A CORPUS STUDY OF *ONLY* IN CHILD-DIRECTED AND CHILD-PRODUCED SPEECH*

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1. Introduction

The current study investigates the role of frequency and distribution in Child-Directed Speech (CDS) and Child-Produced Speech (CPS) in the first language acquisition of the English focus sensitive particle (FSP) *only*. This work is part of a larger research project which aim to model the acquisition of *only* using the standard Input-Output approach found in much of the language acquisition literature. The data set analyzed in this paper will be used as the input data for a cognitive model in subsequent stages of this project. The goal of this study is to answer the following research questions:

i. Is the frequency of occurrence of *only* in CDS a significant predictor of the frequency of occurrence of *only* in CPS?
ii. Is there a significant difference in the distribution of *only* in CDS and CPS?

I show that the frequency of occurrence of *only* in CDS is a significant predictor of frequency of occurrence of *only* in CPS, and that while overall CDS and CPS pattern similarly, there are some significant differences in distribution. Furthermore, I suggest that a detailed analysis of the input to language learning mechanisms is needed for researchers to fully understand how mental representations change over the course of language acquisition. A corpus study such as this one allows researchers to analyze in detail both parental speech and child speech, as well as reduce the chance of task effects.

2. Focus sensitive particles

This section provides an overview of the properties of FSPs. A series of definitions and key assumptions that are necessary for a discussion of the key data that are provided.

FSPs take scope over a specific constituent in an utterance, resulting in that constituent being construed as the focus, i.e. the information that the speaker wants the hearer to attend to (Erteschik-Shir 1973, 1986, 1997). Here, I adopt Szabolcsi's (2001: 607) definition of scope, as seen in (1).

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(1) The scope of an operator is the domain within which it has the ability to affect the interpretation of other expressions.

In other words, functionally speaking, FSPs combine with structured propositions, i.e. propositions that consist of complex predicates in the scope of the FSP, in order to focus an argument (König 1991b). König suggests that the semantic function of FSPs is to partition a sentence into its focus (the non-presupposed information) and background (the presupposed information). That is, FSPs separate a proposition into new and given information. Thus, we can think of FSPs as elements that operate over a specific constituent in a proposition, such that the given constituent is focused.

In English, canonical examples of FSPs include *only*, *even*, and *also*. Consider example (2) from Crain et al. (1994):

(2) In New Haven, only [WILLOUGHBY'S COFFEE] is really good.[1]

In (2), WILLOUGHBY'S COFFEE is the constituent in the scope the FSP *only*, and thus stands out as the focus of the sentence. Importantly, the additional semantic function of FSPs is to signal when a constituent is being contrasted with a set of alternatives (Crain et al. 1994). I will refer to this set of alternatives as the contrast set. In regard to the example in (2), the contrast set exists of all other possible places to get coffee in New Haven. Accordingly, it is clear that contextual information is required to achieve full interpretation of sentences with FSPs.

FSPs have phonological, syntactic, semantic, and pragmatic properties that are all intertwined. Nonetheless, it is widely accepted that FSPs can be identified on the basis of their syntactic and semantic properties (König 1991b). Following Jackendoff (1972) and Jacobs (1983), König (1991b) argues that one of the most interesting syntactic properties of FSPs is their positional variability. There are various semantic and phonological consequences of the positional variability of FSPs. As König (1991b) points out, different syntactic positions result in (a) different syntactic relations between the FSPs and arguments in the sentence (I assume that König is referring specifically to c-command relationships); (b) different intonation patterns of the sentence (especially in terms of main sentence stress); and (c) different interpretations. The fact that FSPs share at the very least syntactic, semantic, and phonological properties with other linguistic phenomena, provides support for the claims that analyzing FSPs is not straightforward. Consider the example in (3), with the FSP *only*:

(3) a. Only [DALE] drinks coffee.
b. Dale only [DRINKS COFFEE].
c. Dale drinks only [COFFEE].
d. Dale drinks [COFFEE] only.

[1] The ALL CAPS notation is used to represent the fact that focus usually receives main sentence stress. That is, in English, the focus of the sentence tends to be perceived as louder compared to the surrounding linguistic environment. A detailed discussion of the acoustic correlates of stress is beyond the scope of this paper.

The most salient interpretation of each of the examples in (6) is dependent on the structural position of *only*. The position of *only* in (6a) results in an interpretation such that Dale is the only person who drinks coffee, and (6b-d) all suggest that the only thing Dale drinks is coffee. The variation in interpretation is because the scope of the FSP is restricted to constituents that the FSP c-commands (Crain et al. 1994, Jackendoff 1972, König, 1991a).[2] In (3a), *only* c-commands Dale, and in (3c,d), *only* c-commands coffee. However, (3b) shows that the FSP c-commands both the Verb Phrase (VP) (i.e. *drinks coffee*) and the constituent inside the VP (i.e. *coffee*), resulting in multiple possible interpretations.[3] This can be seen in (4).

(4) a. Dale only [DRINKS COFFEE].
Interpretation 1: The only thing Dale does with coffee is drink it (he does not sell it or spill it).
Interpretation 2: The only thing Dale does (with his time) is drink coffee.

b. Dale only drinks [COFFEE].
Interpretation: The only thing Dale drinks is coffee (not tea or beer).

Notice in (4) that the same structural position of *only* allows for multiple interpretations. Crain et al. (1994) show that this ambiguity results in children up to age 6;0 being unable to consistently assign an interpretation to sentences like those in (3b). They further argue that the most salient reading for adults is the one shown in (4b). For the present study, the critical finding is that on the reading task in Crain et al. (1994), adults do consistently assign (4b)-type interpretations to sentences with ambiguity arising from the pre-verbal position of the FSP.

3. The learning problem

3.1 Previous studies on the acquisition of FSPs

Although the previous studies on the acquisition of the English FSP *only*[4] vary in participant age groups, experimental tasks, and target constructions, most of the work comes to the same conclusion: the acquisition of FSPs is a difficult task for child learners. When dealing with sentences that contain FSPs, children display non-target-like behaviour until rather late in the course of linguistic development. Despite agreeing on the complexity of the learning problem, previous work shows variability in terms of the factors involved in explaining the complexity.

Following a prior study by Crain et al. (1992), Crain et al. (1994) found that children associated *only* with the entire VP, whereas adults associated *only* with the NP inside the

[2] Jackendoff (1972) discusses this relationship in terms of hierarchical dominance but does not use the term c-command.

[3] Note that stress placement can be used to highlight certain interpretations (i.e. disambiguate).

[4] See Höhle et al. (2016) for a list of studies on the acquisition of FSPs in languages other than English.

VP. In order to explain the behavioural differences between children and adults, Crain et al. (1994) suggest that adults tend to favour interpretations that are true in the broadest range of circumstances. In other words, when *only* is associated with the NP inside the VP there is a minimal commitment, and when *only* is associated with the entire VP, a maximal commitment is required. Ultimately, they argue that the interpretations made by the children are guided by their preference for a maximal commitment.

Philip and Lynch (2000) argue that the high incidence of target-like or non-target-like responses in their study could be an artifact of biases which arise from repeated exposure to specific stimuli in the experimental conditions. Moreover, they suggest that there is a chance that children forget the content that is presented to them orally by the time they are asked to respond. Thus, Philip and Lynch are making claims regarding memory capacity of learners required to process the target stimuli.

Paterson et al. (2003) treat the acquisition of FSPs as a problem of quantification. Essentially, sentences with *only* require a listener to construct a discourse model that contrasts a set of entities with some alternatives (Paterson et al. 2003), a process which is signaled by the FSP *only*. They state that if the set is not made explicit, listeners are required to infer a contrast set using pragmatic knowledge, which is consistent with many of the approaches outlined in the literature. Ultimately, Paterson et al. (2003) argue that children's inability to interpret sentences with pre-verbal *only* in a target-like way is due to their failure to attend to available contrast sets.

In effort to deal with the criticism that prosody was not taken into consideration in Paterson et al. (2003), Paterson et al. (2006) introduced an adult control group who were presented with the sentences in written format instead of orally. Contrary to the claims made by Crain et al. (1994), Paterson et al. (2006) found that children and adults did not perform significantly differently from each other. Instead, adults assigned interpretations that were consistent with associating the pre-verbal FSP with the entire VP. Moreover, they found no significant difference between the adult group that was presented with the stimuli orally vs. the adult group that was presented with the stimuli in written format.

Notley et al., (2009) argue that after the age of 3;6, children's difficulty interpreting sentences with FSPs does not arise from an inability to construct a contrast set. Instead, behavioural differences between children and adults arise from the fact that adults are guided by principles of c-command, but children tend to associate focus with the object in the VP regardless of the surface position of the VP. Their claims differ from those presented above in both the type of error a child makes, as well as the relevant factor responsible for the non-adult-like behaviour. Notley et al. found that even though children are using contrast sets, they still have difficulty interpreting sentences with pre-verbal *only*. Instead, they suggest that regardless of surface position, children treat *only* as a sentential adverbial that c-commands both the subject NP and the VP.

Finally, like Notley et al. (2009), Kim (2011) argues that children are able to compute a contrast set for sentences with pre-subject and pre-object *only*, but they still have interpretation issues due to difficulties with scope. Furthermore, Kim (2011) investigates children's performance on sentences with parallel NPs (e.g. *Toto brought only a book to Mickey Mouse* (Kim 2011: 56)) and suggests that children associate *only* with the last NP in a sentence as a default. In other words, children's interpretation errors are not due to an inability to construe a contrast set or a failure to be guided by the principles of c-command, but instead suggest a default positional association that is applied across the board to sentences that contain *only*.

While the above studies provide valuable information about the acquisition of *only*, the inconsistency in the findings paired with methodological difficulties support the claim that the acquisition of FSPs is a complex endeavor.

3.2 What is the learning problem?

Müller et al. (2011) argue that the following three processing steps are required to fully interpret sentences containing FSPs:

(5) Interpreting sentences with FSPs requires:
  i. identifying the position of the FSP, and the constituent it is associated with;
  ii. building a set of alternatives;
  iii. establishing a contrast between the FSP and the set of alternatives

Following (5), to fully interpret a sentence with *only*, the hearer/perceiver must i. locate the FSP in the string and identify which constituent is the focus, ii. build a set of alternatives to which the focused constituent can be compared, and iii. establish that *only* has a restrictive interpretation,[5] and then compare the focused constituent to the set of alternatives. This process is illustrated using example (1), reproduced here as part of (6).

(6) Full interpretation of *In New Haven, only Willoughby's coffee is really good* requires:
  i. identifying that Willoughby's coffee is in the scope of *only*
  ii. building a set of alternatives, i.e. all other coffee in New Haven
  iii. understanding that the presence of *only* indicates a restrictive reading, and then contrasting Willoughby's coffee with all members in the set of alternatives

Essentially, (6) suggests that the perceiver must process the information that is expressed by the relationship between syntax and discourse. Broken down by linguistic domain, the learning problem consists of the following:

(7) i. child learners must segment and store sound forms from CDS (phonological)
  ii. child learners must figure out the distribution of *only* (syntax)
  iii. child learners must figure out *only* has a restrictive reading (semantics)
  iv. child learners must construct a set of alternatives (pragmatics)

As discussed in Section 2 above, the linguistic properties corresponding to the parts of the learning problem in (7) are all intertwined. Although fully understanding the interaction between phonology, syntax, semantics, and pragmatics is necessary to fully understand

[5] É. Kiss (1998) suggests that *only* establishes identificational focus and adds an evaluative presupposition to a proposition; arguably, this characterization could be extended to *even* and *also*.

what the learner is required to do, investigating the domains one-by-one is necessary to reduce the chance that there are alternative explanations for the potential effects that are found.

3.3 What is *input* and how does it relate to solving the learning problem?

It is widely accepted that exposure to language is necessary for language learning to take place. Different approaches (innatist vs. emergentist, for example) propose different processes for how linguistic structure present in the stimuli is acquired (see Behrens 2006 for a discussion). That being said, it is often the case that researchers from both sides do not make explicit what they mean when they say *exposure* and *input*, and often use the terms interchangeably (Carroll 2017).

Carroll (2017) uses the term *exposure* to refer to the information that is observable and measurable in a given learning context (e.g. CDS), and the term *input* to refer to the information that is relevant to the solution of a learning problem. Based on Fodor (1998a; 1998b), Carroll suggests that researchers should distinguish between the types of input, namely *input-to-language-processors* (e.g. linguistic stimuli which are fed into a learner's language processor and analyzed based on the current state of the learner's grammar), and *input-to-language-acquisition-mechanisms* (e.g. the information that the acquisition mechanisms need to create novel representations). Given that one of the outputs of this study is a data set that will be used in modelling language acquisition, I will use the term *input* to refer to *input-to-language-processors* and *input-to-language-learning-mechanisms*, but in the context of analyzing a data set that is comprised of CDS. The caveat, however, is that what constitutes input is part of what the modelling process will reveal.

In regard to the learning problem at hand, Crain et al. (1994) take input to be the positive evidence used by language acquisition mechanisms to allow children to converge on a target grammar. The notion of positive evidence can be explored in the context of a corpus study, especially one that seeks to understand the properties of CDS and the relationship of those properties to the properties in CPS.

4. The current study

The current study centres on a small part of the learning problem and seeks to determine if there is a direct relationship between the frequency of occurrence of an FSP in CDS and CPS. In particular, the corpus study presented here provides an analysis of frequency and distribution of *only* in CDS and CPS. Although the work presented here seeks to add only a small insight into a complex learning problem, the methodology used attempts to answer research questions related to frequency and distribution of FSPs in both CDS and CPS which have not yet been explored. Although certain methodological issues arise in corpus studies (see Gries, 2015) the current study has the benefit of examining a large range of developmental stages, as well as removing the potential for task effects that are often present in laboratory research.

4.1 Materials

Corpora from the Eng-NA (North American English) collection from the CHILDES databank (MacWhinney 2000) were downloaded and stored locally. The final versions used in the analysis were downloaded on December 19th, 2017. The decision to store the files locally was to ensure that no updates or edits were made by the corpus authors that could potentially affect the subsequent analysis. All files processed in this study were CHAT (.cha) format, a type of plain text file. All scripts for data processing and analysis were written in Python v3.6.0, using the Natural Language Toolkit v3.2.5 (Bird et al. 2009), on a MacBook running OS X Yosemite v10.10.5.

4.2 Procedure

Each file in the data set is treated like an individual measure which corresponds to a unique frequency count for both caregiver and child. Speech from both mothers and fathers is combined to make up caregiver speech on the assumption that speech from either parent has the same communicative function.[6] From a practical standpoint, removing speech from either one of the parents would have reduced the size of the data set as well as reduced the age range of the children, so the decision was made to combine speech from both parents. The following subsections provide an overview of the data set creation and procedures for data cleaning and processing.

4.2.1 Corpus selection

First, all corpora from the Eng-NA collection (n = 61) were downloaded. Information sheets for each corpus were manually reviewed to determine whether the corpus was suitable for the data set. The following criteria for selection were used:

(8) Criteria for inclusion in the data set:
- a. corpus file contains both CDS and CPS
- b. data are from naturalistic situations, and not specific experimental tasks
- c. corpus file includes age information for the child
- d. data are from monolingual speakers of English
- e. data are from typically developing children

The decision to include only files that contained both CDS and CPS was made to avoid the criticism that if files are not matched for speakers there is no direct relationship between CDS and CPS. In order to reduce the chance of task effects in the current study, data from experimental tasks were removed. Given that the previous work on the acquisition of FSPs uses chronological age rather than Mean Length of Utterance as a measure of

[6] It is important to point out that research suggests there are differences in some properties of speech based on the sex of the parent (Gleason, 1975, i.a.; among others).

developmental time, it is necessary that the files included participant age information.[7] Files which included documented speech data from bilingual participants or use of American Sign Language were removed from the data set for consistency. Lastly, files corresponding to participants with atypical developmental trajectories (e.g. Autism Spectrum Disorder, Down Syndrome, visual or hearing impairments) were also removed.

4.2.2 Preprocessing

The first step in processing the data was to label each of the files with a predictable file name, since naming conventions are not standardized across the files in the databank. A Python script was used to append the corpus name to each of the files contained in that corpus.

Corpora from the CHILDES databank often include non-utterance annotations with grammatical information or information regarding participant actions. Thus, punctuation was used to split utterances from annotations. In the CHAT files, all utterance lines start with '*', all annotation tiers start with '%', and all participant ID and situation information starts with '@' . Using this predictable punctuation, utterances and annotations were split into chunks and the annotations were removed. Participant ID and situation information was not removed from the file as it was planned that this information would be extracted and included in the analysis.

After all non-essential content was removed from the files, annotations and non-alphanumeric characters within the utterances were removed, with the exception of commas and utterance-final punctuation. Regular expressions were used to remove all predictable instances of annotations within an utterance.

4.2.3 Data processing

Data processing took place in five steps.

Step 1: Child age and sex information was extracted from each file in the data set and written to an output file. Files were removed from the data set if no child age information was available.

Step 2: After child biographical information was extracted, total utterance count, total word count, child utterance count, child word count, caregiver utterance count, and caregiver word count were extracted from the files in the data set and written to an output file. The output file was then reviewed to determine any instances of caregiver word count being equal to zero. The files containing a zero word count for the caregiver were removed from the data set. However, we would expect word count to be zero for children at early stages of development, though it is worth noting that some researchers include cooing and babbling in the CHAT files. As previously mentioned, one of the criteria for a file to be added to the data set is that it is matched for both child and caregiver speech. Since it would

[7] In the cases where participant age information was not included in the file but available in the corpus information sheet, age was entered into the spreadsheet manually.

not have been feasible to check each file individually to ensure both CDS and CPS were present, the process of removing individual files was completed post-processing.

Step 3: A raw count of *only* was determined for both child and caregiver by searching for each occurrence of *only* in each file. The raw *only* count was written to an output file.

Step 4: A search was completed for utterances containing *only*. The utterance plus the 10 preceding utterances were extracted and written to a text file. The 10 utterances occurring before the target sentence were taken to be the linguistic context. Previous research on the FSP *only* does not discuss the possibility that linguistic context leading up to an utterance containing *only* could potentially have the contrastive information needed for a full interpretation of the utterance.[8]

Step 5: Finally, manual coding of the output was completed. Utterances were coded for the **utterance position** of *only* (e.g. utterance initial, utterance medial, utterance final), the **grammatical position** of *only* (e.g. pre-subject, pre-verb, pre-object, other).

Frequency counts were collected for each file based on the number utterances that contained *only*; CDS and CPS were counted separately. Note that an utterance such as **CHI: **only** the dog is allergic to that* (Weist 2009) would be given a count of 1 for **utterance initial** and a count of 1 for **pre-subject**.

4.3 Descriptive statistics

The final data set is made of up 3 040 CHAT files, with data from 511 different child-caregiver dyads all from the United States. The number of files analyzed per dyad ranges from 1 to 284. Child ages range from 3 months to 117 months. Although the data comes from primarily Caucasian, middle-class families, a portion of the data comes from African American families and low-income families. The data set is made up of a total of 15 857 294 words; 4 375 410 words come from caregiver speech, and 2 300 797 words come from child speech. The remaining word count (9 181 087) is from various sources, such as investigators and research assistants, other family members (siblings, grandparents, aunts, uncles), or television and radio programs that were included in the transcriptions.

5. Results

The analyses presented in this section focus on the frequency and distribution of the English FSP *only* in a data set under discussion. Analyses were completed using R v3.3.2 (R Core Team 2016) and R packages *geepack* v1.2-1 (Højsgaard et al. 2006, Yan 2002, Yan and Fine 2004) and *emmeans* v1.2 (Lenth 2018).

5.1 Data normalization

Comparing frequencies across corpora or corpus parts requires observed frequencies to be normalized (Gries 2010). Specifically, a higher occurrence of a given element in a corpus does not necessarily mean it is more frequent than the same element in a different corpus

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[8] Due to space constraints, these data are not reported on in this paper.

because the observed frequency is based on the size of the corpus (Gries 2010). In other words, we predict a higher frequency of occurrence of an element in a corpus that is larger in size. Thus, a method for normalization, i.e. finding relative frequencies, is needed.

5.1.1 Relative frequencies

Relative frequencies are computed by multiplying the chosen normalization value (e.g. 1 000 or 1 000 000) by the observed frequency count and dividing by the total number of words in the corpus or corpus part. This normalization process was performed on each of the observed frequencies in the data set. For the current study, frequencies were normalized to 1 000. Since the current study compares frequencies between CDS and CPS, relative frequencies were computed for each speaker type (e.g. child and caregiver) in each file.

5.1.2 Dispersion (DP_{norm})

Dispersion is a measure of how evenly target words or patterns are distributed across a corpus or corpus parts (Gries 2010). Gries (2008) argues that flexibility, simplicity, and extendibility are the primary reasons to adopt the DP_{norm} (deviation of proportions) approach. Due to space restrictions, the calculation of DP_{norm} will not be discussed (for an overview, see Gries 2008, 2010; Lijffijt and Gries 2012). In terms of interpreting measures of dispersion, the closer the DP_{norm} value is to 0, the more evenly the target item is distributed throughout the corpus or corpus part.

5.2 Frequency and dispersion of *only* in the data set

Table 1 shows both the observed and relative frequencies broken down by speaker-type.

Observed frequency of *only*		Relative frequency of *only*	
CDS	CPS	CDS	CPS
1 788	920	0.409	0.400

Table 1. *Frequency of 'only' in caregiver and child speech*

Due to the correlated and unbalanced nature of the data, a Generalized Estimating Equation (GEE) was performed to determine whether the occurrence of *only* in CDS is a significant predictor of the occurrence of *only* in CPS. Results show that the frequency of *only* in CDS is a significant predictor of the frequency of *only* in CPS, B = 0.264, SE = 0.077, $\chi^2(1)$ = 11.9, $p < .001$.[9] A GEE was also performed to determine whether the frequency of *only* changed significantly over time, where time is equivalent to child age. Results show that

[9] A GEE was performed to determine whether there were differences in frequency of *only* in CDS and in CPS for male children vs. female children. No significant difference was found between male and female children in CDS, B = -0.047, SE = 0.060, $\chi^2(1)$ = 0.606, p = 0.440 or CPS, B = 0.1204, SE = 0.117, $\chi^2(1)$ = 1.050, p = 0.300. Given that no significant differences were found, sex was not included as a factor in the models.

the frequency of *only* in CDS changes significantly over time, B = 0.008, SE = 0.001, $\chi^2(1) = 52.5$, $p < .001$, and the frequency of *only* in CPS changes significantly over time, B = 0.021, SE = 0.003, $\chi^2(1) = 57.9$, $p < .001$.

Given that frequency of *only* changes significantly over time for both CDS and CPS, it is useful to look at relative frequencies and DP_{norm} measurements at different age groupings over the course of development. Note that after age 7;0, the data were collapsed into a single group (i.e. 7;1+). Table 2 provides a summary of observed frequencies, relative frequencies, and DP_{norm} measurements for CDS and CPS.

Child age	Observed frequency		Relative frequency		DP_{norm}	
	CDS	CPS	CDS	CPS	CDS	CPS
0;0-1;0	58	0	0.191	0.000	0.703	0.000
1;1-2;0	305	9	0.297	0.039	0.543	0.946
2;1-3;0	483	108	0.320	0.127	0.558	0.872
3;1-4;0	309	171	0.482	0.348	0.561	0.744
4;1-5;0	412	440	0.714	0.787	0.366	0.442
5;1-6;0	100	110	0.674	1.199	0.545	0.562
6;1-7;0	45	33	0.556	1.246	0.471	0.617
7;1+	76	49	0.885	1.377	0.410	0.563

Table 2. *Frequencies and dispersion by age group*

A closer examination of Table 2 shows that for both CDS and CPS, as relative frequency increases, DP_{norm} decreases. As one might expect, as the occurrence of *only* increases, the more evenly it becomes spread across the corpus parts.

A GEE was performed for each age group to determine if the occurrence of *only* in CDS is a significant predictor of the occurrence of *only* in CPS (see Table 3).

Child age	B-coefficient	SE	$\chi^2(1)$	*p*
0;0-1;0	---	---	---	---[10]
1;1-2;0	0.036	0.023	2.36	.120
2;1-3;0	**0.052**	**0.023**	**5.21**	**.022**
3;1-4;0	**0.190**	**0.072**	**7.03**	**.008**
4;1-5;0	**0.186**	**0.092**	**4.07**	**.044**
5;1-6;0	**0.654**	**0.270**	**5.85**	**.016**
6;1-7;0	**0.870**	**0.145**	**36.2**	**< . 001**
7;1+	-0.179	0.335	0.285	.590

Table 3. *Results from GEE performed for each age group*

[10] A GEE could not be performed on 0-1;0 age group since no occurences of *only* were present in CPS at that point in the developmental timeline.

The results in Table 3 show that at ages 2;1-3;0, 3;1-4;0, 4;1-5;0, 5;1-6;0, and 6;1-7;0, the frequency of occurrence of *only* in CDS is a significant predictor of the frequency of occurrence of *only* in CPS.

5.3 A distributional analysis of *only* in the data set

Overall, *only* occurs more often in utterance-medial position than it does in utterance-initial or utterance-final position. One thing to note is that this could be an artifact of the spoken register as speech connectives such as *and*, *but*, *well*, *because*, etc. were observed in the data set. Regarding grammatical position, *only* in pre-object position occurs less frequently than *only* in pre-subject, pre-object, and other positions. Further research should be conducted to determine if this is because objects are less frequent in the data set overall.

The figures below show the breakdown of utterance position and grammatical position by CDS and CPS.

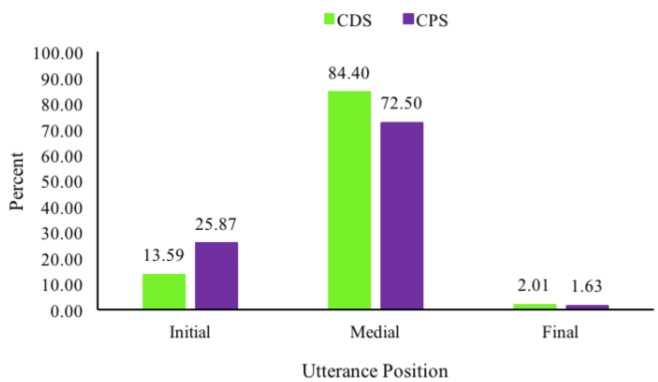

Figure 1. *Percentage of 'only' in each utterance position by CDS and CPS*

As shown in Figure 1, the frequency of *only* appears to pattern in a similar way for CDS and CPS across all utterance positions. GEEs were performed to determine if there was a significant difference in frequency between CDS and CPS. Results along with Estimated Marginal Means (EMMs) and Standard Error (SE) are presented in Table 4:

Utterance position	EMM CDS	SE CDS	EMM CPS	SE CPS	B-coefficient	SE	$\chi^2(1)$	*p*
initial	0.063	0.008	0.103	0.018	**0.040**	**0.017**	**5.95**	**.015**
medial	0.330	0.027	0.026	0.050	-0.072	0.05	2.21	.140
final	0.007	0.002	0.004	0.001	-0.003	0.002	2.20	.140

Table 4. *Difference in frequency for each utterance position*

Results show that for initial position, the frequency of *only* in CPS is significantly higher than the frequency of *only* in CDS. There are no significant differences between CDS and CPS for *only* in medial and final position.

Figure 2 compares the frequencies of *only* in CDS and CPS for each of the grammatical positions. GEEs were performed to determine if there was a significant difference in frequency between CDS and CPS for each position (see Table 5).

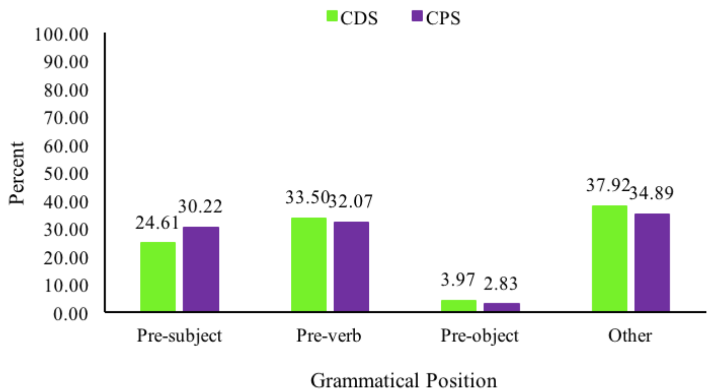

Figure 2. *Percentage of 'only' in each grammatical position by CDS and CPS*

Grammatical position	EMM CDS	SE CDS	EMM CPS	SE CPS	B-coefficient	SE	$\chi^2(1)$	p
pre-subject	0.091	0.011	0.121	0.020	**0.029**	**0.014**	**4.4**	**0.036**
pre-verb	0.132	0.016	0.112	0.023	-0.020	0.024	0.692	0.410
pre-object	0.029	0.009	0.008	0.002	**-0.020**	**0.010**	**4.21**	**0.040**
other	0.146	0.112	0.119	0.024	-0.023	0.024	1.35	0.240

Table 5. *Difference in frequency for each grammatical position*

Results show that for the pre-subject position, the frequency of *only* in CPS is significantly higher than the frequency of *only* in CDS, and for pre-object position, the frequency of *only* in CDS is significantly higher than the frequency of *only* in CPS. There are no significant differences between CDS and CPS in the pre-verb and other positions.

6. Discussion

The study outlined here presents a novel approach to studying the acquisition of the FSP *only*. Overall, the frequency of *only* in CDS is a significant predictor of the frequency of *only* in CPS. More importantly, *only* in CDS is a significant predictor of *only* in CPS in some, but not all of the age groups in the study, with the effect being significant for consecutive age groups. An important question to ask is what has changed in the children's grammar such that the frequency of occurrence of *only* in CDS has a significant effect on their use of the FSP. Recall the discussion of input from Carroll (2017). Carroll (2017) states that *input-to-language-processors* is considered to be all of the relevant linguistic stimuli that is fed into a learner's language processor and analyzed if the current state of the learner's grammar permits it. One hypothesis is that learners are not sensitive to the frequency effects of *only* until their mental grammars allow for it. The next logical question, then, is what triggers this sensitivity? In other words, what mental representations must a learner have in order for the frequency of *only* in CDS to have an effect?

The current study also systematically compares the utterance position of *only* and the grammatical position of *only*. Overall frequencies pattern in a similar way between CDS and CPS, with significant differences in frequencies for initial position, pre-subject position, and pre-object position. Ultimately, the results show that both caregivers and children use *only* in a variety of different positions. Crucially, the significant differences in some positions suggest that children are not simply imitating their parents, but instead are creating novel utterances with *only*.

References

Behrens, Heike. 2006. The input-output relationship in first language acquisition. *Language and Cognitive Processes* 21(1/2/3): 2–24.

Bird, Steven, Ewan Klein, and Edward Loper. 2009. *Natural Language Processing with Python*. Sebastopol, CA: O'Reilly Media Inc.

Carroll, Susanne E. 2017. Exposure and input in bilingual development. *Bilingualism: Language and Cognition* 20(1): 3–16.

Crain, Stephen, Kenneth Drozd, Kazumi Matsuoka, William Philip, and Thomas Roeper. 1992. Only in child language. Paper presented at the 17th Annual Boston University Conference on Language Development, Boston, MA.

Crain, Stephen, Weijia Ni, and Laura Conway. 1994. Learning, parsing, and modularity. In *Perspectives on sentence processing*, ed. Charles Clifton, Lyn Frazier, and Keith Rayner, 443–467. Hillsdale, NJ: Lawrence Erlbaum.

É. Kiss, Katalin. 1998. Identificational focus versus information focus. *Language* 74(2): 245–273.

Erteschik-Shir, Nomi. 1973. On the nature of island constraints. Doctoral dissertation, Massachusetts Institute of Technology.

Erteschik-Shir, Nomi. 1986. Wh-questions and focus. *Linguistics and Philosophy* 9: 117–149.

Erteschik-Shir, Nomi. 1997. *The dynamics of focus structure*. Cambridge: Cambridge University Press.

Fodor, Janet Dean. 1998a. Learning to parse? *Journal of Psycholinguistic Research* 27: 285–319.

Fodor, Janet Dean. 1998b. Parsing to learn. *Journal of Psycholinguistic Research* 27: 339–74.

Gleason, Jean Berko. 1975. Fathers and other strangers: Men's speech to young children. In *Developmental psycholinguistics: Theory and applications (26th Annual Roundtable)*, ed. Daniel Peter Dato, 289–297. Washington, DC: Georgetown University Press.

Gries, Stefan Th. 2008. Dispersions and adjusted frequencies in corpora. *International Journal of Corpus Linguistics* 13(4): 403–437.

Gries, Stefan Th. 2010. Useful statistics for corpus linguistics. In *A mosaic of corpus linguistics: Selected approaches*, ed. Aquilino Sánchez and Moisés Almela, 269–291. Frankfurt am Main: Peter Lang.

Gries, Stefan Th. 2015. Some current quantitative problems in corpus linguistics and a sketch of some solutions. *Language and Linguistics* 16(1): 93–117.

Höhle, Barbara, Tom Fritzsche, and Anja Müller. 2016. Children's comprehension of sentences with focus particles and the role of cognitive control: An eye-tracking study with German-learning 4-year-olds. *PLoS ONE* 11(3): e0149870.

Højsgaard, Søren, Ulrick Halekoh, and Jun Yan. 2006. The R package geepack for Generalized Estimating Equations. *Journal of Statistical Software* 15(2): 1–11.

Jackendoff, Ray. 1972. *Semantic interpretation in generative grammar*. Cambridge, MA: MIT Press.

Jacobs, Jaochim. 1983. *Fokus und Skalen. Zur Syntax und Semantik der Gradpartikeln im Deutschen*. Tübingen: Niemeyer.

Kim, Soyoung. 2011. Focus particles at the syntactic, semantic, and pragmatic interfaces: The acquisition of only and even in English. Doctoral dissertation, University of Hawaii at Manoa.

König, Ekkerhard. 1991a. *The meaning of focus particles: A comparative perspective*. London: Routledge.

König, Ekkerhard. 1991b. Identical values in conflicting roles: The use of German ausgerechnet, eben, genau, and gerade as focus particles. In *Discourse particles: Descriptive and theoretical investigations on the logical, syntactic and pragmatic properties of discourse particles in German*, ed Werner Abraham, 11–36. Amsterdam: John Benjamins.

Lenth, Russell. 2018. *emmeans: Estimated Marginal Means, aka Least-Squares Means*. R package v1.1.

Lijffijt, Jefrey, and Stefan Th. Gries. 2012. Correction to "Dispersions and adjusted frequencies in corpora". *International Journal of Corpus Linguistics* 17(1): 147–149.

MacWhinney, Brian. 2000. *The CHILDES Project: Tools for analyzing talk (3rd ed.)*. Mahwah, NJ: Lawrence Erlbaum Associates.

Müller, Anja, Petra Schulz, and Barbara Höhle. 2011. How the understanding of focus particles develops: Evidence from child German. In *Selected Proceedings of the 4th Conference on Generative Approaches to Language Acquisition North America (GALANA 2010)*, ed. Mihaela Pirvulescu, María Cristina Cuervo, Ana T. Pérez-Leroux, Jeffrey Steele, and Nelleke Strik, 163–171. Somerville, MA: Cascadilla Proceedings Project.

Notley, Anna, Peng Zhou, Stephen Crain, and Rosalind Thornton. 2009. Children's interpretation of focus expressions in English and Mandarin. *Language Acquisition* 16: 240–288.

Paterson, Kevin B, Simon P. Liversedge, Caroline Rowland, and Ruth Filik. 2003. Children's comprehension of sentences with focus particles. *Cognition* 89, 263–294.

Paterson, Kevin B., Simon P. Liversedge, Diane White, Ruth Filik, and Kristina Jaz. 2006. Children's interpretation of ambiguous focus in sentences with "only". *Language Acquisition* 13: 253–284.

Philip, William, and Emily Lynch. 2000. Felicity, relevance, and acquisition of the grammar of every and only. In *Proceedings of the 24th Annua l Boston University Conference on Language Development*, ed. S. Catherine Howell, Sarah A. Fish, and Thea Keith-Lucas, 583–596. Somerville, MA: Cascadilla Press.

R Core Team. 2016. *R: A language and environment for statistical computing*. R Foundation for Statistical Computing, Vienna, Austria.

Szabolcsi, Anna. 2001. The syntax of scope. In *Handbook of contemporary syntactic theory*, ed. Mark Baltin and Chris Colins, 607–634. Oxford: Blackwell Publishers.

Weist, Richard M., Aleksandra Pawlak, and Karen Hoffman. 2009. Finiteness systems and lexical aspect in child Polish and English. *Linguisitics* 47(6): 1321–1350.

Yan, Jun. 2002. geepack: Yet another package for Generalized Estimating Equations. *R-News* 2/3: 12–14.

Yan, Jun, and Jason Fine. 2004. Estimating Equations for association structures. *Statistics in Medicine* 23: 859–880.

(A complete list of the corpora included in the data set and the Python code written for data processing can be obtained by contacting the author.)