removed the by-item random intercept and report only the model that includes random intercept by participant. Thus, the final model regressed mutual exclusivity adherence on the following predictors: age, condition, language background, and the condition by language interaction. The full output of the final model is presented in Table 5.

Table 5.

*Effects of Age, Condition, Language Background, and Condition by Language Background Interaction on Adherence to Mutual Exclusivity*

	<i>Estimate</i>	<i>OR</i>	<i>SE</i>	<i>z</i>	<i>p</i>	
Intercept	-5.15	0.005	1.68	-3.06	.002	**
Age	0.20	1.22	0.06	3.36	<.001	***
Condition	1.32	3.73	0.33	4.05	<.001	***
Language Background	0.07	1.07	0.28	0.23	.82	
Condition x Language Background	-0.60	0.55	0.42	-1.44	.15	

*Note.* For the Condition variable, No Syntax was the reference group. For the Language variable, monolingual was the reference group.

Results from the mixed-effects logistic regression revealed a significant effect of the Syntax condition on disambiguation task performance. Figure 1 illustrates this effect by showing how monolinguals and bilinguals in the Syntax and No Syntax conditions performed on the mutual exclusivity task. As can be seen, the Syntax condition strongly affected children's adherence to mutual exclusivity. Relative to the No Syntax condition, children were 3.73 times more likely to adhere to mutual exclusivity in the Syntax condition ( $p < .001$ ). However, the performance of bilingual and monolingual children did not differ in their adherence to mutual exclusivity. The results also identified the usual tendency for older children to adhere to mutual exclusivity more than younger children. With every one-month increase in age, the odds of children adhering to mutual exclusivity increased by a factor of 1.22 ( $p < .001$ ).

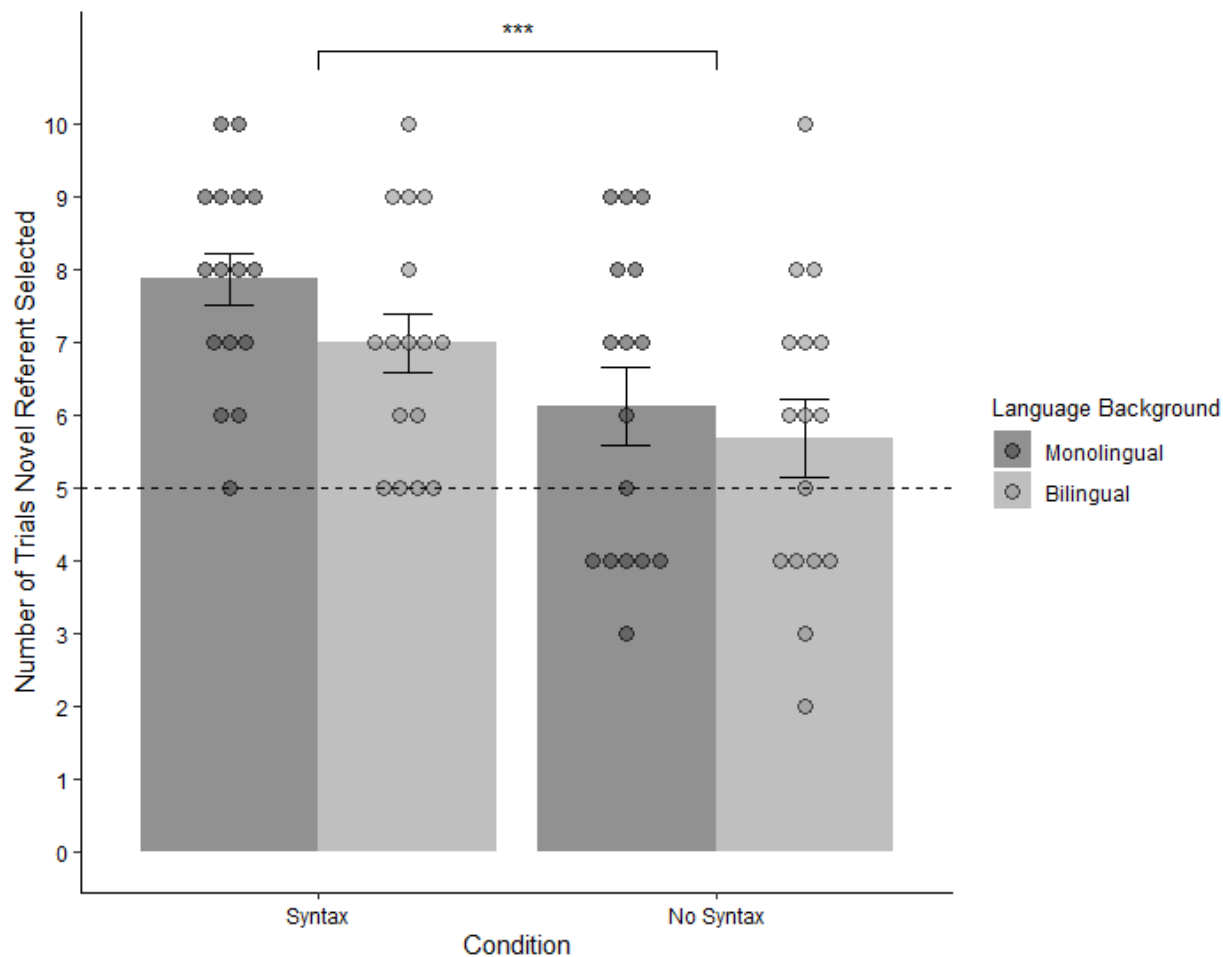


Figure 1. Number of trials in which children adhered to the mutual exclusivity principle by selecting the novel referent with respect to the children's language background and the syntactic conditions to which they were assigned. Each dot represents one child; error bars represent the standard error of the mean. No significant difference between monolinguals and bilinguals was observed. However, both monolingual and bilingual children selected the novel referent more often in the Syntax condition than the No Syntax condition (\*\* $p < .001$ ).

Furthermore, when children's performance was compared to chance (i.e., adhering to mutual exclusivity in 5 out of 10 trials) and multiple comparisons were Bonferroni-corrected (i.e., only  $p$ -values less than .0125 were considered statistically significant), both monolinguals

and bilinguals in the Syntax condition performed significantly above chance (monolinguals:  $M=7.88$ ,  $SD=1.45$ ,  $t(15)=7.904$ ,  $p<.0001$ , Cohen's  $d=1.99$ ; bilinguals:  $M=7.00$ ,  $SD=1.63$ ,  $t(15)=4.899$ ,  $p=.0002$ , Cohen's  $d=1.23$ ). In contrast, the performance of both monolinguals and bilinguals in the No Syntax condition did not differ from chance (monolinguals:  $M=6.13$ ,  $SD=2.13$ ,  $t(15)=2.117$ ,  $p=.051$ , Cohen's  $d=0.53$ ; bilinguals:  $M=5.69$ ,  $SD=2.12$ ,  $t(15)=1.297$ ,  $p=.214$ , Cohen's  $d=0.33$ ).

### **3.1 Performance on the disambiguation task across age**

Because we found a significant effect of age in our logistic regression, we examined how children's adherence to mutual exclusivity changed with development using correlations. After Bonferroni corrections for multiple comparisons, a significant relationship between age and adherence to mutual exclusivity was only found for bilinguals in the Syntax condition ( $n=16$ ; age range: 24.6-30.8 months;  $r=.71$ ,  $p=.002$ ), such that bilinguals adhered to mutual exclusivity more with age. Such a relation was not found for monolinguals in the Syntax condition ( $n=16$ ; age range: 24.2-30.4 months;  $r=.19$ ,  $p=.482$ ). Moreover, age was not significantly related to adherence to mutual exclusivity among monolinguals ( $n=16$ ; age range: 25.2-30.7 months;  $r=.50$ ,  $p=.047$ ) or bilinguals ( $n=16$ ; age range: 24.3-30.0 months;  $r=.16$ ,  $p=.551$ ) in the No Syntax condition. Thus, age-related differences in children's mutual exclusivity adherence were found only among bilinguals in the Syntax condition.

### **3.2 Vocabulary and performance on the disambiguation task**

We also examined how the content of children's vocabularies related to performance in the mutual exclusivity task. Preliminary analyses revealed that only a small proportion of bilingual children's total vocabularies consisted of translation equivalents ( $M=0.09$ ,  $SD=0.06$ , range=0.00-0.22) and that there were age-related differences in children's vocabulary.

Specifically, age was significantly related to total conceptual vocabulary in monolinguals ( $n=32$ ; age range: 24.2-30.7 months;  $r=.50$ ,  $p=.004$ ), but not in bilinguals ( $n=32$ ; age range: 24.3-30.8 months;  $r=.21$ ,  $p=.257$ ). Age was also unrelated to the proportion of translation equivalents known by bilinguals ( $n=32$ ;  $r=.17$ ,  $p=.355$ ). Across language groups, no significant relation was found between children's total conceptual vocabulary and reliance on mutual exclusivity ( $n=64$ ;  $r=.07$ ,  $p=.609$ ). Moreover, among bilinguals, adherence to mutual exclusivity was not significantly correlated with total English vocabulary ( $n=32$ ; English MCDI range: 33-602 words;  $r=-.12$ ,  $p=.511$ ), total Spanish vocabulary ( $n=32$ ; Spanish MCDI range: 6-558 words;  $r=.15$ ,  $p=.424$ ), or proportion of translation equivalents known ( $n=32$ ;  $r=.02$ ,  $p=.911$ ); these results remained consistent even when only the bilinguals in the Syntax condition were examined (all  $ps>.40$ ).

#### 4.0 Discussion

The goal of the present study was to understand how syntactic context influences young children's adherence to mutual exclusivity to disambiguate the meaning of new words and how such adherence to mutual exclusivity may change across development. We used a word disambiguation task to examine 24- to 30-month-old monolinguals' and bilinguals' reliance on mutual exclusivity when novel words were presented within a syntactic context or in isolation. Overall, our findings suggest that syntactic context may facilitate children's disambiguation of the meaning of new words and that monolinguals and bilinguals do not differ in their adherence to mutual exclusivity.

We found that both monolinguals and bilinguals consistently adhered to mutual exclusivity when presented with novel words within a syntactic context but did not do so when novel words were presented in isolation. A potential explanation for this finding is that two-year-



old children undergo rapid lexical and syntactic development (e.g., Fenson et al., 1994; Pearson et al., 1993) and may be particularly sensitive to the syntactic contexts in which they encounter new words. Indeed, evidence suggests that syntactic cues may guide young children's online language processing (e.g., Fernald et al., 2010; Lew-Williams & Fernald, 2007), as well as adults' artificial language learning (e.g., Arnon & Ramscar, 2012). Our findings support these previous findings and suggest that syntactic cues facilitate children's ability to disambiguate the meaning of new words in mutually exclusive ways (e.g., Byers-Heinlein & Werker, 2009; Davidson & Tell, 2005; Fennell & Byers-Heinlein, 2014; Frank & Poulin-Dubois, 2002; Houston-Price et al., 2010; Kalashnikova et al., 2015; Kalashnikova et al., 2018), whereas the lack of syntactic cues may lead to greater guessing about the meaning of a new word (cf. Byers-Heinlein et al., 2013; Byers-Heinlein et al., 2014). Specifically, syntactic cues in the form of an English phrase (e.g., "Can you give me the *blick*? Where's the *blick*?") may be especially informative when inferring the meaning of novel words because children are provided with clues regarding the word-class (i.e., that the novel word is a noun) *and* information about what to do in the task (e.g., "Can you give me the *blick*?"). When presented in isolation, it is unclear whether the novel word is a noun, verb, or adjective, *and* children must remember what to do in the task (i.e., hand the *blick* to the experimenter). As a result, the lack of syntactic cues may be more cognitively demanding, and children may be more likely to accept the novel word as an adjective describing the familiar object or a verb associated with the familiar object. Conversely, when children are provided with syntactic information that cues the novel word's word-class as a noun *and* reminds them of the task at hand, children may be less likely to accept the two-to-one mapping and instead be more likely to map the novel word onto the novel object.

It should be further noted that it is not the syntax per se that influences disambiguation for bilingual children but rather the larger linguistic context that the syntactic cues provide. Indeed, we predicted that the lack of syntactic context would deprive bilingual children of information about both word class and the language being used. Thus, we expected bilingual children to adhere less to mutual exclusivity in the absence of syntactic cues than monolinguals (cf. Byers-Heinlein et al., 2014). However, we did not find monolinguals and bilinguals to differ in their performance in the No Syntax condition, suggesting that the lack of syntactic information may be cognitively demanding for both groups. In order to tease apart the influence of syntax and the larger linguistic environment, further research could compare children's disambiguation during trials in which the syntactic cues are given in a phrase (e.g., "Can you give me the *blick*? Where's the *blick*?") to trials in which an English linguistic context is provided but without syntactic information (e.g., "*Blick!* Here! *Blick!*"). Although we did not find quantitative differences between monolingual and bilingual children's adherence to mutual exclusivity based on syntactic cues, it should be noted that 12 of the 14 children who did not complete the study—and were thus excluded—were bilingual children in the No Syntax condition. An examination of background variables (e.g., age, English exposure, vocabulary, maternal education) between bilingual children who completed versus did not complete the study revealed no significant differences between the two groups (see Table S2 in the Supplementary Materials). We initially expected bilingual children to be particularly affected by the lack of syntactic cues because bilingual children are sensitive to the linguistic context of their environment (e.g., Comeau et al., 2007; Nicoladis, 1998; Petitto et al., 2001; Schonberg et al., 2020) and syntactic cues in this study were posited to provide stronger cues about the English context of the study (e.g., Byers-Heinlein, 2014). Though a study drop-out rate is not direct evidence for the main questions asked

in this study, it is possible that the lack of syntactic cues made the mutual exclusivity task especially difficult for bilingual children to attend to and complete. For instance, bilingual children are sensitive to pragmatic cues when learning new words (e.g., Brojde et al., 2012). Given that the presentation of words in isolation is pragmatically unusual, the study drop-out rate of bilingual children potentially suggests that bilinguals—compared to monolinguals—may have been more sensitive to the lack of syntactic cues in the No Syntax condition as well.

Another sociopragmatic cue children may draw upon when faced with ambiguous linguistic contexts is the speaker's race/ethnicity. Indeed, recent findings suggest that monolingual and bilingual children adhered to mutual exclusivity more when the speaker was of a familiar race/ethnicity and adhered to mutual exclusivity less when the speaker was of an unfamiliar race/ethnicity (Weatherhead et al., 2021). In the current study, different experimenters of different races and ethnicities interacted with each child (although all experimenters spoke with a non-foreign accent), which means that some children were exposed to speakers of a familiar race/ethnicity, and others were exposed to speakers of an unfamiliar race/ethnicity. We recognize that such variability in speaker familiarity may have potentially influenced children's adherence to mutual exclusivity.

We also examined whether monolingual and bilingual children's reliance on mutual exclusivity varied as a function of productive language skills. Because bilinguals' knowledge of translation equivalents inherently violates mutual exclusivity, studies have examined whether bilinguals adhere to mutual exclusivity less than monolinguals (e.g., Byers-Heinlein & Werker 2013; Frank & Poulin-Dubois, 2002; Kalashnikova et al., 2019). However, in line with previous work on a similar age range (Frank & Poulin-Dubois, 2002; Kalashnikova et al., 2019; Rocha-Hidalgo et al., 2021), we found no difference in adherence to mutual exclusivity between

monolinguals and bilinguals, as well as no evidence of a relation between bilinguals' knowledge of translation equivalents and adherence to mutual exclusivity (cf. Byers-Heinlein & Werker 2013). Although it is possible that the MCDI—which was used in this study, as well as in Frank and Poulin-Dubois (2002)—does not adequately reflect young bilingual children's translation equivalent knowledge, our findings corroborate previous evidence that knowledge of translation equivalents may not be related to bilingual children's mutual exclusivity bias.

If, however, knowledge of translation equivalents is indeed a mechanism underlying reliance on mutual exclusivity, then there may be a non-linear relation between translation equivalent knowledge and mutual exclusivity. That is, there may be a critical threshold where the proportion (or number) of translation equivalents known begins to affect children's mutual exclusivity bias. Among the bilinguals in this study, only a small proportion (up to 20%) of bilinguals' total conceptual vocabulary consisted of translation equivalents; thus, it is possible that the range of translation equivalent knowledge among bilinguals in this study was restricted and that the conceptual vocabulary of the bilinguals in this study did not consist of enough translation equivalents. However, the range of translation equivalent knowledge in this sample is typical for bilinguals in this age range, as the proportion of translation equivalents in a bilingual child's vocabulary tends to be small before the age of 18 months and does not reach 30% until the age of 36 months (David & Wei, 2008; Lanvers, 1999; Nicoladis & Secco, 2000; Pearson et al., 1995). Further research is necessary to understand how bilinguals' knowledge of translation equivalents relates to the mutual exclusivity bias and also to develop more comprehensive theories for how monolinguals' and bilinguals' word disambiguation may differ.

We also aimed to understand age-related differences in monolinguals' and bilinguals' adherence to mutual exclusivity to disambiguate the meaning of novel words. Although

monolinguals' adherence to mutual exclusivity did not vary with age, bilinguals adhered to mutual exclusivity more with age when presented with novel words within a syntactic frame. Our findings are contrary to what has been found before with three- to six-year-old monolinguals and bilinguals (Davidson & Tell, 2005; Kalashnikova et al., 2015): monolinguals have been found to rely more on mutual exclusivity with age, whereas bilinguals have been found to rely less on mutual exclusivity with age. However, our study examined 24- to 30-month-olds, suggesting that monolingual and bilingual children may have different developmental trajectories in regard to their reliance on mutual exclusivity. It is possible that from age two to six years, bilinguals initially have a stronger mutual exclusivity bias that tapers with age, whereas monolinguals may initially have a weaker mutual exclusivity bias that strengthens with age. Longitudinal studies will be necessary to further examine such developmental trajectories of monolingual and bilingual children's mutual exclusivity biases.

## **5.0 Conclusions**

The present study demonstrated that: (1) 24- to 30-month-old monolinguals and bilinguals did not differ in their adherence to mutual exclusivity when disambiguating the meaning of new words, (2) children relied more on mutual exclusivity when novel words were presented with syntactic cues, and (3) bilingual children's knowledge of translation equivalents did not affect their mutual exclusivity bias. Combined with findings from previous studies of bilinguals' mutual exclusivity bias (e.g., Byers-Heinlein et al., 2014; Frank & Poulin-Dubois, 2002; Kalashnikova et al., 2015; Kalashnikova et al., 2018), these findings challenge the assumption that bilinguals rely on mutual exclusivity less than monolinguals. In accord with recent discussions about mutual exclusivity in monolingual and bilingual children (Chan, 2019), our findings suggest that the assumption about bilingual children may not be a robust finding in

this mutual exclusivity paradigm. Moreover, our findings add to the body of evidence suggesting that bilinguals' knowledge of translation equivalents is *not* the mechanism underlying this assumption (e.g., Frank & Poulin-Dubois, 2002). Future research that longitudinally investigates bilingual children's vocabulary development—perhaps using more sensitive measures of word disambiguation—is necessary to understand how the developmental trajectory of children's reliance on mutual exclusivity may vary by age, vocabulary content, and language experience.

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