Plural marking and agreement in Yucatec Maya at the syntax-processing interface

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Abstract

We investigate the relationship between a universal semantic category and language-specific variation in its morphosyntactic representation and real-time processing. We examine this issue through the lens of non-obligatory plural marking on nouns and non-obligatory co-variant plural marking on verbs in Yucatec Maya. In previous work, we have argued that Yucatec presents a previously unobserved case in the typology of plural marking predicted by Wiltschko (2008). We review these arguments and summarize elicitation and quantitative behavioral evidence in support of it. The behavioral results, however, reveal that other factors contribute to speakers’ preferences to morphologically mark or not mark plural phrases in Yucatec. In two sentence production experiments, we find that speakers’ gradient preferences to realize non-obligatory plural marking in Yucatec is subject to the same effects that contribute to agreement errors in languages with obligatory plural marking, such as English. We discuss the implications of these results for linguistic theory, for psycholinguistics and for the grammar of Yucatec and Mayan languages in general.
1 Introduction
One of the goals of linguistic theory is to examine the range of variation among languages in consideration of proposed universal tendencies. The major goal of examining the interface between syntax and sentence processing is to investigate the pressures of real-time incremental sentence processing that shape the nature of linguistic representations. We investigate the morphosyntax-processing interface by using field-based experimental methods. Field-based psycholinguistics has a number of methodological advantages for linguistic and psychological accounts of language alike. First, we show how quantitative experimental methods can provide unique empirical and replicable evidence for morphosyntactic representations. Second, through field-based experimental methods, we can investigate the processing of a linguistic feature in a language-type that is rarely or never studied by psycholinguists, a head-marking polysynthetic language with non-obligatory plural marking and number agreement.

We examine the relationship between semantics, morphosyntax and sentence processing in non-obligatory plural marking and number agreement in Yucatec Maya. Though some languages may lack plural marking, plural marking is a presumed universal semantic category. There is evidence, however, that the morphosyntax of plural varies across languages (Wiltschko 2008). We review the evidence from Butler (under review) that the plural marker in Yucatec is adjoined to the determiner projection rather than heading a functional number phrase as has been argued for many other languages. We review additional quantitative evidence from a field-based sentence processing experiment for the determiner-adjoined plural hypothesis for Yucatec Maya, first presented in Butler (To appear).

We present the results of two additional field-based sentence processing experiments with speakers of Yucatec Maya. Experiments 1 and 2 examine semantic factors that influence the use of non-obligatory plural marking in real-time sentence processing. We examine the effects of notional plurality on the use of non-obligatory plural marking and co-variant plural marking on verbs in Yucatec Maya. Experiments 1 and 2 additionally contrast two different experimental methods, timed translation and picture description. Finally, we discuss the implications of this work for linguistic theory,

2 The morphosyntax of plural marking in Yucatec Maya
We begin by summarizing the analysis of Butler (under review) that the morphosyntax of the plural morpheme –o’ob in Yucatec Maya varies from that of plural morphosyntax in other languages. We follow Wiltschko (2008) who argues that plural markers across languages can vary in their morphosyntactic properties. In Section 2.1, we summarize Wiltscko (2008), and in Section 2.2, we summarize the theoretical proposal in Butler (under review) and the quantitative behavioral evidence in Butler (to appear).

2.1 The syntax of plural marking (Wiltschko 2008)
Wiltschko (2008) proposed a syntactic typology of plural marking according to which languages can vary by two parameters: 1) how the plural merges and 2) where the plural merges. Sections 2.2.1 and 2.2.2 review Wiltscho’s proposal for how and where the plural merges, and I then apply these diagnostics to data from Yucatec Maya.
2.1.1 How the plural merges

According to Wiltschko (2008), the first parameter along which languages vary is how the plural marker merges: as a head or an adjunct (Wiltschko 2008). A plural morpheme that merges as the head of a phrase has the ability to change the label of the constituent with which it merges. In the tree in (3) (adapted from Wiltschko (2008)), the plural of category x merges with a constituent of category y, and the resulting constituent takes the label of x. In languages with obligatory, inflectional plural marking, like English or Spanish, plural morphology merges as such.

\[(3)\]
\[
\begin{array}{c}
\text{x: PLURAL} \\
\text{} \\
\text{x: PLURAL} \\
\text{y}
\end{array}
\]

A plural morpheme that merges as an adjunct, however, lacks this category-changing potential that a head shows. In the tree in (4) (adapted from Wiltschko (2008)), a plural adjunct merges with a constituent of category y. The resulting constituent carries the label of y, not of the plural morpheme (for further discussion, see Hornstein and Nunes, 2008; Sato, 2010). A language in which plural morphology merges as such is Halkomelem (Salishan; Canada).

\[(4)\]
\[
\begin{array}{c}
\text{y} \\
\text{PLURAL} \\
\text{y}
\end{array}
\]

Wiltschko (2008) provides two diagnostics for a plural that merges as an adjunct, that it is non-obligatory and that it does not trigger agreement. In English, plural marking is obligatory, as is number agreement. In Upriver Halkomelem, however, Wiltschko provides evidence that plural marking is non-obligatory. In (5a) and (5b), a noun phrase with the numeral three does not require plural marking. Similarly, number agreement is non-obligatory, as illustrated in (6a) through (6d).

\[(5)\]
\[
\begin{align*}
\text{a. } & \text{te lhíxw swíweles} \\
& \text{DET three boy} \\
\text{b. } & \text{te lhíxw swóweles} \\
& \text{DET three boy.PL} \\
& \text{‘the three boys’ (Wiltschko 2008: 642)}
\end{align*}
\]

\[(6)\]
\[
\begin{align*}
\text{a. } & \text{t’ílém ye s-i:wi:qe} \\
& \text{sing DET.PL man.PL} \\
& \text{‘The men are singing’}
\end{align*}
\]
b. t’ilém te s-i:wi:qe
   sing DET man.PL
   ‘The men are singing’

c. t’ilém ye swiyeqe
   sing DET.PL man
   ‘The men are singing’

d. t’ilém te swiyeqe
   sing DET man
   ‘The man is singing’ (Wiltschko 2008: 643)

Wiltschko concludes that plural marking and number agreement are not obligatory, and
this is evidence that the plural marker in Halkomelem is an adjunct.

2.1.2 Where the plural merges

The second parameter by which the syntax of plural marking can vary is where the plural
merges (Wiltschko 2008). Since the advent of the DP hypothesis (Abney 1987, also
Brame 1982, Szabolczi 1983, 1987), which proposes that the noun phrase is dominated
by a determiner phrase (DP), a number of other functional projections have been
proposed between the DP and the noun, or root of the nominal phrase. Wiltschko
considers the determiner projection (or DP), the number projection (abbreviated NumP or
#P), the categorizing nominal projection (nP) and the root as potential sites for a plural to
merge along the spine of the DP (see the tree diagram in (7) below).

(7) Wiltschko (2008) argues that the plural marker in Upriver Halkomelem adjoins to the
root. The main evidence for this is that it can occur inside of compounds and derivational
morphology. The example in (8) shows an adjective that can be nominalized with the
prefix –s, as in (9). When the noun in (9) is pluralized, via reduplication, the reduplicated
morpheme does not contain the nominalizer, as shown in (10). In other words, the
process of pluralization via reduplication ignores the presence of derivational
morphology.

(8) p’eq’
   white
   ‘white’
Evidence that the plural can occur inside of a compound is shown in (11). And, the interpretation of the plural morpheme in the compound refers to the first noun, stripes, not the compound as a whole, chipmunk, as shown in (11) below.

(11) s-xexp’-í:tsel
    NML-stripe.PL-back
    ‘chipmunk (with more than two stripes)’  (Wiltschko 2008: 644, data from Galloway 1980: 63)

Another piece of evidence that the Upriver Halkomelem plural merges at the (acategorial) root is that it can combine with a verb (as in (12)) resulting in a pluractional semantics with an interpretation that the event is repeated. Likewise, the plural can combine with adjectives resulting in an intensification of the property, as shown in (13).

(12) qw’óleqw-et
     whip.PL-TRANS
     ‘whip something/someone several times’  (Wiltschko 2008: 679)

(13) tsméth’-meth’
     blue.PL
     ‘very/lots of blue’  (Wiltschko 2008: 680)

Table 1 summarizes the diagnostics for the syntactic variation of the plural morpheme in English and Upriver Halkomelem.

<table>
<thead>
<tr>
<th>Diagnostic</th>
<th>English</th>
<th>Halkomelem</th>
</tr>
</thead>
<tbody>
<tr>
<td>obligatory plural marking</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>obligatory agreement</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>plural inside compounds</td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td>plural inside derivational morphology</td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td>acategorial</td>
<td>no</td>
<td>yes</td>
</tr>
</tbody>
</table>

Following these diagnostics, we now turn to an analysis of how and where the plural morpheme –o ’ob in Yucatec Maya merges.
2.2  The determiner-adjoined plural in Yucatec Maya (Butler Under review)
We first introduce the basics of person and number cross-reference marking paradigm in Yucatec Maya based on Bricker (1981) and Bohnemeyer (2002). Then, we review the proposal of Butler (2012, under review) for the plural marker as adjoined to the determiner projection of the nominal phrase.

2.2.1  Yucatec Maya person and number cross-reference paradigm
Yucatec is a head-marking language that marks person and number with cross-reference morphemes that affix to the verbal core. Yucatec exhibits split or ‘mixed’ morphological ergativity (Bohnemeyer 2004 and references therein). It has two sets of cross-reference markers, called Set A and Set B. Set A (corresponding to the ergative set in Mayan languages without a split) involves a set of clitics that precede the lexical verb, but follow the initial aspect-mood marker. The plural Set A markers are discontinuous morphemes involving a suffix on the right edge of the verb. The suffixal component of the third person plural Set A marker is homophonous with the nominal plural and, its use is non-obligatory. Set A markers are used to mark possessors and the single arguments of intransitive verbs in the imperfective aspect and other aspect-mood categories.

Table 2: Set A cross-reference markers

<table>
<thead>
<tr>
<th>Person</th>
<th>Singular</th>
<th>Plural</th>
</tr>
</thead>
<tbody>
<tr>
<td>First</td>
<td>in</td>
<td>k…-o’on</td>
</tr>
<tr>
<td>Second</td>
<td>a(w)</td>
<td>a(w)...-e’ex</td>
</tr>
<tr>
<td>Third</td>
<td>u(y)</td>
<td>u(y)...(-o’ob)</td>
</tr>
</tbody>
</table>

The Set B markers are all verbal suffixes. The Set B markers are used to mark the single arguments of intransitive verbs in the perfective aspect and in subjunctive mood.

Table 3: Set B cross-reference markers

<table>
<thead>
<tr>
<th>Person</th>
<th>Singular</th>
<th>Plural</th>
</tr>
</thead>
<tbody>
<tr>
<td>First</td>
<td>-en</td>
<td>-o’on</td>
</tr>
<tr>
<td>Second</td>
<td>-ech</td>
<td>-e’ex</td>
</tr>
<tr>
<td>Third</td>
<td>-Ø-ij</td>
<td>-o’ob</td>
</tr>
</tbody>
</table>

In transitive clauses, Set A marks the agent/actor argument, while Set B indicates the undergoer/theme/patient argument. There is some ambiguity inherent in third person plural cross-reference marking in the language, since the plural Set B markers are homophonous with the second element of the discontinuous morpheme of the Set A marker. And, as mentioned, the third person plural –o’ob is homophonous with the nominal plural marker. Thus, the sentences in (14) and (15) below have three potential interpretations.

(14)  T-u  bis-aj-o’ob
   ‘S/he took them.’ / ‘They took it.’ / ‘They took them.’ (Lucy 1992: 53)
In the remainder of the paper, we refer to the nominal plural –o’ob simply as the plural morpheme and to the plural cross-reference markers as either the (Set A or Set B) third person plural cross-reference marker.

### 2.2.2 Adjunction of the plural in Yucatec

The first piece of support for the proposal that the plural morpheme –o’ob in Yucatec Maya is not a syntactic head is that its use is non-obligatory. In Yucatec, the presence of the plural morpheme is not necessary for a nominal phrase to be interpreted as referring to a plurality. The phrase in (16) without plural marking can be interpreted as referring to one or more than one girl. The example in (17) with plural marking must refer to more than one girl.

\[(16) \text{le x-ch’úupal-o’} \quad \text{DEF FEM-girl-D2} \quad \text{‘the girl’ / ‘the girls’} \]

\[(17) \text{le x-ch’úupal-o’ob-o’} \quad \text{DEF FEM-girl-PL-D2} \quad \text{‘the girls’} \]

The second piece of evidence that the plural morpheme –o’ob in Yucatec Maya merges as an adjunct and not as a functional head is that it does not trigger obligatory number agreement.

In the example in (18), the adjective does not need to be marked with the plural morpheme when the noun is plural-marked (though it may be, when it is postnominal). This example shows that there is no number agreement required between nouns and adjectives in the noun phrase.

\[(18) \text{le x-ch’úupal-o’ob ki’ichpam(-o’ob)} \quad \text{DEF FEM-girl-PL pretty(-PL)} \quad \text{‘the pretty girls’} \]

In the sentence in (19), the plural morpheme –o’ob can non-obligatorily be used on the postverbal noun. The covariation of plural form with the third person plural Set A marker –o’ob is also non-obligatory. This example shows that subject-verb agreement for number is not obligatory in Yucatec Maya, and it supports the conclusion that the plural marker merges as an adjunct in the language (see also the results of Experiments 1 and 2).
The girls are singing

In the next section, we examine the distributional facts in favor of the analysis of the nominal plural morpheme in Yucatec Maya as adjoined to the DP.

2.2.3 *The plural in Yucatec is adjoined to the determiner (not the root, noun or number)*

The plural marker in Yucatec Maya does not merge at the root or the categorizing noun projection. The plural morpheme –o’ob can combine with verbs and adjectives, but when it does, it does produce the pluractional reading (shown in (20)) or an intensification of the property (shown in (21)), as it does in Halkomelem. It is arguably the homophonous third person plural cross-reference marker –o’ob that attaches to verbs and adjectives co-referencing a third person plural argument.

(20) Táan u yaalkab-o’ob
PROG A3 run-PL
‘They are running’ / NOT: ‘Running repeatedly.’

(21) ki’-o’ob
delicious-PL
‘They are sweet/delicious.’ / NOT: ‘very sweet/delicious’

These facts indicate that the plural marker in Yucatec does not merge at or below the level of the categorizing head. It does not show the variation in meaning that would be expected if it adjoins at or below the syntactic head that determines the category, as is the case for Halkomelem.

In addition, the nominal plural marker –o’ob cannot occur inside of compounds (as shown in (22)), nor can it occur inside of derivational morphology (as shown in (23) with the instrumental suffix and in (24) with the inalienable possession suffix).

(22) le pol-ch’oom-o’ob-o’
def head-village-PL-D2
‘governors’

(23) x-muk-ub-o’ob
AG-bury-INSTR-PL
‘shovels’ (Bricker et al. 1998: 365)

(24) in b’aak-el-o’ob
A1 bone-IP-PL
‘my bones’ (Bricker et al. 1998: 359)

Thus, we can conclude that in Yucatec, unlike Upriver Halkomelem, the plural morpheme merges higher than the root and the categorizing head. Table 4 repeats the
diagnostics for adjuncthood and position outlined previously in Table 1 incorporating the
observations thus far for Yucatec Maya.

Table 4: Properties of plural marking in English, Halkomelem and Yucatec Maya

<table>
<thead>
<tr>
<th>Diagnostic</th>
<th>English</th>
<th>Halkomelem</th>
<th>Yucatec Maya</th>
</tr>
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<tbody>
<tr>
<td>obligatory plural marking</td>
<td>yes</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>obligatory agreement</td>
<td>yes</td>
<td>no</td>
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<td>plural inside derivational morphology</td>
<td>no</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>acategorial</td>
<td>no</td>
<td>yes</td>
<td>no</td>
</tr>
</tbody>
</table>

In Walloon (Gallo-Rhaetian; Belgium, France), a language for which there is evidence
that the plural marker heads the Number projection, a plural marker can occur on a
prenominal adjective, unlike in Yucatec. The examples in (26) and (27) from Bernstein
(1991) show the plural marker occurring on prenominal adjectives. The tree in (27)
diagrams the phrase in (25) and the position of the adjective in relation to the plural
marker in the head of the number projection.

(25) dēs vētēs-ouh
    some  green.PL-door
    ‘some green doors’

(26) dēs nēurs-ouy
    some  black.PL-eye
    ‘some black eyes’  (Bernstein 1991, data from Remacle 1952 and Morin 1986)

(27)
```
      determiner
        dēs
        some
        number
          adjective
            vēt
            green
            -ēs
            -PL
          number'
          noun
            ouh
            door
```

In Yucatec, adjectives can non-obligatorily take the plural marker –o’ob but only when
the adjective is in postnominal position. The variant in (28b) is unacceptable with plural
marking on the prenominal adjective (whether or not the noun has plural morphology).
The variant in (28a) without plural on the prenominal adjective and the variant in (28c)
with plural marking on a postnominal adjective are acceptable.

(28) a. le  ki’ichpam x-ch’úupal(-o’ob)
    DEF  pretty     FEM-girl(-PL)

b. *le  ki’ichpam-o’ob x-ch’úupal(-o’ob)
    DEF  pretty-PL  FEM-girl(-PL)
c. le x-ch’úupal(-o’ob) ki’ichpam(-o’ob)  
DEF FEM-gir(-PL) pretty-PL  
‘The pretty girls’

Assuming that prenominal adjectives merge at the number projection (perhaps arrive via movement, as in Kayne (1994)), then the fact that plural marking in Yucatec Maya is ungrammatical on prenominal adjectives (but not postnominal adjectives) can be explained. The example in (28a) is diagrammed in the tree in (29) below. It shows that the prenominal adjective, adjoined as a specifier to the number projection, cannot take plural marking, since the plural is adjoined to the DP and not lower. If the plural morpheme headed the Number Phrase, we would expect it to combine with a prepositional adjective in Yucatec, but it cannot.

(29)

In order to derive the morpheme order facts of Yucatec, with the DP-adjoined plural occurring in phrase-final position, we have to assume that the plural morpheme is right-adjoined to the DP. The facts just presented on the lack of plural marking on prenominal adjectives do not unambiguously support the proposal that the plural is adjoined (rightward) to the DP, versus the NumberP or another layer of the DP, so we turn to other evidence that it merges higher than NumberP.

Another piece of distributional evidence in support of the DP-adjoined hypothesis for Yucatec Maya comes from the phenomenon of plural marking with conjoined nouns. The syntax of coordination arguably involves a structure that is headed by a coordinate phrase (Munn 1993, Progovac 1997) and dominated by a phrase of the same category as the conjuncts (Jackendoff 1977, Chomsky 1981, Gadzar et al. 1985, Sag et al. 1985). In other words, in a coordinate structure, the two determiner phrases are dominated by a maximal determiner projection. Given that the plural marker –o’ob in Yucatec adjoins to DPs, we predict that it should be possible for the plural morpheme to adjoin to the highest DP, which dominates the DPs of both conjuncts. This means that in Yucatec the plural marker can be adjoined to either of the DPs of the two conjoined nouns or to the highest DP, which dominates the conjunct as a whole, as shown in (30).
Because the plural morpheme can be adjoined to the highest determiner projection, as shown in (30), it can occur in phrase-final position of a DP with two conjoined nouns and result in the interpretation that both nouns of the conjunct are singular. It can also result in the meaning that the first noun is singular and the second plural or that the first noun is plural and the second singular, or that both nouns are plural. The example in (31) demonstrates this phenomenon in Yucatec.

(31) [le x-ch’úupal yéetel le xi’ipal -o’ob]
   DEF FEM-girl and DEF boy -PL
   ‘the girl and the boy’ / ‘the girls and the boy’ / ‘the girl and the boys’ / ‘the girls and the boys’

The meaning in which both nouns of the conjunct are singular or that the first is plural and the second singular is only possible if the plural marker adjoins to the highest DP and not one of the lower DPs. This is unambiguous evidence that the plural marker in Yucatec is adjoined to the DP. It would not show the behavior it does with conjoined nouns if it were merged at the Number Phrase or lower.

Going back to the syntactic typology proposed by Wiltschko (2008), we can diagram the language types that we have discussed in this section in the tree in (32) below. Yucatec Maya provides evidence for the determiner-adjoined plural type. Walloon has been analyzed as a number-head plural type (Bernstein 1991), and Halkomelem shows properties of a root-adjoining plural type (Wiltschko 2008). Butler (2012) discusses additional language types in the morphosyntax of plural marking, specifically the noun-adjoining type and a quantifier-adjoining type, and Butler (2012) also addresses how this typology might be constrained in particular ways.
In the next subsection, we present the results of the experiment reported in Butler (to appear) that provide quantitative empirical evidence for the determiner-adjoined analysis of the plural marker –o’ob in Yucatec Maya.

3 Summary of experimental evidence for the determiner-adjoined plural in Yucatec (Butler to appear)

In this section, we report the methods and results of a timed translation experiment presented in Butler (to appear), which provides quantitative evidence from real-time sentence production for the hypothesis that the plural morpheme –o’ob in Yucatec Maya is adjoined to the determiner projection (DP). We report the full methods of the experiment presented in Butler (to appear) in addition to the results because Experiment 1, presented in Section 4 of this paper, uses the same method, and Experiment 2, presented in Section 5 of this paper, uses the same method but with picture stimuli instead of auditory stimuli.

3.1 Method

The experiment presented in Butler (to appear) is a timed translation task in which participants heard stimulus sentences with conjoined nouns and an intransitive verb in Spanish. The participants translated these sentences into Yucatec under time pressure.

3.1.2 Participants

Twenty-eight bilingual Yucatec Maya-Spanish speakers between the ages of 18 and 42 participated in the experiment. Participants were compensated 25 Mexican pesos (just over 2 U.S. dollars) for their participation. The experiment was carried out in a soundproof recording room or an unoccupied classroom at La Universidad del Oriente in Valladolid, Yucatan, Mexico.

3.1.3 Materials

There were 18 items in 4 conditions, shown in Table 5. Of the 18 items, 5 had both of the conjoined nouns referring to humans (e.g. “the girl and the woman” or “the doctor and the nurse”). The remaining 13 items had both of the nouns of the conjunct referring to animals (e.g. “the frog and the rabbit” or “the cat and the dog”).vi There were 36 fillers. Twelve of the fillers consisted of transitive sentences in which the number of the subject varied. Another twelve consisted of transitive sentences with conjoined object nouns varying in number, and the final twelve were sentences with predicate adjectives. The items and fillers were pseudo-randomized and arranged in a Latin Squares design into four experimental lists. The Spanish stimuli were recorded from the synthetic voice of Alberto, a male Latin American Spanish synthetic voice from the AT&T Labs Natural Voices test-to-speech project®.
Table 5: Experiment 1 conditions

<table>
<thead>
<tr>
<th>Condition</th>
<th>Noun 1 (N1)</th>
<th>Noun 2 (N2)</th>
<th>Verb</th>
</tr>
</thead>
<tbody>
<tr>
<td>Singular-Singular (Sg-Sg)</td>
<td><em>La muchacha y</em> The girl-SG and</td>
<td><em>la mujer</em> the woman-SG</td>
<td><em>están cocinando</em> are-PL cooking</td>
</tr>
<tr>
<td>Singular-Plural (Sg-Pl)</td>
<td><em>La muchacha y</em> The girl-SG and</td>
<td><em>las mujeres</em> the women-PL</td>
<td><em>están cocinando</em> are-PL cooking</td>
</tr>
<tr>
<td>Plural-Singular (Pl-Sg)</td>
<td><em>Las muchachas y</em> The girls-PL and</td>
<td><em>la mujer</em> the woman-SG</td>
<td><em>están cocinando</em> are-PL cooking</td>
</tr>
<tr>
<td>Plural-Plural (Pl-Pl)</td>
<td><em>Las muchachas y</em> The girls-PL and</td>
<td><em>las mujeres</em> the women-PL</td>
<td><em>están cocinando</em> are-PL cooking</td>
</tr>
</tbody>
</table>

3.1.4 Procedure
Participants were seated at a table in front of a laptop. Participants wore a Siemens headset with a unidirectional microphone. The experiment was delivered with the Experiment Builder software developed at the University of Rochester. The participants were given oral instructions from the experimenter and were given written instructions on screen in Spanish before the experiment began. Participants completed four practice trials before the experimental trials began.

The Spanish stimulus sentence was presented auditorily once then repeated two times for a total of three presentations per trial. The participant was instructed that he or she could listen to the Spanish stimulus sentence all three times or press the spacebar anytime after hearing the sentence the first time to advance to the recording of the Yucatec translation. On the screen, there was a cartoon picture of an ear when the participant was to be listening to the Spanish stimulus and a cartoon picture of a mouth when the participant was to be saying the Yucatec translation. Once the recording was initiated, a time bar appeared at the bottom of the screen and participants had 15 seconds to produce their spoken translation. Participants could press the spacebar to advance to the next trial. The experiment took no longer than 30 minutes to complete.

3.2 Results
3.2.1 Coding and exclusions
In Table 6, we report the inclusion/exclusion criteria that were established in order to determine whether responses should be included in the statistical analyses. We report the exclusions for the experiment reported in Butler (to appear) as well as for Experiment 1 (presented in Section 4) and Experiment 2 (presented in Section 5).
Table 6: Exclusions for experiment in Butler (to appear), Experiment 1 and Experiment 2

<table>
<thead>
<tr>
<th>Exclusions</th>
<th>Uncodable</th>
<th>Constituency</th>
<th>Total included</th>
<th>Total responses</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>#</td>
<td>%</td>
<td>#</td>
<td>%</td>
</tr>
<tr>
<td>Experiment in Butler (to appear)</td>
<td>58</td>
<td>12%</td>
<td>40</td>
<td>8%</td>
</tr>
<tr>
<td>Experiment 1</td>
<td>72</td>
<td>8%</td>
<td>26</td>
<td>3%</td>
</tr>
<tr>
<td>Experiment 2</td>
<td>54</td>
<td>8%</td>
<td>38</td>
<td>6%</td>
</tr>
</tbody>
</table>

The Yucatec responses were coded by two native speakers of Yucatec Maya and by the first author. We coded for plural marking on the first noun, the second noun, and the verb. Responses were excluded from the analyses under the category of “Uncodable” if they were partly or completely unintelligible, if there was no response, or if the response was given all in Spanish. Responses were excluded from the analyses under the category of “Constituency” if they were missing a constituent, or if they included additional constituents that might influence the use of the plural. For example, if a response did not include a verb or a noun, it was excluded for constituency. Additionally, if a response was translated as a transitive verb with an object or as a reflexive verb form, it was excluded because these additional constituents might affect the use of plural marking on the verb. Responses with constituents that were borrowed from Spanish were included if they had Yucatec morphology (e.g. the Yucatec definite determiner, the distal deictic marker, the plural marker, or verbal morphology) because additional tests did not reveal a significant effect of Spanish borrowings on the likelihood of the use of the Yucatec plural marker –o’ob in the experimental responses.

3.2.2 Statistical analyses
Chi-squared tests revealed significant dependence between the use of plural marking in the Yucatec responses and the Spanish stimulus conditions. There were significantly more plurals marked on the second noun in the SP and PP conditions, compared to the SS and PS conditions ($\chi^2(3)=161, p < 0.001$). In addition, there were significantly more plurals marked on the first noun in the PS and PP conditions compared to the SS and SP conditions ($\chi^2(3)=101, p < 0.001$) (see Figure 1).
In addition, after collapsing across the experimental conditions, there were significantly more plurals marked after the second noun than the first. This result is unexpected given that the number of singular and plural first and second nouns was equal in the Spanish stimuli. Figure 2 shows that in the Yucatec responses the first noun was marked with plural morphology in only about 15% of the responses, while the second noun had plural morphology in about 38% of the responses (a significant difference ($X^2(1)=23, p < 0.001$)).

3.5 Discussion
The results of this experiment provide evidence for the hypothesis that the plural morpheme –o’ob in Yucatec Maya is adjoined to the determiner projection. There were a
number of responses that could only be unambiguously accounted for by the determiner-adjoined plural hypothesis. These responses are: 1) in the SS condition when there was a plural used after the second noun, 2) in the Pl-Sg condition when a plural was used after both the first and second nouns, and 3) in the Pl-Sg condition when a plural was used only after the second noun. In addition, we observed that in all of the experimental responses, plural marking after the second noun was significantly more likely than after the first. These two observations based on the variation in the use of plural marking in the quantitative corpus of the experimental responses support the proposal that the plural morpheme in Yucatec is adjoined high to the determiner projection.

The DP-adjoined proposal of Butler (under review) explains the otherwise curious distribution of some of the plural marking in the experiment summarized here (first reported in Butler, to appear). However, this proposal does not address other potential influences on the use of the plural marker. In the psycholinguistic literature on what is called the “Agreement Attraction Effect,” a number of influences on the occurrence of number agreement “errors” have been brought to light. An example of a number agreement “error” is “The key to the cabinets ARE on the table” (an example made famous by Bock and Miller (1991) who first examined the effect experimentally (though linguists had discussed such errors for some time). In agreement attraction, a plural local distracter noun, such as “cabinets” triggers plural number agreement on the verb, though canonical agreement should be controlled by the singular head noun “key.” A number of factors have been observed to influence the effect. Conceptual (or notional, or semantic; all of these terms are used in the literature) factors can influence the likelihood of the agreement attraction effect for number. For example, the more likely a noun phrase is to have a distributive interpretation, the more likely agreement on the verb is plural, even with a singular head noun (e.g. “The label on the bottles” (example from Vigliocco and Nicol 1996). In addition, Eberhard (1997) found that the use of a numeral greatly reduced the agreement attraction effect for number agreement (e.g. “One key to the cabinets…” led to significantly less plural agreement on the verb compared to “The key to the cabinet…”).

In Experiments 1 and 2, we investigate the influence of conceptual/notional/semantic factors on the use of optional plural marking in Yucatec Maya to investigate whether the same factors that influence number agreement “errors” in obligatory agreement (Indo-European)-type languages are at work in non-obligatory head-marking type languages, such as Yucatec Maya. The type of language represented by Yucatec Maya, polysynthetic, head-marking, has received little to no attention in psycholinguistic research (Jaeger & Norcliffe 2009), so we also seek to “expand the empirical base” of theories of sentence production. Importantly, the non-obligatory language type has not, to our knowledge been examined in this light (with the exception of some recent work on dialects of Spanish in which the plural marker is elided or phonologically reduced and thus not highly perceptually salient (e.g. Foote and Bock 2011).
4 Experiment 1: Singular, “two” and plural in timed translation

4.1 Methods
The method in Experiment 1 is the same as that of the experiment summarized from Butler (to appear) except that the stimuli did not involve conjoined nouns but rather simple noun phrases with noun phrases that were singular, plural or with the numeral “two.”

4.1.2 Participants
Thirty bilingual speakers of Yucatec Maya and Spanish from the same population as the experiment reported in Butler (to appear) participated in Experiment 1 and were given the same compensation for this experiment, which also lasted no longer than 30 minutes.

4.1.3 Materials
As in the timed translation experiment reported in Butler (to appear), the stimuli in Experiment 1 were created by the synthesized male Latin American Spanish voice from AT&T Labs Natural Voices® text-to-speech project. There were 30 items of which 16 referred to humans and 14 to animals. There were 32 fillers. Half of the fillers were transitive sentences in which the object varied in number or sentences. The other half of the fillers were sentences with predicate adjectives. The items and fillers were arranged in a Latin Squares design into three pseudo-randomized lists. Table 6 provides example items for each of the three conditions, listing both the Spanish stimulus and potential responses in Yucatec Maya.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Spanish stimulus</th>
<th>Potential Yucatec response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Singular</td>
<td>El muchacho está jugando DEF boy be.3SG play.GER “The boy is playing”</td>
<td>Le xi’ipal-o’ táan u baxal DEF male.child-D2 PROG A3 play “The boy is playing”</td>
</tr>
<tr>
<td>“Two”</td>
<td>Dos muchachos están jugando two boy.PL be.3PL play.GER “Two boys are playing”</td>
<td>Ka’a-túul xi’ipal(o’ob) táan u baxal(-o’ob) two-CL.AN male,child(-PL) PROG A3 play(-PL) “Two boys are playing”</td>
</tr>
<tr>
<td>Plural</td>
<td>Los muchachos están jugando DEF.PL boy.PL be.3PL play.GER “The boys are playing”</td>
<td>Le xi’ipal(-o’ob)-o’ táan u baxal(-o’o’b) DEF male,child(-PL)-D2 PROG A3 play(-PL) “The boys are playing”</td>
</tr>
</tbody>
</table>

4.1.4 Procedure
The procedure for Experiment 1 is the same as for the experiment reported in Butler (to appear), summarized in Section 3.1.4.

4.2 Results
4.2.1 Coding and exclusions
The coding and inclusion criteria for Experiment 1 are the same as for the experiment reported in Butler (to appear) and are summarized in Table 6 in Section 3.2.1.
4.2.2 Statistical analyses

Chi-squared tests revealed significantly more plural marking in the “two” condition compared to the singular condition for both nouns ($\chi^2(1) = 253.2, p < .0001$) and verbs ($\chi^2(1) = 355.5, p < 0.0001$). There was significantly more plural marking on nouns in the plural condition compared to the “two” condition ($\chi^2(1) = 48.8, p < .0001$), but the effect did not hold for verbs ($\chi^2(1) = 2.8, p < .1$). Though there was significantly more plural marking on nouns in the plural versus the “two” condition, the difference between plural marking on verbs in the “two” versus the plural condition was not significant.

Over 98 percent of the responses in Experiment 1 were verb-final. Even after excluding cases that were verb-initial (out of 15 total verb-initial responses, 11 had no plural marker on verbs in the “two” and plural conditions) and cases in which there was no classifier used in the “two” condition (19 excluded) and cases in which verbs were transitive (and the plural could have been marked on an object nominal) (76 excluded), the effect for verbs was still not significant ($\chi^2(1) = 0.2, p < 0.1$). The difference between plural marking on verbs in the “two” and plural conditions was not significant (or marginally significant). Figure 1 shows the proportion of plural marking on nouns and verbs in Experiment 1.

![Figure 3: Proportion of plural marking on nouns, verbs and both (noun and verb)](image)

A Spearman's rank correlation coefficient revealed a significant preference for covariation of plural form across conditions ($R^2(1) = 0.53, p < .001$). Participants significantly preferred to mark both the subject noun and verb in the same way. Participants marked both the subject noun and the verb with the plural morpheme, or they marked neither. Plural marking on the DP and VP were significantly dependent on one
another ($\chi^2(1) = 418, p < .001$), as the Spearman's rank suggests. Figure 2 shows the proportion of covariant plural marking across conditions. Additionally, human versus animal agent-subjects did not show a significant difference in being plural marked on nouns ($\chi^2(1) = 0.005, p < 1$) or verbs ($\chi^2(1) = 0.003, p < 1$).

4.6 Discussion

In this experiment, we compared the effect of singular versus plural morphology and the use of the numeral “two” in translations from Spanish to Yucatec. The translation method employed in this experiment was chosen due to its simplicity and naturalness for the participants who may not be as experienced with psycholinguistic experiments and testing paradigms in general as are university students in more developed nations (cf. Henrich et al. 2009) There are, however, many potential drawbacks of the translation method. The high rate of usage of plural morphology in the Yucatec responses could have been affected by the obligatory number marking in the Spanish stimuli. The results we see in Experiment 1 could have been affected by morpho-syntactic priming (or persistence) from Spanish to the Yucatec responses.

There are two separate phenomena that go under the name “syntactic priming.” One is the facilitated processing of a word due to congruence with a prior syntactic context. The other is the facilitatory effect of processing a full sentence structure based on a previous congruent syntactic structure (Nicol 1996). These different areas of research have in common the idea that a larger syntactic context can influence the course of subsequent word and sentence production. For example, Gurjanov et al. (1985) showed that in Serbo-Croatian, adjectives inflected for gender and case facilitated lexical access of nouns with the same gender and case specifications. In addition, Bock (1986) showed that ditransitive and passive sentences would prime the use of the same structures in unrelated sentences for speakers of English. Though these studies were not across two languages, there is independent evidence that syntactic priming in sentence production (if not also in lexical decision) has an effect across languages. Loebell and Bock (2003) found that ditransitives and prepositional datives primed the same structures between German and English. Similarly, Hartsuiker et al. (2004) found passives sentences primed other passives between English and Spanish. There are some limits on the extent of the effect of syntactic priming, however, Loebell and Bock (2003) did not find syntactic priming for passives between German and English, presumably because the German passive sentences were verb-final, while the English passives were not. In addition, Bock and Griffin (2003) found that syntactic priming did not affect high frequency or highly preferred structures (see Branigan 2007) for an overview of syntactic priming at the sentence level).

Thus, in the case of Experiment 1, it is possible that the processing of words with plural morphology in Yucatec Maya was facilitated by the previous context in which a Spanish sentence with plural morphology was presented. Experiment 2 was designed to address this potential confound. Experiment 2 is a picture description task with nearly identical stimuli to those presented in Experiment 1 but in picture form. There are three conditions depicting one, two or many (seven) humans or animal depicting an intransitive action.
5  Experiment 2: One, two and many (seven) in picture description

5.1  Methods
Experiment 2 is a picture description task with three conditions: one, two and many (seven). The one condition has pictures that depict one character, human or animal, doing an intransitive action. The “two” condition has pictures that show two of the same characters doing an intransitive action, and the many condition has pictures that show seven of the same characters doing an intransitive action. The prediction of Experiment 2 is that if plural marking was affected by morphosyntactic persistence from the Spanish stimuli in Experiment 1, then we expect to see lower overall proportions of plural marking in Experiment 2 compared to Experiment 1.

5.2  Participants
Twenty-seven participants, fourteen females and thirteen males between the ages of 19 and 26 from the same population as the experiment presented in Butler (to appear) participated in the experiment and were compensated the same for this experiment, which also lasted no longer than 30 minutes.

5.3  Materials
Participants were shown pictures in three conditions, one, two and many (seven). The one condition had one person or animal depicting an intransitive action, such as a baby crying, or a frog jumping, as shown in Table 7.

Table 7: Stimuli and conditions for Experiment 2

<table>
<thead>
<tr>
<th>Condition</th>
<th>One</th>
<th>Two</th>
<th>Many (seven)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Human</td>
<td>![Image]</td>
<td>![Image]</td>
<td>![Image]</td>
</tr>
<tr>
<td>Animal</td>
<td>![Image]</td>
<td>![Image]</td>
<td>![Image]</td>
</tr>
</tbody>
</table>

All of the stimulus pictures were clipart style, simple but clear drawings of people and animals in black and white or grayscale. There were 24 items (12 human and 12 animal) and 48 fillers. The fillers depicted transitive actions with one two, three or seven objects (e.g. a man eating two sandwiches). The items were counterbalanced for the direction in which the character was facing (left, right, or forward). Three lists were arranged into a Latin Squares design and randomized with the fillers into three lists.
5.4 Procedure
The procedure for Experiment 2 is the same as for Experiment 1 and the experiment reported in Butler (to appear), summarized in Section 3.1.4.

5.5 Results
5.5.1 Coding and inclusion criteria
The coding and inclusion criteria for Experiment 2 are the same as for Experiment 1 and the experiment reported in Butler (to appear) and are summarized in Table 6 in Section 3.2.1.

5.5.2 Statistical analyses
There was significantly more plural marking in the two condition than the one condition for subject nouns ($\chi^2(1) = 101.5, p < .001$) and verbs ($\chi^2(1) = 139.7, p < .001$). And, there was significantly more plural marking in the many condition compared to the two condition, for nouns ($\chi^2(1) = 33.5, p < 0.001$) and verbs ($\chi^2(1) = 11, p < .001$). Figure 7 shows the proportion of plural marking on nouns and verbs in the three conditions, one, two and many.

![Figure 7: Proportion of plural marking on nouns, verbs and both (noun and verb)](image_url)

A Spearman's rank correlation coefficient revealed a significant preference for covariation of plural form across conditions ($R^2(1) = 0.61, p < .001$). This statistic even includes cases in which a numeral and classifier was used. Plural marking on the noun and verb were significantly dependent on one another ($\chi^2(1) = 299, p < 0.001$), confirming the results of the Spearman's rank statistic. We also tested the effect of humanness on the likelihood of plural marking, since half of the items depicted humans and the other half animals. Chi-squared tests revealed that humanness, however, did not
significantly affect the use of plural marking on nouns ($\chi^2(1) = 0.78, p < .5$) or verbs ($\chi^2(1) = 0.05, p < .5$) in the descriptions of the picture items.

5.6 Discussion
Comparing plural usage in Experiments 1 and 2
At this point, we can compare the use of plural marking across the different experimental methods used in Experiment 1 (translation) and Experiment 2 (picture description). In Experiment 1, there was significantly more plural marking in the “two” condition compared to the singular condition and in the plural condition compared to the “two” condition for nouns. For plural marking on verbs, however, there was not significantly more plural marking in the plural condition compared to the “two” condition. In Experiment 2, the picture description task, there was significantly more plural use in the two condition compared to the one condition and in the many condition than the two condition for both nouns and verbs.

Figure 7 shows that the proportion of plurals used on nouns and verbs in Experiment 1, the translation task, was overall higher than in Experiment 2, the picture description task. The chart also reveals, interestingly, that the patterns across experiments remained very similar. There was somewhat less plural marking on nouns than verbs in the two conditions of both experiments, but in the plural/many conditions, plural marking was closer to equally proportioned on nouns and verbs for both experiments.

Figure 7: Proportion of plural marking in Experiment 1 (left) (singular, two, plural translation) and Experiment 2 (right) (one, two and many (seven) pictures)

In both Experiments 1 and 2, participants still significantly preferred covariation of plural form on the verb when it was also marked on the noun. Even though there was no direct influence from a Spanish stimulus sentence in Experiment 2, participants still preferred
the subject noun and verb to have matching form, either both plural or both unmarked, despite plural marking being somewhat suppressed by the presence of a numeral in the noun phrase.

6  General Discussion
In this investigation, we’ve used field-based experimental methods to address a number of issues at the syntax-processing interface in Yucatec Maya. In this discussion, we will address the implications of our research for three relevant areas of inquiry: 1) the typology of plural marking, 2) psycholinguistics and in particular the production of number marking and agreement, and 3) the morphosyntax of Yucatec Maya.

6.1  Typology of plural marking
Butler (under review) proposed that the plural morpheme in Yucatec is adjoined to the determiner projection, according to the syntactic typology of plural marking proposed by Wiltschko (2009). This proposal expanded the empirical coverage of Wiltschko’s typology, which, upon being proposed, provided mainly evidence for Halkomelem as a root-adjoining type of plural. In addition to the elicitation data presented in Butler (under review), we summarized quantitative experimental evidence presented in Butler (to appear). In the experimental responses, there were some utterances that could only be unambiguously explained by the determiner-adjoined plural hypothesis for Yucatec. As mentioned, Butler (under review, to appear) expanded the typology of Wiltschko (2008) in demonstrating a language type that Wiltschko predicted but did not provide evidence for. Butler (under review, to appear) provides additional diagnostics for the determiner-adjoined plural type language. Butler (to appear) also highlights evidence for other language types couched within Wiltschko’s typology, namely, a quantifier-adjoined plural in Korean and other evidence for nP-adjoining plurals (as discussed, e.g. by Acquaviva 2008).

6.2  The production of number marking and agreement
The results of Experiment 1 and 2 showed that the same factors which have been shown to influence agreement attraction in English and other Indo-European languages. Agreement attraction “errors” are more frequent the more likely the noun phrase is to be interpreted as semantically plural or distributive. In non-obligatory plural marking, the more semantically/notionally plural, the more likely plural marking is to be used. In addition, the use of a numeral with the head noun reduced the likelihood of agreement attraction in English (Eberhard 1997), and in Yucatec, the use of a numeral reduced the likelihood of use of non-obligatory plural marking.

In the agreement attraction literature, it is unclear whether attraction is due to a direct influence of semantic information on agreement computation (Vigliocco & Hartsuiker 2002) or whether the effect can be indirect (via conceptual “marking” followed by morphological/structural “morphing”) (Bock et al. 2001). On this dual approach, Eberhard et al. (2005) comment:
“...it is an important (and open) question whether verbs in languages with different or richer verb morphology are directly marked with information about number of participants” (Eberhard et al. 2005: 538).

In this case, a language like Yucatec would be predicted to show sensitivity to semantic/conceptual information for the use of plural marking on nouns as well as on verbs, which is what we have found here. This question relates closely to the processing of number information on verbs and pronouns in inflectional languages like English. There is evidence that pronominal number is computed differently than verbal inflectional number (Eberhard et al. 2004). It has been show to be more susceptible to semantic influences. We can draw a parallel between pronominal number and cross-reference marking of number information in that both appear to be more susceptible to semantic information than true verbal inflectional number agreement.

6.3  
Morphosyntax of Yucatec and Mayan

England (2011) pointed out the startling observation that there is very little work on number agreement in Mayan languages. This research can be considered an addition to the small, but growing, body of research on number marking and agreement in Mayan languages. We contribute a quantitative corpus of data to show syntactic and semantic effects on the use of plural marking in experimental behavioral research.

As mentioned in Endnote vi in Section 3.1.3, Lucy (1992) proposed that the use of plural marking in Yucatec is determined by an animacy hierarchy (human>animal>inanimate). Since our experimental stimuli made reference to humans and animals, we can at least test the highest part of the hierarchy. We found no significant difference in the use of plural marking in human versus animal items. The implication of this finding is that the use of non-obligatory plural marking in Yucatec may be more strongly influenced by other semantic factors, such as numerosity rather than animacy.

We can, however, speculate on the relationship between plural marking and animacy. In Butler et al. (in prep), we examine constituent order variation in transitive clauses with a video description task. More animate agents (humans>animals>inanimates) led to significantly more Agent-Verb-Patient orders, while more animate patient led to more Patient-Verb-Agent orders. So, animacy is a factor in word order variation.

In addition, in an experiment not reported here, we examined the use of plural marking on verb-initial versus verb-final clauses. We found that verb-initial clauses were significantly less likely to be marked with the plural cross-reference marker compared to verb-final clauses. A human referent is more likely to be sentence-initial in Yucatec, and also, a sentence-initial clause with a plural referent in Yucatec is more likely to be marked with the non-obligatory plural marker. Thus, we propose that the relationship between plural marking and animacy is mediated by constituent order. More animacy noun phrase referents are more likely to be sentence-initial, and noun-phrase initial sentences are more likely to be marked with plural agreement.
Interestingly, Bock and Miller (1991) found no effect of animacy on the likelihood of number agreement attraction errors (e.g. “The author of the speeches” versus “The speech by the authors”) (though Barker, Nicol and Garrett (2001) found a marginally significant effect of animacy on number agreement attraction).

To conclude, we argue that neither the theoretical nor the behavioral results alone could have led to such a comprehensive analysis of non-obligatory plural marking in Yucatec Maya. For psycholinguistics, Yucatec Maya offers a lens into number marking and agreement processes without recourse to agreement errors. We argue that both of these conclusions clearly demonstrate the merit of well-controlled experimental research with less-commonly studied languages in field settings.
References
Butler, Lindsay Kay. Under review. The DP-adjoined plural in Yucatec Maya and the syntax of plural marking.


Nicol, Janet. 1996.


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i Wiltschko (fn. 9) notes that the example in (6d) is normally interpreted as singular in the absence of any plural marking, but it is also compatible with a plural interpretation and the presence of a numeral of cardinality greater than one.

ii This three-way homophony is curious and may not be accidental (as an anonymous reviewer points out). The nominal plural –o’ob may have been borrowed from the third person plural cross-reference marking paradigm. Other Mayan languages have a distinct
nominal plural. For example, Chol (a Mayan language spoken in Chiapas, Mexico) use a distinct nominal plural –la in addition to the –o’ob plural (Coon, pc.). Yucatec also has a plural-like morpheme –tak that affixes to adjectives. If the nominal plural was indeed borrowed from the cross-reference marking paradigm, this fact may also be related to the syntax of the nominal plural in the DP in Yucatec. These are questions that we regrettably leave for future research.

iii The definite determiner “le” is not obligatory in this phrase. It is grammatical without the definite determiner, but it has a kind or generic interpretation.

iv It is possible that Yucatec Maya lacks a Number Phrase altogether (as Wiltschko discusses for Upriver Halkomelem and as Kwon and Zribi-Hertz (2004) argue for the plural in Korean). I do not have clear evidence at this point to say definitively that the language lacks a Number Phrase. I will have to leave the issue for future research.

v See Butler (under review) for a more explicit treatment of the full structure of the noun phrase including other nominal constituents in Yucatec Maya).

vi Lucy (1992) proposed that plural marking in Yucatec Maya is determined by an animacy hierarchy (human>animal>inanimate). Since our stimuli include human and animal referents, we test for a statistically significant difference between plural marking with human vs. animal referents, and we discuss these results in the General Discussion section on the morphosyntax of Yucatec, Section 6.3.