Modeling obviation in Algonquian*

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1. Introduction

Algonquian languages make a distinction in third person arguments in a discourse between proximate and obviative where proximate marks salient third persons and obviative marks non-salient. Once a proximate has been established, a speaker has a choice whether to introduce the next noun as either proximate or obviative (Goddard 1990, Thomason 2003). Consider the following excerpt from a text from Meskwaki (Central Algonquian).[1]

(1) a. o·ni=na·hkači nekotenwi **mahkate·wi-anakwe·wa** e·=ši·ša·či, e·h=nesa·či *pešekesiwani.*
And then another time **Black Rainbow (P)** went hunting and killed a *deer (O)*.

b. e·=wi·naniha·či, e·h=mo·hki·hta·koči *aša·hahi*, e·h=ma·ne·niči.
As **he (P)** was butchering *it (O)*, some *Sioux (O)* rushed out at **him (P)**, a lot of *them (O)*. (Goddard 1990, 324)

The central character of the text is Black Rainbow, marked as proximate, in (1a), and the less central character, the deer, is marked as obviative. In (1b), 'some Sioux' is introduced as obviative, maintaining Black Rainbow as proximate. This pattern of proximate- and obviative-marked third person arguments is found across the Algonquian language family (e.g., Goddard 1990 for Meskwaki; Valentine 2001, §12.4 for Ojibwe; Russell 1991 for Swampy Cree).

To investigate the semantics of the phenomenon of obviation, or, the difference between proximate- and obviative-marked nouns, we use data from fieldwork on Mi'gmaq, an Eastern Algonquian language. To illustrate the proximate/obviative contrast more simply, con-

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[1]Gloss abbreviations: 3 = third person; AI = animate intransitive; DIR = direct (subject ranked over object); INV = inverse (object ranked over subject); PST = past; PROX, **P** = proximate; OBV, *O* = obviative

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sider the differences between pronouns in English and obviation marking in Mi'gmaq. The pronoun *she* in (2) is ambiguous—it could refer to either 'Susan' or 'Mali'.

(2) *Context:* Susan and Mali got into a patch of poison ivy which made them break out in itchy bumps. They started scratching each other.

Susan$_i$ scratched Mali$_j$ then she$_{i/j}$ went home.

The parallel construction in Mi'gmaq is not ambiguous, as the following example displays. The second clause of (2) can be translated into Mi'gmaq as two unambiguous sentences.

(3) *Context:* Susan and Mali got into a patch of poison ivy which made them break out in itchy bumps. They started scratching each other.

Susan gejgapa'l-a-pn-n *Mali-al*
Susan.PROX scratch-DIR-PST.3-OBV *Mali*-OBV
'**Susan (P)** scratched *Mali (O)*.'

a. ... toqo enmie-**p**.
then go.home-**3.PST.PROX**
'...then **she (Susan)** went home.'

b. ... toqo enmie-*nipnn*.
then go.home-3.PST.OBV
'...then *she (Mali)* went home.'

In (3) 'Susan' is marked as proximate (PROX) and 'Mali' is marked as obviative (OBV). The third person agreement on the verb *enmie-* 'go home' is proximate in (3a) and obviative in (3b), and thus there is no ambiguity as to who went home. In this paper we adapt a system, Predicate Logic with Anaphora (Dekker 1994), which is designed to account for English anaphora, as in (2), to model obviation in Mi'gmaq.

This paper is organized as follows. First, in section 2, we give background on obviation and how Mi'gmaq marks proximate and obviative nouns. In section 3, we introduce and exemplify how Predicate Logic with Anaphora works using the English example above. Using this system, in section 4 we analyze the basic pattern of Mi'gmaq obviation, as demonstrated in (3). Section 5 considers more complicated data and extends the formal system. In section 6 we conclude.

2. Obviation in Algonquian languages

Proximate and obviative are two ways to differentiate third person arguments in Algonquian languages. In contexts with two third persons, the salient third person is proximate and the non-salient third person is obviative. Only one argument of the verb can be proximate. Furthermore, a proximate-marked individual *must* be established *first* before any obviative-marked individual can be introduced (Goddard 1990). Though the general pattern of obviation as a system to differentiate salience of third persons works similarly throughout the Algonquian language family (e.g., Goddard 1990 for Meskwaki; Valentine 2001, §12.4 for Ojibwe; Russell 1991 for Swampy Cree), we use Mi'gmaq to exemplify the basics in this paper.

We illustrate the proximate/obviative marking on the noun *e'pite's* 'young woman' in Mi'gmaq. In (4) the zero-marked noun is proximate, while the obviative suffix '*-l*' on the noun in (5) signals that the noun is obviative.[2]

(4) e'pite's
woman
'**woman (P)**'

(5) e'pite's-*l*
woman-OBV
'*woman (O)*'

In transitive verbs, a theme sign (underlined in the data below) signals the relative ranking of the subject and object. A direct theme sign signifies that something higher on the person hierarchy is acting on something lower on the person hierarchy. In cases with third persons, this means that the proximate is acting on the obviative (6). The inverse theme sign signifies the opposite: something lower on the person hierarchy acting on something higher, so in third person contexts, the obviative acts on the proximate (7).

(6) Gesal-<u>a</u>-t-l.
love-<u>DIR</u>-3-OBV
'**She (P)** loves *her (O)*.'

(7) Gesal-<u>Ø</u>-t-l.
love-<u>INV</u>-3-OBV
'*She (O)* loves **her (P)**.'

Note the inverse theme sign in (7) is null (Ø) but the two verb forms are still different (compare *gesalatl* (direct) versus *gesaltl* (inverse)). With a negative morpheme, we can see the inverse theme sign overtly realized as *-gu*:

(8) Mu gesal-<u>gu</u>-gu-*l*
NEG love-<u>INV</u>-3.NEG-OBV
'*She (O)* doesn't love **her (P)**.' (Hamilton 2015, 20)

To sum, in third person environments when the proximate is the subject and the obviative is the object the direct theme sign (DIR) appears and when the obviative is the subject and the proximate is the object, the inverse theme sign (INV) appears.

A brief note about first and second person, or speech act participants, is needed. Speech act participants are inherently proximate and are always ranked above any third person. As for proximate and obviative arguments interacting with speech act participants, Thomason (2003, 143) comments that "[v]ery, very rarely, you run across an inclusive, second, or first person interacting with an obviative, but in general, third persons juxtaposed to non-third persons are marked as proximate". As these forms are very rare throughout Algonquian, we set aside any interactions of proximate and obviative individuals with speech act participants in this paper.

[2] Unlike in other Algonquian languages, there is no overt morphology that differentiates proximate and obviative plural animate nouns in Mi'gmaq. When both arguments of the verb are animate plural, the ordering of the nouns signals which one is the subject and which is the object. See Little (To Appear) for discussion.

To demonstrate how obviation works in Mi'gmaq, we review in detail the data introduced in section 1, repeated below. The first sentence, (9), introduces two individuals: **Susan (P)** and *Mali (O)*.

(9) **Susan** gejgapa'l-a-pn-n *Mali-al*
Susan.PROX scratch-DIR-PST.3-OBV *Mali*-OBV
'**Susan (P)** scratched *Mali (O)*.'

a. ... toqo enmie-**p**.
then go.home-**3.PST.PROX**
'... then **she (Susan)** went home.'

b. ... toqo enmie-*nipnn*.
then go.home-3.PST.OBV
'... then *she (Mali)* went home.'

'Susan', the proximate argument, is introduced first, establishing her as the more salient participant in the discourse.[3] Marking on the verb *enmie-* 'go home' in (9a) and (9b) can pick out whether the proximate individual went home ('Susan') or the obviative individual went home ('Mali'). In (9a) the marking on the verb is the third person proximate past (*-p*), so the proximate argument 'Susan' went home. In (9b) the marking on the verb is the third person obviative past (*-nipnn*[4]), so 'Mali' went home.

The morphemes on the verbs in (9a) and (9b) keep track of these individuals, and in this way keep track of the salience of individuals in the discourse. Predicate Logic with Anaphora keeps track of salience of individuals in a discourse, and thus is a natural way to capture this proximate/obviative contrast. Additionally, Predicate Logic with Anaphora was developed to capture pronominal anaphora in English, so it can be used to compare English anaphora to the Mi'gmaq equivalent—obviation marking. Its ability to model salience and its design as a model of nominal anaphora make Predicate Logic with Anaphora well suited to model obviation.

In the next section, we provide background on Predicate Logic with Anaphora and then give an analysis of the data in (9) in section 4. New data from fieldwork demonstrates we must modify the analysis introduced in section 4 to account for ambiguities once a third individual has been introduced into the discourse.

3. Background on Predicate Logic with Anaphora

Predicate Logic with Anaphora (Dekker 1994; henceforth, PLA) extends standard Predicate Logic in order to keep track of individuals in a discourse. It does this by adding information states, which store lists of individuals. An example information state can be seen in (10).

[3] One speaker also commented that sometimes proximate and obviative markings are used to show deference or respect for certain individuals, where the individual being treated with respect is marked as proximate.

[4] For convenience, we gloss this whole morpheme as the third person past obviative. However, it can be separated out as *-ni-pn-n* or 3.OBV-PST-OBV.

(10) **Sample PLA information state**

$$s = \{\langle \underset{\underset{\mathsf{p}_2}{\uparrow}}{a}, \underset{\underset{\mathsf{p}_1}{\uparrow}}{b}, \underset{\underset{\mathsf{p}_0}{\uparrow}}{c} \rangle\}$$

In PLA the semantics includes regular truth conditions, but a formula is interpreted as an update of an information state. The information states store lists of individuals that have been introduced by indefinite noun phrases (translated with existential quantifier, $\exists$). The individuals can be referenced using pronouns, $\mathsf{p_i}$, where i indexes the position of the pronoun in the list.

The information state in (10) contains one list, called a *case*, which is a string of individuals. A pronoun with index $\mathsf{0}$ ($\mathsf{p_0}$) refers to the rightmost individual of each list in an information state. In (10), $\mathsf{p_0}$ is c. Each succeeding number refers to the individual in the next position to the left.

In order to demonstrate how PLA works, we use the ambiguous English (2), repeated in (11). The ambiguity of (11) is captured by two translations into PLA. One meaning of (11), where *she* refers to *Susan*, can be translated as in (12). The meaning where *she* refers to *Mali* can be translated as in (13). Notice that the only difference between the two translation is in the final pronoun argument of W: it is $\mathsf{p_0}$ in (12) and $\mathsf{p_1}$ in (13).[5]

(11) Susan$_i$ scratched Mali$_j$ then she$_{i/j}$ went home.

(12) $\exists \mathsf{x}(\mathsf{x} = \mathsf{s} \wedge \exists \mathsf{y}(\mathsf{y} = \mathsf{m} \wedge \mathsf{Sxy})) \wedge \mathsf{Wp_0}$

(13) $\exists \mathsf{x}(\mathsf{x} = \mathsf{s} \wedge \exists \mathsf{y}(\mathsf{y} = \mathsf{m} \wedge \mathsf{Sxy})) \wedge \mathsf{Wp_1}$

The interpretation of (12) can be seen in Table 1. The rows of the table correspond to the clauses. The "Pro. Interpr." column contains the interpretation of any pronoun terms in the PLA column. The "Output State" column has the information state that results from updating the information state in the row above it with the PLA formula in its own row. For example, s_0 in (a) is the input to the PLA formula in (b) and this update results in the output state in (b), s_1.[6]

Table 1: Interpretation of (12)

	English	PLA	Pro. Interpr.	Output State
a.				$s_0 = \{\langle\rangle\}$
b.	Susan$_i$ scratched Mali$_j$	$\exists \mathsf{x}(\mathsf{x} = \mathsf{s} \wedge \exists \mathsf{y}(\mathsf{y} = \mathsf{m} \wedge \mathsf{Sxy}))$		$s_1 = \{\langle m, s\rangle\}$
c.	then she$_i$ went home.	$\mathsf{Wp_0}$	$[\mathsf{p_0}]_{s_1} = s$	$s_2 = \{\langle m, s\rangle\}$

[5] We are translating *then* and the Mi'gmaq equivalent *toqo* into PLA simply as $\wedge$, treating it as a conjunction and ignoring any temporal contribution.

[6] The symbol $\wedge$ simply indicates sequential update, so it is omitted in the table between two 'steps'.

The initial information state in (a) is a set containing an empty list. In (b), the quantifier with narrow scope first adds to the information state any individual that can replace y in $\mathsf{y} = \mathsf{m} \wedge \mathsf{Sxy}$, namely *m*. Then the quantifier with wides scope adds to the information state any individual that replace x in $\mathsf{x} = \mathsf{s} \wedge \exists \mathsf{y}(\mathsf{y} = \mathsf{m} \wedge \mathsf{Sxy})$, namely *s*. In (c), p_0 is interpreted as, *s*, the rightmost individual of input information state, s_1. Thus we get the interpretation where it is *Susan* who *went home*.

The semantic interpretation of (13) can be seen in Table 2.

Table 2: Interpretation of (13)

	English	PLA	Pro. Interpr.	Output State
a.				$s_0 = \{\langle\rangle\}$
b.	Susan$_i$ scratched Mali$_j$	$\exists \mathsf{x}(\mathsf{x} = \mathsf{s} \wedge \exists \mathsf{y}(\mathsf{y} = \mathsf{m} \wedge \mathsf{Sxy}))$		$s_1 = \{\langle m, s\rangle\}$
c.	then she$_j$ went home.	Wp_1	$[\mathsf{p}_1]_{s_1} = m$	$s_2 = \{\langle m, s\rangle\}$

This analysis works exactly like the previous until step (c). In (c), p_1 is interpreted as the second-to-rightmost individual of the input information state, s_1, namely *m*. Thus we get the interpretation where it is *Mali* who *went home*.

4. Analysis of Mi'gmaq obviation using PLA

In English the ambiguity of *she* is represented in PLA by different pronoun terms: p_0 and p_1. Intuitively we can represent the lack of ambiguity in the Mi'gmaq data, repeated below, by uniformly translating the proximate and obviative agreement as p_0 and p_1, respectively. Thus, a verb, V, with DIRECT morphology would be translated as $\mathsf{Vp}_0\mathsf{p}_1$ with the proximate argument acting on the obviative argument, and a verb, V, with INVERSE morphology would be translated as $\mathsf{Vp}_1\mathsf{p}_0$ with the obviative argument acting on the proximate argument. Additionally, there need to be two separate quantifiers: one ($\exists_\mathsf{p}$) to introduce individuals to the proximate (0) position of the list and one ($\exists_\mathsf{o}$) to introduce individuals to the obviative (1) position of the list. These are all summarized below:

(14)
a. PROX: p_0
b. OBV: p_1
c. DIR: $\mathsf{Vp}_0\mathsf{p}_1$
d. INV: $\mathsf{Vp}_1\mathsf{p}_0$
e. $\exists_\mathsf{p}$: adds to list position 0
f. $\exists_\mathsf{o}$: adds to list position 1

Note that the names are not being translated as direct arguments of the verb. In this way the semantics are not representing the syntactic structure as much as being guided by them. The word *toqo* translated into English as 'then' can be translated into PLA as $\wedge$, which as mentioned above simply indicates sequential update and is omitted from the tables below. The Mi'gmaq data from (3), repeated in (15) can be translated into PLA as in (16-18).

(15) **Susan** gejgapa'l-a-pn-n *Mali-al*
Susan.PROX scratch-DIR-PST.3-OBV *Mali*-OBV
'**Susan (P)** scratched *Mali (O)*.'

a. ... toqo enmie-**p**.
then go.home-**3.PST.PROX**
'... then **she (Susan)** went home.'

b. ... toqo enmie-*nipnn*.
then go.home-3.PST.OBV
'... then *she (Mali)* went home.'

(16) (15) $\rightsquigarrow \exists_p y(y = s) \wedge \exists_o x(x = m) \wedge Sp_0p_1$

(17) (15a) $\rightsquigarrow Wp_0$

(18) (15b) $\rightsquigarrow Wp_1$

(15) can be interpreted as in Table 3.

Table 3: Interpretation of (15)

	Gloss	PLA	Pro. Intp.	Output State
a.				$s_0 = \{\langle\rangle\}$
b.	Susan.PROX	$\exists_p y(y = s)$		$s_1 = \{\langle s\rangle\}$
c.	Mali-OBV	$\exists_o x(x = m)$		$s_2 = \{\langle m, s\rangle\}$
d.	scratch-DIR-PST.3-OBV	Sp_0p_1	$[p_0]_{s_2} = s$, $[p_1]_{s_2} = m$	$s_3 = \{\langle m, s\rangle\}$

In (a), we start with an empty information state. In (b), $\exists_p y(y = s)$ adds s to the proximate position at the end of the list to form information state s_1. Then, in (c) $\exists_o x(x = m)$ adds m to the obviative position on the list, namely to the left of s to produce information state s_2. In (d), Sp_0p_1 is the translation of the transitive, direct verb meaning 'scratch'. p_0 is interpreted as the rightmost individual of the input state (s_2), namely s. p_1 is interpreted as the second-to-rightmost individual of the input state (s_2), namely m. Thus we correctly get the interpretation where *Susan* is the subject of *scratch* and *Mali* is the object.

In Table 4 is the interpretation of (15a). (15a) follows (15), so the output state of Table 3 is the input state of Table 4.

Table 4: Interpretation of (15a)

	Gloss	PLA	Pro. Intp.	Output State
e.	go.home-3.PST.PROX	Wp_0	$[p_0]_{s_3} = s$	$s_4 = \{\langle m, s\rangle\}$

In step (e) of Table 4, the Mi'gmaq intransitive verb, *enmie-**p*** ('**she (P)** went home'), has proximate agreement so it is translated into PLA with p_0 as the subject of the verb. p_0 is interpreted as the rightmost individual of the input information state (s_3), namely s.

In Table 4 is the interpretation of (15b), the other follow up sentence to (15). Again, the output state of Table 3 is the input state of Table 5.

Table 5: Interpretation of (15b)

	Gloss	PLA	Pro. Intp.	Output State
e.	then go.home-3.PST.OBV	$\mathsf{W}\mathsf{p}_1$	$[\mathsf{p}_1]_{s_3} = m$	$s_4 = \{\langle m, s\rangle\}$

In step (e) of Table 5, the Mi'gmaq intransitive verb, *enmie*-nipnn ('*she (O)* went home'), has obviative agreement so it is translated into PLA with p_1 as the subject of the verb. p_1 is interpreted as the second-to-rightmost individual of the input information state (s_3), i.e., m.

Thus this simple application of Dekker's PLA is able to produce the expected different meanings for verbs with proximate or obviative subject agreement.

5. Introducing a third individual creates ambiguity

In this section we present new data which will lead us to modify the system in section 4. In the preceding section, there were only two individuals. This new data shows that introducing a third individual ('Anna') creates ambiguity as to who the third individual is scratching in (19a) and (19b).[7,8] The output information state of each clause as predicted by the analysis in section 4 is given to the right of each line.

(19) **Susan** gejgapa'l-a-t-l *Mali-al*.
Susan.PROX scratch-DIR-3-OBV *Mali*-OBV
'**Susan (P)** scratches *Mali (O)*.' $\{\langle m, s\rangle\}$

a. **Anna** gejgapa'l-a-t-l.
Anna.PROX scratch-DIR-3-OBV
'**Anna (P)** scratches *her (O)*.' $\{\langle m, s, a\rangle\}$

b. *Anna-l* gejgapal-Ø-t-l.
Anna-OBV scratch-INV-3-OBV
'*Anna (O)* scratches **her (P)**.' $\{\langle m, a, s\rangle\}$

In (19a) and (19b) the object of 'scratch' could be either 'Susan' or 'Mali'.

The analysis in section 4 predicts that in (19a) when a ('Anna') is added to the end of the list, the obviative agreement, p_1 is expected to pick out s ('Susan') unambiguously.

[7] We use a different tense here (present) than in (15) however the ambiguity is also preserved in the past.

[8] The ambiguity goes away if *elg* 'too/also' is added. Though this shows that the particle *elg* targets the VP in Mi'gmaq, like it does in English.

(i) *Anna-l* elg gejgapal-Ø-t-l.
Anna-OBV too scratch-INV-3-OBV
'*Anna (O)* scratches **her (P)**, too.' (Anna scratches Mali.)

However, this is not the case: 'Mali' is also an available antecedent. To capture this ambiguity in the previous analysis, we could posit that the obviative agreement is translated as any index that is not 0, so p_1 or p_2 can pick out the obviative argument. However, the data in (19b) creates a complication for this: when *a* is introduced as an obviative argument and added in the second to last position on the list, it is not clear how we could say that either p_0 or p_2 can pick out the proximate argument. In the next section, we explain how modifying the one-list system to a **two-list system** can better capture this ambiguity.

5.1 Two list system analysis

To capture this new data, we develop a two-list version of PLA, which keeps track of proximate and obviative individuals in separate lists, which we call Two-List Predicate Logic with Anaphora (TLPLA). The idea of using two lists for storing individuals comes from Bittner's (2001) Update with Centering system. We adopt the notation from her system to identify the two lists, where $\top$ means proximate and $\bot$ means obviative.

A simple information state from this system can be seen in (20). The proximate individuals are in the list on the left ($\top$), and the obviative individuals are in the list on the right ($\bot$). Individuals on the list are identified by a pronoun term, p, with a superscript $\top$ or $\bot$ to indicate the proximate or obviative list, and a subscript index, e.g., 0, which indicates the position of the individual on the list. As with the one-list system, 0 refers to the rightmost position of a list, 1 refers to the second-to-rightmost position of a list, etc. Thus, in example (20), $\mathsf{p}_0^\top$ refers to *b* and $\mathsf{p}_1^\bot$ refers to *c*.

(20) **A sample two list information state**

$$s = \{\langle \; \langle a, \; b\rangle, \; \langle c \; \; d\rangle \; \rangle\}$$

$$\uparrow \quad \uparrow \quad \uparrow \quad \uparrow$$

$$\mathsf{p}_1^\top \quad \mathsf{p}_0^\top \quad \mathsf{p}_1^\bot \quad \mathsf{p}_0^\bot$$

(21)
a. a-PROX: $\exists^\top \mathsf{x}(\mathsf{x} = \mathsf{a})$
b. b-OBV: $\exists^\bot \mathsf{x}(\mathsf{x} = \mathsf{b})$
c. PROX: $\mathsf{p}_\mathsf{i}^\top$
d. OBV: $\mathsf{p}_\mathsf{i}^\bot$
e. DIR: $\mathsf{V}\mathsf{p}_\mathsf{i}^\top \mathsf{p}_\mathsf{i}^\bot$
f. INV: $\mathsf{V}\mathsf{p}_\mathsf{i}^\bot \mathsf{p}_\mathsf{i}^\top$

When a noun, *a*, in Mi'gmaq is marked with proximate, it is translated as in (21a). This has the effect of adding *a* to the proximate ($\top$) list. When a noun, *b*, is marked with obviative, it is translated as in (21b), which adds *b* to the obviative ($\bot$) list. Proximate agreement on a verb is translated as a $\top$-pronoun term, as in (21c), and obviative agreement is translated as a $\bot$-pronoun term as in (21d). Then, direct and inverse marked verbs are translated as in (21e) and (21f), respectively. In addition to adding an individual to its designated list, a noun marked with proximate or obviative morphology has the effect of shifting all of the individuals that were on the list that the new individual is being added to from that list to the other list. This is meant to capture the ambiguity in referring to less recent individuals and the lack of ambiguity in referring to the newest individual. This can be schematized as in (22) for a proximate marked noun and as in (23) for an obviative marked noun.

(22) **PROX marker**

$$s_n = \{\langle\ \langle b,\ c\rangle,\ \langle d,\ e\rangle\ \rangle\} \overset{a-\text{PROX}}{\rightarrow} s_{n+1} = \{\langle\ \langle a\rangle,\ \langle d\ \ e,\ b,\ c\rangle\ \rangle\}$$

(23) **OBV marker**

$$s_n = \{\langle\ \langle b,\ c\rangle,\ \langle d,\ e\rangle\ \rangle\} \overset{a-\text{OBV}}{\rightarrow} s_{n+1} = \{\langle\ \langle b\ \ c,\ d,\ e\rangle,\ \langle a\rangle\ \rangle\}$$

In (22), *a*-PROX adds the individual *a* to the proximate list, but it also shift *b* and *c*, which were on the input proximate list, to the obviative list. Similarly, in (23), *a*-OBV adds *a* to the obviative list and shifts *d* and *e* from the obviative list to the proximate list.

5.2 Accounting for data in (15)

The new system can still account for the data that the one-list system captures. (15) is translated into TLPLA as in (24-26). This translation looks like the first translation except $\top$ replaces p and $\bot$ replaces o.

(24) (15) $\rightsquigarrow \exists^{\top}\mathsf{x}(\mathsf{x}=\mathsf{s}) \wedge \exists^{\bot}\mathsf{y}(\mathsf{y}=\mathsf{m}) \wedge \mathsf{S}\mathsf{p}_0^{\top}\mathsf{p}_0^{\bot}$

(25) (15a) $\rightsquigarrow \mathsf{W}\mathsf{p}_0^{\top}$

(26) (15b) $\rightsquigarrow \mathsf{W}\mathsf{p}_0^{\bot}$

The interpretation of (24) can be seen in Table 6.

Table 6: TLPLA Interpretation of (15)

	Gloss	PLA	Pro. Intp.	Output State
a.				$s_0 = \{\langle\langle\rangle,\langle\rangle\rangle\}$
b.	Susan.PROX	$\exists^{\top}\mathsf{x}(\mathsf{x}=\mathsf{s})$		$s_1 = \{\langle\langle s\rangle,\langle\rangle\rangle\}$
c.	Mali-OBV	$\exists^{\bot}\mathsf{y}(\mathsf{y}=\mathsf{m})$		$s_2 = \{\langle\langle s\rangle,\langle m\rangle\rangle\}$
d.	scratch-DIR-PST.3-OBV	$\mathsf{S}\mathsf{p}_0^{\top}\mathsf{p}_0^{\bot}$	$[\mathsf{p}_0^{\top}]_{s_2} = s$, $[\mathsf{p}_0^{\bot}]_{s_2} = m$	$s_3 = \{\langle\langle s\rangle,\langle m\rangle\rangle\}$

The initial information state in (a) is a set containing a list that consists of two empty lists. In (b), $\exists^{\top}\mathsf{x}(\mathsf{x}=\mathsf{s})$ adds *s* to the proximate list. In (c), $\exists^{\bot}\mathsf{y}(\mathsf{y}=\mathsf{m})$ adds *m* to the obviative list. In (d), $\mathsf{p}_0^{\top}$ is interpreted as the rightmost individual of the proximate list of the input state, namely *s*, and $\mathsf{p}_0^{\bot}$ is interpreted as the rightmost individual of the obviative list of the input state, namely *m*.

The interpretation of (15a) can be seen in Table 7.

Table 7: TLPLA Interpretation of (15a)

	Gloss	PLA	Pro. Intp.	Output State
e.	go.home-3.PST.PROX	$\mathsf{Wp}_0^\top$	$[\mathsf{p}_0^\top]_{s_3} = s$	$s_4 = \{\langle\langle s\rangle, \langle m\rangle\rangle\}$

In (e), the proximate agreement on the verb is translated with $\mathsf{p}_0^\top$ as the verb's argument. $\mathsf{p}_0^\top$ is interpreted as the rightmost individual of the proximate list of the input information state (s_3 from Table 6), namely s.

The interpretation of (15b) can be seen in Table 8.

Table 8: TLPLA Interpretation of (15b)

	Gloss	PLA	Pro. Intp.	Output State
e.	go.home-3.PST.OBV	$\mathsf{Wp}_0^\perp$	$[\mathsf{p}_0^\perp]_{s_3} = m$	$s_4 = \{\langle\langle s\rangle, \langle m\rangle\rangle\}$

In (e) of Table 8, the obviative agreement on the verb is translated with $\mathsf{p}_0^\perp$ as the verb's argument. $\mathsf{p}_0^\perp$ is interpreted as the rightmost individual of the obviative list of the input information state (s_3 from Table 6), namely m.

Thus, TLPLA can still account for the initial data.

5.3 Accounting for ambiguity in (19)

(19) can be translated into TLPLA as in (27). The two meanings of (19a) can be translated as in (28), and the two meanings of (19b) can be translated as in (29). Notice that the different meanings are borne out in the index on the pronoun terms, which works the same as it does in English. The index on the obviative term in (28) can be 0 or 1, and the index on the proximate term in (29) can also be 0 or 1.

(27) (19) $\rightsquigarrow \exists^\top \mathsf{x}(\mathsf{x} = \mathsf{s}) \wedge \exists^\perp \mathsf{y}(\mathsf{y} = \mathsf{m}) \wedge \mathsf{Sp}_0^\top \mathsf{p}_0^\perp$

(28) (19a) $\rightsquigarrow \exists^\top \mathsf{x}(\mathsf{x} = \mathsf{a}) \wedge \mathsf{Sp}_0^\top \mathsf{p}_0^\perp$
(19a) $\rightsquigarrow \exists^\top \mathsf{x}(\mathsf{x} = \mathsf{a}) \wedge \mathsf{Sp}_0^\top \mathsf{p}_1^\perp$

(29) (19b) $\rightsquigarrow \exists^\perp \mathsf{x}(\mathsf{x} = \mathsf{a}) \wedge \mathsf{Sp}_0^\perp \mathsf{p}_0^\top$
(19b) $\rightsquigarrow \exists^\perp \mathsf{x}(\mathsf{x} = \mathsf{a}) \wedge \mathsf{Sp}_0^\perp \mathsf{p}_1^\top$

(19) is the same as (15) above. The interpretation of this sentence is repeated in Table 9.

Table 9: TLPLA Interpretation of (19)

	Gloss	PLA	Pro. Intp.	Output State
a.				$s_0 = \{\langle\langle\rangle, \langle\rangle\rangle\}$
b.	Susan.PROX	$\exists \mathsf{x}(\mathsf{x} = \mathsf{s})$		$s_1 = \{\langle\langle s\rangle, \langle\rangle\rangle\}$
c.	Mali-OBV	$\exists^\perp \mathsf{y}(\mathsf{y} = \mathsf{m})$		$s_2 = \{\langle\langle s\rangle, \langle m\rangle\rangle\}$
d.	scratch-DIR-PST.3-OBV	$\mathsf{Sp}_0^\top \mathsf{p}_0^\perp$	$[\mathsf{p}_0^\top]_{s_2} = s$, $[\mathsf{p}_0^\perp]_{s_2} = m$	$s_3 = \{\langle\langle s\rangle, \langle m\rangle\rangle\}$

The interpretation of (19a) can be seen in Table 10.

Table 10: TLPLA Interpretation of (19a)

	Gloss	PLA	Pro. Intp.	Output State
e.	Anna.PROX	$\exists^{\top}\mathsf{x}(\mathsf{x}=\mathsf{a})$		$s_4 = \{\langle\langle a\rangle, \langle m,s\rangle\rangle\}$
f1.	scratch-DIR-3-OBV	$\mathsf{S}\mathsf{p}_0^{\top}\mathsf{p}_0^{\perp}$	$[\mathsf{p}_0^{\top}]_{s_4} = a$, $[\mathsf{p}_0^{\perp}]_{s_4} = s$	$s_5 = \{\langle\langle a\rangle, \langle m,s\rangle\rangle\}$
f2.	scratch-DIR-3-OBV	$\mathsf{S}\mathsf{p}_0^{\top}\mathsf{p}_1^{\perp}$	$[\mathsf{p}_0^{\top}]_{s_4} = a$, $[\mathsf{p}_1^{\perp}]_{s_4} = m$	$s_5 = \{\langle\langle a\rangle, \langle m,s\rangle\rangle\}$

In step (e) of Table 10, the proximate list is added to the obviative list from input state, s_1, to form the obviative list of the output state, s_2, and a becomes the only member of the proximate list of the output state. In (f1), the subject ($\mathsf{p}_0^{\top}$) is interpreted as a. The object ($\mathsf{p}_0^{\perp}$) is interpreted as s, the rightmost individual of the obviative list. In (f2), the subject is the same, but the object ($\mathsf{p}_1^{\perp}$) is interpreted as m, the second-to-rightmost individual of the obviative list. The two available translation of the obviative pronoun come from there being two individuals on the obviative list.

The interpretation of (19b) can be seen in Table 11.

Table 11: TLPLA Interpretation of (19b)

	Gloss	PLA	Pro. Intp.	Output State
e.	Anna-OBV	$\exists^{\perp}\mathsf{x}(\mathsf{x}=\mathsf{a})$		$s_4 = \{\langle\langle s,m\rangle, \langle a\rangle\rangle\}$
f1.	scratch-INV-3-OBV	$\mathsf{S}\mathsf{p}_0^{\perp}\mathsf{p}_0^{\top}$	$[\mathsf{p}_0^{\perp}]_{s_4} = a$, $[\mathsf{p}_0^{\top}]_{s_4} = m$	$s_5 = \{\langle\langle s,m\rangle, \langle a\rangle\rangle\}$
f2.	scratch-INV-3-OBV	$\mathsf{S}\mathsf{p}_0^{\perp}\mathsf{p}_1^{\top}$	$[\mathsf{p}_0^{\perp}]_{s_4} = a$, $[\mathsf{p}_1^{\top}]_{s_4} = s$	$s_5 = \{\langle\langle s,m\rangle, \langle a\rangle\rangle\}$

In step (e) of Table 11, the obviative list is added to the obviative list from input state, s_1, to form the proximate list of the output state, s_2, and a becomes the only member of the obviative list of the output state. In (f1), the subject ($\mathsf{p}_0^{\perp}$) is interpreted as a. The object ($\mathsf{p}_0^{\top}$) is interpreted as m, the rightmost individual of the proximate list. In (f2), the subject is the same, but the object ($\mathsf{p}_1^{\top}$) is interpreted as s, the second-to-rightmost individual of the proximate list. The two available translation of the proximate pronoun come from there being two individuals on the proximate list.

This way the ambiguity in Mi'gmaq is represented in the same way as in English where translating the pronoun term with different indices generates the different meanings.

6. Conclusion

In this paper we presented basic data on obviation patterns in Algonquian, using Mi'gmaq to illustrate the basic pattern. We discussed two PLA analyses for how to account for this data. The first account uses Dekker's (1994) one-list system whereas the second account modifies his system to two lists to separate proximate- and obviative-marked individuals.

New fieldwork on Mi'gmaq shows that an ambiguity arises when a third individual has been introduced in a discourse. This makes the two-list system better equipped to account for the new data because it captures the ambiguity.

This account only captures the data that involves singular, third person arguments as Dekker's (1994) PLA does not include first, second person, or plural arguments. Incorporating plural arguments into the system will be left to future work. As discussed above, though proximate and obviative individuals can be distinguished when a third person argument appears in a sentence with a first or second person argument, this is rare.

The phenomenon of obviation makes for an interesting case study on how languages keep track of individuals in a discourse. On a broader point, data from understudied languages like Mi'gmaq can inform us on much studied topics like discourse anaphora.

Appendix. Two List Predicate Logic with Anaphora

- Adapted from Dekker (1994) with additions and modifications indicated with a $*$

DEFINITION 1.1 (Basic Expressions of PLA)

1. $C = \{\mathsf{a}, \mathsf{b}, \ldots \mathsf{n}\}$ (entity) constants
2. $V = \{\mathsf{x}, \mathsf{y}, \mathsf{z}, \mathsf{x}', \mathsf{y}', \mathsf{z}', \ldots\}$ (entity) variables

$*$3. $A = \{\mathsf{p}_\mathsf{i}^\top \mid \mathsf{i} \in \mathscr{N}\}$ (entity) pronouns of $\top$ list

$*$4. $B = \{\mathsf{p}_\mathsf{i}^\perp \mid \mathsf{i} \in \mathscr{N}\}$ (entity) pronouns of $\perp$ list

$*$5. $T = C \cup V \cup A \cup B$ (entity) terms

6. $R^n = \{\mathsf{A}^1, \ldots, \mathsf{A}^n, \mathsf{B}^1, \ldots, \mathsf{Z}^n\}$ n-ary predicates

DEFINITION 1.2 (Syntax of PLA) The set L of PLA formulas is the smallest set such that:

1. if $\mathsf{t}_1, \ldots, \mathsf{t}_\mathsf{n} \in T$ and $\mathsf{R} \in R^n$, then $\mathsf{R}\mathsf{t}_1 \ldots \mathsf{t}_\mathsf{n} \in L$
2. if $\mathsf{t}_1, \mathsf{t}_2 \in T$, then $\mathsf{t}_1 = \mathsf{t}_2 \in L$
3. if $\phi \in L$, then $\neg\phi \in L$

$*$4. if $\phi \in L$ and $x \in V$, then $\exists^\top \mathsf{x}\phi \in L$

$*$5. if $\phi \in L$ and $x \in V$, then $\exists^\perp \mathsf{x}\phi \in L$

6. if $\phi, \psi \in L$, then $(\phi \wedge \psi) \in L$

DEFINITION 2.1 (Information States)

$*$1. $S^n = \mathscr{P}(D^a \times D^b)$ is the set of information states about n subjects, where a is the number of subjects in the $\top$ list, b is the number of subjects in the $\perp$ list, and $a + b = n$

2. $S = \cup_{n \in \mathscr{N}} S^n$ is the set of information states

*3. For a state $s \in S^n$ and case $e = \langle\langle d_1^{\top}, \ldots, d_a^{\top}\rangle, \langle d_1^{\perp}, \ldots, d_b^{\perp}\rangle\rangle \in s$, where $a + b = n$ and $0 < j \leq a$, $d_j^{\top}$, also written as $l_j^{\top}$, is a possible value for the j-th subject of top list, $l^{\top}$, where $e = \langle l^{\top}, l^{\perp}\rangle$

*4. For a state $s \in S^n$ and case $e = \langle\langle d_1^{\top}, \ldots, d_a^{\top}\rangle, \langle d_1^{\perp}, \ldots, d_b^{\perp}\rangle\rangle \in s$, where $a + b = n$ and $0 < k \leq b$, $d_k^{\perp}$, also written as $l_k^{\perp}$, is a possible value for the k-th subject of bottom list, $l^{\perp}$, where $e = \langle l^{\top}, l^{\perp}\rangle$

*5. $s_0 = \{\langle\langle\rangle, \langle\rangle\rangle\}$ is the initial state of information: $D^0 \times D^0$

*6. $\top^n = D^a \times D^b$ is the minimal state of information about n subjects, where $a + b = n$

*7. $\{e\}$ for any $e = \langle\langle d_1^{\top}, \ldots, d_a^{\top}\rangle, \langle d_1^{\perp}, \ldots, d_b^{\perp}\rangle\rangle \in D^a \times D^b$ is the maximal state of information about n subjects, where $a + b = n$

8. $\perp^n = \{\}$ is the absurd information state about n subjects, where $n > 0$

DEFINITION 2.2 (Notational Convention)

*1. If list $l \in D^n$ and list $l' \in D^m$, then $l \cdot l' = \langle l_1, \ldots l_n, l'_1, \ldots, l'_m\rangle \in D^{n+m}$

*2. A case $e' = \langle l^{\top\prime}, l^{\perp\prime}\rangle$ is an extension of some case $e = \langle l^{\top}, l^{\perp}\rangle$, written $e \leq e'$, iff $\exists l:\ l^{\top} \cdot l = l^{\top\prime}$ & $\exists l'':\ l^{\perp} \cdot l'' = l^{\perp\prime}$, or $l^{\top} \cdot l^{\perp} = l^{\top\prime}$, or $l^{\perp} \cdot l^{\top} = l^{\perp\prime}$

*3. For $s \in S^n (i \in D^n)$, $N_s = n (= a + b)$, $N_a = a$, $N_b = b$, the number of subjects of s (i)

DEFINITION 2.3 (Information Update)

1. State s' is an update of state $s, s \leq s'$, iff $N_s \leq N_{s'}$, and $\forall e' \in s'\ \exists e \in s : e \leq e'$

DEFINITION 3.1 (Interpretation of Terms)

1. $[\mathsf{c}]_{\mathscr{M},s,e,g} = F(\mathsf{c})$ for all constants c

2. $[\mathsf{x}]_{\mathscr{M},s,e,g} = g(\mathsf{x})$ for all variables x

*3. $[p_i^{\top}]_{\mathscr{M},s,e,g} = l_{N_a - i}^{\top}$ for all pronouns $p_i^{\top}$ and e and $l^{\top}$ and s such that $l^{\top} \in e$ and $e \in s$ and $N_a > i$

*4. $[p_i^{\perp}]_{\mathscr{M},s,e,g} = l_{N_b - i}^{\perp}$ for all pronouns $p_i^{\perp}$ and e and $l^{\perp}$ and s such that $l^{\perp} \in e$ and $e \in s$ and $N_b > i$

DEFINITION 3.2 (Semantics of PLA)

1. $s[\![\mathsf{R}\mathsf{t}_1 \dots \mathsf{t}_\mathsf{n}]\!]_{\mathscr{M},g} = \{e \in s \mid \langle [\mathsf{t}_1]_{\mathscr{M},s,e,g}, \dots, [\mathsf{t}_\mathsf{n}]_{\mathscr{M},s,e,g} \rangle \in F(\mathsf{R})\}$ (if $N_s > I_{\mathsf{t}_1,\dots,\mathsf{t}_\mathsf{n}}$)
2. $s[\![\mathsf{t}_1 = \mathsf{t}_2]\!]_{\mathscr{M},g} = \{e \in s \mid [\mathsf{t}_1]_{\mathscr{M},s,e,g} = [\mathsf{t}_2]_{\mathscr{M},s,e,g}\}$
3. $s[\![\neg\phi]\!]_{\mathscr{M},g} = \{e \in s \mid \neg\exists e' : e \leq e' \ \& \ e' \in s[\![\phi]\!]_{\mathscr{M},g}\}$

$*$4. $s[\![\exists^{\top} x\phi]\!]_{\mathscr{M},g} = \{\langle\langle\rangle \cdot d, l^{\perp} \cdot l^{\top}\rangle \mid d \in D \ \& \ \langle l^{\top}, l^{\perp}\rangle \in s[\![\phi]\!]_{\mathscr{M},g[x/d]}\}$

$*$5. $s[\![\exists^{\perp} x\phi]\!]_{\mathscr{M},g} = \{\langle l^{\top} \cdot l^{\perp}, \langle\rangle \cdot d\rangle \mid d \in D \ \& \ \langle l^{\top}, l^{\perp}\rangle \in s[\![\phi]\!]_{\mathscr{M},g[x/d]}\}$

6. $s[\![\phi \wedge \psi]\!]_{\mathscr{M},g} = s[\![\phi]\!]_{\mathscr{M},g}[\![\psi]\!]_{\mathscr{M},g}$

DEFINITION 4.1 (Support and Entailment)

a. s supports ϕ wrt $\mathscr{M}$ and g, $s \vDash_{\mathscr{M},g} \phi$ iff $\forall e \in s : \exists e' : e \leq e' \ \& \ e' \in s[\![\phi]\!]_{\mathscr{M},g}$

b. $\phi_1, \dots, \phi_n$ entail $\psi, \phi_1, \dots, \phi_n \vDash \psi$ iff $\forall \mathscr{M}, g \ \forall s \in S : s[\![\phi_1]\!]_{\mathscr{M},g} \dots [\![\phi_n]\!]_{\mathscr{M},g} \vDash_{\mathscr{M},g} \psi$ (if defined)

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