I. Objectives

Sentences in natural language can depict situations of a collective or of a distributive type. In (1), for example, are there multiple boys, each of whom is pushing his own car, or are there several boys pushing one car?

(1) Some boys pushed a car.

Determining whether the action in such sentences should be interpreted as collective (many boys – one car) or distributive (many boys – each with his own car) can be linguistically encoded in the noun phrase that is the subject. For example, in sentence (2) the subject each boy makes the interpretation obligatorily distributive.

(2) Each boy pushed a car.

Distributivity can also be a property of predicates, as in the verb phrase inoculated some patients in sentence (3), where inoculations, as a matter of common experience, are carried out in a distributive, and not a collective, manner.

(3) The doctors inoculated some patients.

Finally, context can imply distributivity, as for sentence (1), if we imagine a group of boys wanting to clear an alley so that they can play a game, but a car is in the way, so, together they push it out of the way.

Existing studies (e.g. Musolino 2009, Syrett & Musolino 2013) suggest that even preschool aged children can access both collective and distributive interpretations of sentences as a function of the syntax of the sentence and as a function of the context in which the sentences occur. The same studies, however, suggest that where the collective vs. the distributive meaning of a sentence is crucially expressed in lexical items, such as the obligatorily distributive quantifier each, or the obligatorily collective adverb together, preschool children’s performance is not yet adult-like. A recent study of child Italian finds that children allow sentences using the obligatorily distributive quantifier ciascuno (each) in collective contexts in high, non-adult-like, proportions and only begin to reject such sentences at adult-like levels at 10 years of age.

In the current study, our goal is to better understand the interaction between lexical and pragmatic development. Specifically, we seek to determine whether there is an underlying collective/distributive syntactic-semantic feature of quantifiers driving the development of children’s judgments with both cada and unos or whether what develops is the relation among quantifiers on the pragmatic scale {all/each, most, many, some, few, none}, including cada and unos, which higher order reasoning consults when determining which quantifier is appropriate for a context. That both are true is also possible.
Following Pagliarini et al (2012), we will measure children’s knowledge of both the obligatorily distributive quantifier *cada* (each) and the definite article *los* (the), which is unspecified for distributivity/collectivity and receives its collective/distributive interpretation from context and/or the verb phrase. If we find in Spanish the same correlation they found in Italian, it will confirm their hypothesis that what it developing is a pragmatic scale containing both *cada* and *los*, on which *cada* is more informative. Extending Pagliarini et al’s suggestion, we will also test the obligatorily collective Spanish quantifier *unos* (some), which, if Pagliarini et al are correct, should also correlate with *los*, as it too falls on the distributive/collective pragmatic scale, though at the opposite end from *cada*. Additionally, we will independently measure lexical development, as it could correlate with the collective/distributive feature of *unos* and *cada* judgments, but perhaps not with those associated with *los*, as it lacks this feature.

II. Background and Rationale

There is evidence that preschool children grasp collective and distributive interpretations of language at the conceptual level, syntactic level and pragmatic level. What develops more slowly appears to be the lexical representation of distributivity vs. collectivity in lexical items such as quantifiers (*each, ciascuno, together, unos*).

**Development of Collectivity and Distributivity as Concepts**

Where can we find evidence that children, independently of sentence-level grammar, grasp the concepts of collectivity and distributivity? In the literature on the development of counting, children are shown to use what Gelman & Gallistel (1978) refer to as the Counting Principles. One of these principles, the Cardinality Principle, has been the subject of a great deal of research (Barner & Bachrach 2010, Bloom & Wynn 1997, Fuson 1988, Gelman 1993, Gelman & Meck 1983, Carey 2004, 2009, Sarnecka & Carey 2008, Wynn 1990, 1992, inter alia). This principle dictates that the last cardinal number in the conventional count routine (e.g. 1 orange, 2 oranges, 3 oranges, 4 oranges, 5 oranges…) represents the size of the set enumerated up to that point. Within that noun phrase (e.g. 5 oranges), the items quantified over are represented collectively by the final cardinal number. Similarly, another Counting Principle, the One-to-One Principle, dictates that each item counted must correspond to one and only one number in the count routine. This principle guarantees that the counting process represents a pairing of numbers in the count routine to items counted that is crucially distributive. While the language of the count routine is highly specific and known to have different properties than the language of clausal syntax, the conclusions of this research are nevertheless consistent with the claim that children have active distributive and collective concepts at work at the language-number interface. Obviously, the distributivity of the count routine is a property of the noun phrase used in the count routine only, and is not combinatorial between the noun phrase and verb phrase, as in the clausal syntax the produces sentences in natural language. The point, however, is that children do not evince any general impediment to cognitive processes that manifest collective and distributive properties. Thus if they appear unlike adults in their ability to deploy collective and distributive interpretations of sentences, it would seem unlikely to be the result of their lacking the basic concepts that underlie them.
**Development of the Syntax-Semantics of Quantifier Scope and Distributivity/Collectivity**

Concepts, however, are deployed in natural language combining lexical items, using syntax. Are there syntactic impediments to children using collective and distributive interpretations in the adult-like way? Research into children’s knowledge of the syntax-semantics interface has shown children have a tendency to resolve scope ambiguity in a way that favors distributive interpretations. Specifically, they have a tendency to assign quantifier scope to the syntactic positions that quantifiers appear in phonetically. Though there is some controversy as to how alternative quantifier scope readings arise, one influential proposal is that they move syntactically by Quantifier Raising (May 1977) to different positions in the clause. For example, in a sentence such as (4), there are at least two prominent interpretations, given in (5) and (6).

(4) The detective didn’t find two guys.

(5) **Surface Scope** – The detective did not find any guys.

(6) **Inverse Scope** – There are two guys that the detective didn’t find.

Musolino (1998) and much subsequent research has shown that children prefer the surface scope interpretation of such sentences (this is known as the Isomorphism Effect), but can, through syntactic and pragmatic manipulations, converge on the inverse scope interpretation as well. The relevance of this literature to distributivity and collectivity is that in a sentence like (7), the most prominent surface scope interpretation is distributive, but the most prominent inverse scope interpretation is collective.

(7) Three boys held two balloons.

(8) **Surface Scope (Distributive)** – Each boy held two balloons (a total of six balloons).

(9) **Inverse Scope (Collective)** – There are two balloons that the three boys held (just two balloons).

Musolino (2009) has shown that children in fact prefer the surface scope (distributive) interpretation of such sentences. He also shows, however, that they strongly prefer the inverse scope (collective) interpretation of sentences such as (10), showing that the lexical specification of the quantifier *each* as [+ distributive] can override the Isomorphism Effect.

(10) Three boys held each balloon.

Thus, children appear to have conceptual knowledge of collectivity and distributivity and, though they have a non-adult-like tendency to adopt distributive interpretations with
ambiguous sentences, appear to manage the syntax of quantifier scope in a way that is consistent with the lexical-syntactic features of quantifiers like *each*.

**Pragmatics, Lexical Development and Collectivity/Distributivity**

The concepts represented by quantifiers and syntax are used in particular pragmatic contexts. Syrett & Musolino (2013) show that when the quantifiers interacting with the syntax are not lexically specified for collectivity vs. distributivity, but rather are ambiguous between them, children are capable of distinguishing distributive from collective contexts. Thus, they show that children allow sentences such as (11) in both distributive and collective contexts.

(11) Some boys pushed a car.

(12) Some boys pushed a car together.

They also show that when the collective adverb *together*, as in (12), is added, children preferred the collective to the distributive interpretation, though they found that children’s performance was not as influenced by the addition of collective words like *together* or distributive words like *each* as was adult performance.

Along the same lines, Pagliarini, Fiorin & Dotlačil (2012) show that Italian preschoolers allow the obligatorily distributive quantifier *ciascuno* (*each*) in both distributive and collective contexts, while adults only allow them in distributive contexts. In a large, cross-sectional sample, they show that as children get older, they allow this less, and also allow the definite article, which is unspecified for collectivity vs. distributivity, correspondingly less in distributive contexts. They show that these changes correlate in their sample.

They attribute this correlation to the gradual integration of *ciascuno* and the definite article into a pragmatic scale, which entails an implicit comparison of the two quantifiers in distributive contexts, as to which is most informative. We surmise that this half of the explanation. As children mature, the definite article, which is unspecified for distributivity, becomes less acceptable in distributive contexts because the distributive quantifier *ciascuno* is more informative, as they point out. This occurs, however, because the distributive feature of the more informative *ciascuno* gets stronger and somehow less acceptable in collective contexts, as evidenced by its increasing unacceptability in collective contexts. The following table from Pagliarini et al (2012) illustrates the pattern.
<table>
<thead>
<tr>
<th>Age Group</th>
<th>Ciascuno ('each') in Collective Contexts</th>
<th>i (definite article ‘the’) in Distributive Contexts</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 year olds</td>
<td>89</td>
<td>96</td>
</tr>
<tr>
<td>5 year olds</td>
<td>92</td>
<td>99</td>
</tr>
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<td>6 year olds</td>
<td>81</td>
<td>98</td>
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</tr>
<tr>
<td>12 year olds</td>
<td>11</td>
<td>71</td>
</tr>
<tr>
<td>13 year olds</td>
<td>11</td>
<td>72</td>
</tr>
<tr>
<td>Adults</td>
<td>9</td>
<td>50</td>
</tr>
</tbody>
</table>

Table 1 – Mean Proportion of True Answers (compiled from Pagliarini et al 2012, p. 394, Table 2)

Pagliarini et al report a Spearman’s rho of .5 (p <.001, n = 286) for this correlation.

In summary, children’s lexical knowledge of the distributive features of the quantifiers ciascuno (each) in Italian and each in English, and of the collective adverb together in English, are not adult-like in preschoolers, and may take until children (Italian speakers, at least) are 10 before they approach adult-like performance. There appears to be a gradual strengthening of the lexical-semantic distributive feature of ciascuno in Italian, which simultaneously makes it less acceptable in collective contexts, as a function of the lexical semantics-contextual pragmatics interface and, and makes the definite article less acceptable in distributive contexts, as function of its relation in the lexicon to the more specified and therefore more informative distributive quantifier ciascuno.

**Spanish and Collective ‘unos’**

Spanish has a version of the quantifier each, which is cada, but unlike Italian or English, it also has an existential quantifier unos (most like some in English), which resists distributive interpretations. Thus, in pragmatic situations that would call for the representation of a distributive action, the sentence in (13) with the collective quantifier unos in subject position would be infelicitous, while the sentence in (14) with the distributive quantifier cada in subject position would felicitous.

(13) **Unos** niños trajeron una bolsa al carro.

Some children brought a bag to the car.

(14) **Cada** niño trajo una bolsa al carro.

Each child brought a bag to the car.
In contrast, in a situation that called for a collective interpretation, (14) would be infelicitous and (13) would be felicitous.

We hypothesize that the difference between these quantifiers is a lexical syntactic feature that is [+distributive] in cada and [-distributive] in unos. Further, we hypothesize that as these feature specifications come to be more closely associated with the lexical items that they correspond to, as children age, the [-distributive] quantifier, unos, should become less acceptable in distributive pragmatic contexts and that the [+distributive] quantifier, cada, should become less acceptable in collective pragmatic contexts. If, indeed, the interaction of this lexical feature with pragmatic context is a primary determinant of children’s acceptability judgments, we should expect a correlation between judgments of each quantifier in the disallowed pragmatic contexts. Additionally, if Pagliarini et al are correct, we should expect the acceptability of the definite article los to be correlated with each of these quantifiers, by virtue of forming a pragmatic scale of collectivity-distributivity with them, in which it is less informative than either. Finally, to determine whether the development of the collectivity/distributivity features of these quantifiers is due to lexical development in general, independent of pragmatic context, we might expect a general measure of lexical development, such as the Test de Vocabulario en Imágenes Peadbody (TVIP - Dunn, Lugo, Padilla & Dunn 1986) to correlate with them.

Research Questions

Our hypotheses, then, lead to the following research questions:

1. Are child Spanish-speakers different from adults in their understanding of the felicity of using the quantifiers cada, unos and los in collective and distributive situations, as in English and Italian?

2. If so, is there a correlated developmental trajectory between judgments of the unacceptable use of distributive, collective and unspecified quantifiers in collective and distributive pragmatic contexts?

3. Does lexical development measured independently of the judgment task correlate with either the unos or the cada judgments?

III. Procedures

A. Research Design

The study proposed here is quantitative and experimental. The results of the children will be compared to those of the adults. The study will consist of a 3 (unos vs. cada vs. los quantifiers) by 5 (7 year-olds, 8 year-olds, 9 year-olds, 10 year-olds, 11 year-olds and adults < 18 years-old) by 2 (distributive pragmatic context vs. collective pragmatic context) design, which will be analyzed using a mixed effects logistic regression model, with participant and items as random effects. We will also use a Spearman’s rho correlation to determine the degree to which children’s judgments correlate with one another and a linear regression analysis to determine the degree to
which PPVT scores predict children’s proportions of correct judgments with *unos* and *
cada*.

**B. Sample**

The participants in the study will consist of 20 participants for each of the 6 age groups, for a total of 120. Participants will be neurotypical, monolingual Spanish-speakers recruited from elementary schools near Mayagüez, Puerto Rico. Participants will be excluded from the study if they have a history of language disorder, as determined by our language background questionnaire.

**C. Measurement/Instrumentation**

Our instruments will consist of: a language background questionnaire, a set of video-recorded Truth Value Judgment Tasks and the Test de Vocabulario en Imágenes Peabody (Dunn, Lugo, Padilla & Dunn 1986). The language background questionnaire will allow us to determine whether the child is a monolingual Spanish-speaker, what the maternal level of education is, what the child’s birthdate is and whether the child is likely to have a speech or language disorder. The Truth Value Judgment Task will allow us to measure children’s knowledge of how acceptable quantifiers *cada*, *unos* and *los* are in collective and distributive contexts. The TVIP, which has a version normed for Puerto Rico, will give us an independent measure of lexical development, which we can then compare to children’s proportion of correct judgments to determine whether a relationship exists between/among them.

**D. Detailed Study Procedures**

- Children’s parents will be contacted through their elementary schools.
- We will obtain informed consent from parents for children’s participation in our study and, if given, we will then attempt to obtain assent from the child.
- Parents will be asked to answer the language background questionnaire.
- Children will be given our two tests at their schools, in either one or two sessions, depending on how long they are able to focus.
  - Children will watch the video-recorded Truth Value Judgment Tasks and have their yes/no answers written on an answer sheet by a researcher.
  - Children will take the Spanish TVIP and the results will be recorded on paper by a researcher.
- The entire procedure should take roughly 60 minutes.
- Results will be recorded in an excel sheet, using random identifier numbers for each child. A separate excel sheet that matches participant names with identifiers will be kept elsewhere.
- Only aggregate results will be reported.
- No individual child’s results on any of our measures will be provided to anyone at any time.

**E. Internal Validity**

The purpose of the video-recorded Truth Value Judgment Tasks is assure that experimental items are delivered in a consistent, reliable fashion. We will perform a Cronbach’s Alpha test of internal coherence on our test items during piloting to maximize
confidence in the coherence of the construct we are attempting to measure. To assure that children are focused, on-task and understand our experiment, it will include warm-up and filler items. Children will have to pass the filler items, which will test their interpretations of a lexical item that is unrelated to our research question, but likely to be understood by our participants, such as a spatial preposition or the negative quantifier *ningún*. To be included in our sample, children will have to pass these items at above chance rates.

F. Data Analysis
Again, we plan to use a mixed effects logistic regression model, with participant and items as random effects to compare performance across groups and to determine whether there is an interaction between age, quantifier type and collective vs. distributive context. We will also use a Spearman’s rho correlation to determine the degree to which children’s judgments correlate with one another and a linear regression analysis to determine the degree to which TVIP scores predict children’s proportions of correct judgments with *unos* and *cada*. The nonparametric Spearman’s rho is motivated by the likelihood of ties in our Truth Value Judgment Task data, due to the small number of items per condition that will be used, given that each item can take a substantial amount of time.

IV. Bibliography


