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SENTENCE PROCESSING IN A "NONCONFIGURATIONAL" LANGUAGE

VOLUME I

By

Kiel Tobias Christianson

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ABSTRACT

SENTENCE PROCESSING IN A "NONCONFIGURATIONAL" LANGUAGE

By

Kiel Tobias Christianson

The three experiments in human sentence processing reported here were conducted in the Algonquian language of Odawa. They represent the first psycholinguistic experiments to be conducted in an indigenous North American language. This dissertation argues that Odawa is not in fact a "nonconfigurational" language by adopting and providing supporting Odawa evidence for a configurational account of Algonquian syntax; however, the syntactic properties of the language include several phenomena not found in those languages in which psycholinguists have traditionally focused their work. These phenomena include a verbal "direction" system (direct/inverse), an obviation system (proximate/obviative), very free word order, frequent *pro*-drop of all NP arguments, and the lack of an indigenous writing system.

The broad goals of this research were (a) to determine the extent to which psycholinguistic investigation of "exotic" languages like Odawa could inform theories of sentence processing, (b) the extent to which psycholinguistic investigation might illuminate issues in a language's syntax, and (c) the extent to which psycholinguistic investigation is feasible in an endangered, geographically isolated language.

Experiment 1 investigated sentence production in Odawa. Its goals were two-fold. First, since Odawa is not a written language, this production experiment was designed to elicit some basic frequency statistics with respect to verb form and word order. Second,

the experimental design allowed for an investigation of the effect of conceptual accessibility on word order, topicality, and syntax. The results suggested that conceptual accessibility affects the syntactic planning of utterances. Experiment 2 investigated sentence comprehension. It was designed to elicit both on-line measures and an off-line measure in order to assess the effects of word order, verb form, and the distance between thematic assigners and assignees on sentence comprehension and interpretation. The results were broadly consistent with a configurational account of Odawa syntax. Furthermore, sentences in which thematic assigners and assignees were in close proximity were found in most word orders to be more difficult to comprehend than sentences in which they were separated by one intervening adverb, but not much more difficult than sentences in which they were separated by two adverbs. This pattern of results was interpreted as evidence for a "good enough" processing strategy based on a linear heuristic, which allowed participants to derive relatively accurate interpretations without undertaking complex syntactic revision. Experiment 3 investigated the interpretation of *pro*s. It was designed to investigate how discourse factors and animacy interact when participants were asked to comprehend sentences lacking external context. The results suggested that when context is lacking, Odawa speakers posit features for null NPs based on the features of the overt NP, as a sort of sentence-internal context.

Despite the difficulties associated with conducting experiments in "field psycholinguistics," this dissertation serves as an example of how such research can be carried out on endangered languages before they disappear.

To my family

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According to tradition, the first acknowledgement made is to one's advisor. In my case, however, it is not simply tradition that compels me to extend an almost inexpressible gratitude to Fernanda Ferreira. Without her belief that the things in which I was interested were indeed worthy of interest, I do not know when, where, or how my doctoral pursuits would have ended. Without her support, this work would most certainly not have been completed. I could not have wished for a better advisor.

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KEY TO ABBREVIATIONS

1>2	first person subject/agent, second person object/patient
2>1	second person subject/agent, first person object/patient
1>3	first person subject/agent, third person object/patient
2>3	second person subject/agent, third person object/patient
3>1	third person subject/agent, first person object/patient
3>2	third person subject/agent, second person object/patient
3>3'	third person proximate subject/agent, third person obviative object/patient
3'>3	third person obviative subject/agent, third person proximate object/patient
Conj	conjunct verb order/morphology
Dir	direct verb form
Inv	inverse verb form
Loc	locative marker
NP	noun phrase
Obv	obviative marker
PAST	past tense
Pl	plural
PRESENT	present tense
Prox	proximate
Sing	singular
VAI	animate intransitive verb
VII	inanimate intransitive verb

VTA	animate transitive verb
VTI	inanimate transitive verb

Chapter 1

Introduction to a "nonconfigurational" language

1.0 Introduction

Almost invariably, when relating portions of this dissertation research to both linguists and psycholinguists unfamiliar with Algonquian languages, I am asked, "How do Odawa speakers understand each other?" Although this question is posed facetiously in one sense, it is a perfectly valid question in another sense, which is the focus of this research: What processing mechanisms must be at work to allow the real-time comprehension and production of a "nonconfigurational" language such as Odawa? Specifically, what does the human language processor do in order to facilitate real-time communication when word order is extremely flexible, case-marking is absent (or largely ambiguous), *pro*-drop is pervasive, and both nominal and verbal agreement morphology is crucial in establishing syntactic and thematic relations?

Ultimately, the goal of all psycholinguistic research is to uncover and describe systems operating in the human brain that allow all normally developed humans to produce and comprehend language. If we wish to claim that these systems are innate to the species and constant across all human brains, we should endeavor to test current theories and models of how these systems work in the context of as many different languages as possible. The rapidly shrinking number of languages in the world poses a serious threat to this undertaking.

My goal in this dissertation is to begin investigating potential influences on the processing of Odawa sentences. As far as I know, this is the first such attempt to examine sentence processing—either comprehension or production—in an indigenous North

American language. Since Odawa is a gravely endangered language (with no more than 3,000-4,000 speakers scattered around the northern Great Lakes region), this could end up being the lone study on processing in Odawa. If the indigenous languages of North America continue toward extinction at their present pace, and if psycholinguists continue to focus their work primarily on Indo-European languages, the present study may be one of only a handful that will ever be done on the endangered languages of the Americas.

Psycholinguists have also generally devoted a great deal of time and attention to "on-line" measures of comprehension, e.g., eye-movements and button-press latencies. Researchers have shown considerably less interest in examining the actual interpretations of sentences, especially the interpretations of mono-clausal sentences of the type used in Experiments 2 and 3 below. Yet we know relatively little about how speakers of *any* language go about processing—or interpreting—even the most basic simple sentences (Ferreira, in press). This lack of interest may prove detrimental to our overall understanding of the language processing systems, as recent experimental results (Christianson, Hollingworth, Halliwell, & Ferreira, 2001; Ferreira, in press; Ferreira, Ferraro, & Bailey, 2002; and Sanford, 2002) suggest that hearers and readers can arrive at interpretations that are inconsistent with the syntactic form of an input string.

This research has three primary purposes. First, there is a methodological question as to the feasibility of conducting experimental field research on "exotic," endangered languages. The experiments reported here show that "field psycholinguistics" is indeed feasible. Second, I hope to show that this type of research is not only feasible, but also worthwhile. I believe that data from such languages can be useful in examining certain claims and predictions of current production and comprehension theories in the context of a "nonconfigurational" language like Odawa. And finally, I believe that processing data can be recruited as evidence for or against competing syntactic accounts of languages like Odawa, whose basic syntactic properties are disputed by linguists.

The specific issues dealt with in the three experiments reported here are: (1) establishing frequency data in Odawa (Experiment 1); (2) incrementality in language production (Experiment 1); (3) the extent to which both automatic syntactic processes and strictly non-linguistic mechanisms—specifically frequency information, memory limitations, computational burden, and animacy—affect the parse and interpretation of simple Odawa sentences (Experiments 2 and 3); and (4) the possibility that some types of heuristic-based processing are employed by speakers/hearers in certain contexts to arrive at a plausible interpretation of a given input string (Experiments 2 and 3).

The organization of this dissertation is as follows: In the remainder of Chapter 1, I describe Odawa and lay out the assumptions I make regarding the syntax of the language. I also outline the issues in human language production and comprehension to which Odawa data are particularly pertinent. Chapter 2 presents the dual motivations, predictions, methodology, and results of Experiment 1, which deals with sentence production. Experiment 1 also establishes important frequency data required to interpret the results of subsequent comprehension experiments. Chapter 3 presents the issues, predictions, methodology, and results of Experiment 2, which deals with sentence comprehension and syntactic parsing. Chapter 4 presents the issues, predictions, methodology, and results of Experiment 3, which deals with sentence comprehension and the application of heuristics in the interpretive process. In Chapter 5, I summarize the cumulative results, attempt to pull together the common threads, and propose future research that should be carried out either in Odawa or in similar endangered languages before the opportunity to do so has vanished along with the speakers of these languages.

1.1.1 Why Odawa is interesting: Morphology and syntax

1.1.2 Language typology

Odawa (also known as Ottawa or, along with the languages most closely related to it, Nishnaabemwin) is an Algonquian language spoken in the Great Lakes region of North America. Odawa is a part of a much more wide-spread grouping of languages, spoken from central Canada south to Montana and east to northern Michigan and southern Ontario, often referred to as Ojibwa (Ojibwe) or Anishinaabemowin. Odawa is sometimes designated as a dialect of Ojibwa (Valentine, 2001). The major concentrations of Odawa speakers today—both native and non-native speakers—are in the First Nation Reserve of Walpole Island in southern Ontario and the First Nation Reserves located on Manitoulin Island in northern Ontario. The largest of the Reserves on Manitoulin Island is Wikwemikong, whose population of full-time residents is approximately 4,000. According to Wikwemikong Band Council estimates, around half of those residents are still considered to be "fluent" speakers of Odawa, although some of these speakers may have learned it as a second language. The dissertation research reported here—both the linguistic fieldwork and the experimental sessions—took place almost exclusively in Wikwemikong with the aid of native Odawa speakers. In this way I hoped to avoid, as much as possible, complicated issues of dialectal variation, which can obtain even between Odawa speakers living just a few miles from each other in neighboring reserves, or members of different nations, whose dialects have more or less coalesced due to generations of living together on the same reserves.[1] Although the Roman alphabet has been adopted in recent years by Odawa language teachers (not without a bit of disagreement regarding spellings/representations), the language is traditionally oral.[2] The vast majority of native speakers do not read or write the language, which required that the stimuli for Experiments 2 and 3 below be auditory.

Odawa, like all Algonquian languages, possesses a complex morphology with respect to both nouns and verbs. Nouns inflect for grammatical gender (animate or inanimate), number (singular or plural), obviation status (proximate or obviative, see pp. 6-11), and may also inflect for agreement with a possessor in genitive constructions, and location (the rich derivational nominal and verbal morphology are not discussed here).

Verbs agree with both subject and object in both number and obviation status, and also inflect for tense, negation, and a number of properties considered as aspectual. These agreement morphemes appear as both prefixes and suffixes. Verbs are traditionally divided into classes according to the semantic roles they assign: Animate Intransitive verbs (VAI) can take only grammatically animate subjects. Inanimate Intransitive verbs (VII) can take only grammatically inanimate subjects. Transitive Inanimate verbs (VTI) agree with animate subjects and inanimate objects. Transitive Animate verbs (VTA) agree with animate subjects and objects.[3] All verbs can appear in one of three "orders,"

[1] Several sessions collecting linguistic data took place in Traverse City, Michigan, with Kenny Pheasant. Mr. Pheasant is originally from Wikwemikong, and his sister, Genevieve Peltier, served as my primary source of information and assistance in Wikwemikong. Other key sources of information were Helen Roy and her brother Alex Peltier. Although Kenny and Genevieve sometimes describe their "native language" (their family lineage is historically Potowatomi) as being slightly different from Helen and Alex's (whose family lineage is historically Odawa), years of contact with all four of them have revealed almost no noticeable dialectal differences.
[2] In transcribing Odawa here, I will generally use the informal Roman transcription, rather than phonetic transcription, since none of the theoretical assumptions or conclusions here hinge on phonetic or phonological characteristics of the language.
[3] The relative animacy of NPs in transitive clauses is one of the central issues of Experiment 3 (Chapter 4).

which differ in morphology and have distinct but overlapping distributions. The independent order appears mostly, but not exclusively, in independent clauses. The conjunct order appears mostly, but not exclusively, in subordinate and conjoined clauses. And the imperative order appears in imperative clauses. Both the Independent and Conjunct orders have their own arrays of tense and aspectual markers, creating what is known in the Algonquian literature as "modes" (e.g., LeSourd, submitted). Since the experiments detailed in this dissertation include only Independent clauses, I will not discuss the Conjunct or Imperative orders, except where such discussion is relevant to the syntactic issues at hand.

1.1.2 Direct and inverse verb forms

VTA verbs can occur in two distinct inflectional forms: direct and inverse. The direct form agrees in person and number with its subject and object, as does the inverse. The difference between the direct and inverse lies in the so-called "direction marker" or "theme sign" on the verb and its relation to the obviation marker on the verb, which corresponds with an obviation oarker on one of the two NP arguments. The difference is illustrated in examples (1.1-1.2).

(1.1) Direct vs. inverse morphology: two third persons

a. mooz gii-digishkow-aa-n niniw-an

moose 3.PAST-kick-**DIRECT**(Dir).3>3'-Obv man-Obv[4]

'A/The moose kicked a/the man'

b. moozw-an gii-digishkow-igoo-n nini

[4] Dir=direct verb form; Inv=inverse verb form; Obv=obviative marker; 3=third person; PAST=past tense; 3>3'=third person proximate subject, third person obviative object; 3'>3=third person obviative subject, third person proximate object

moose-Obv 3.PAST-kick-**INVERSE**(Inv).3'>3-Obv man

'A/The moose kicked a/the man'

(1.2) Direct vs. inverse morphology: mixed person (adapted from Valentine, 2001, pp. 270-271)[5]

a. g-waabam-Ø 'You see me'

2.Sing.PRESENT-see-DIRECT.2>1

b. g-waabm-in 'I see you'

2.Sing.PRESENT-see-INVERSE.1>2

c. g-waabm-aa 'You see ANIMATE SINGULAR'

2.Sing.PRESENT-see-DIRECT.2>3

d. n-waabm-aa 'I see ANIMATE SINGULAR'

1.Sing.PRESENT-see-DIRECT.1>3

e. g-waabm-ig 'ANIMATE SINGULAR sees you'

2.Sing.PRESENT-see-INVERSE.3>2

f. n-waabm-ig 'ANIMATE SINGULAR sees me'

1.Sing.PRESENT-see-INVERSE.3>1

The examples in (1.1) illustrate that whereas the subject and thematic agent is unmarked (proximate) and the object and thematic patient is marked (obviative) in the direct, the situation is reversed in the inverse, where the agent is marked (obviative) and the patient is unmarked (proximate).

Although the obviation system of Algonquian languages is not fully understood, the following generalizations can be made. First, as seen in the examples in (1.2) (and

[5] I limit description and discussion to singular forms.

described immediately below), in mixed person contexts when the subject and thematic experiencer outranks the object and thematic paitient in person (a, c, d), the direct must be used. When the object outranks the subject (b, e, f), however, the inverse must be used. The ranking of arguments in Odawa follows a broadly cross-linguistic pattern whereby "local" arguments (1st and 2nd person) outrank "non-local" arguments (usually just 3rd persons, but others have been proposed for certain languages) (Aissen, 1997, 2001; Christianson 2001a, b, in press). In Odawa, the local arguments are also ranked, such that 2nd persons outrank 1st persons (Christianson, 2001 a, b, in press; McGinnis, 1995; Valentine, 2001). This ranking is evidenced by the required use of the inverse form when there is a 1st person agent and a 2nd person patient. The term often used in the Optimality Theory (Prince & Smolensky, 1993) literature for this ranking of arguments is participant hierarchy (Aissen, 1997, 1999a, b, 2001). In the Algonquian literature it is also sometimes broadly referred to as a topicality hierarchy (Valentine, 2001) or as one part of the Algonquian Agency Scale (Rhodes, 1994). The complete hierarchy is shown in (1.3), and is given as a descriptive convenience only, with no claims as to its purpose or existence in any theoretical framework.

(1.3) *Participant Hierarchy for Odawa*

2nd > 1st > 3rd Proximate (3) > 3rd Obviative (3')

Second, when two 3rd persons are involved, the decision as to which will be proximate (signified as 3) and which obviative (signified as 3') depends on the relative "centrality" of each actor (cf. Richards, 2001), as determined by an apparently complex interaction of animacy, discourse, and thematic properties (cf. Aissen, 1997, 1999a, b, 2001; Christianson, 2001a, b, in press; see also Chapter 4). Certain linguists consider the direct-inverse (or "direction") system and/or obviation system as indicative of a split-ergative case marking system (Déchaine & Reinholtz, 1998), a possibility that will be discussed in Section 1.1.1.2.

As is standard practice in psycholinguistics, I will concentrate in the present sentence processing research on single clauses with Independent VTA verbs, specifically those in which two third persons occur. The reason for this is that it is extremely difficult to construct stimuli materials that effectively establish first or second person referents. Of particular interest, therefore, is the difference between direct and inverse verb forms with respect to obviation marking of full 3^{rd} person NP arguments.

1.1.3 Case and obviation

Unlike the situation in Indo-European languages sometimes termed "free word order" languages, in which studies of sentence processing have already been carried out (for example German, Russian, Polish), it is unclear whether Odawa contains morphological case marking. Some Algonquinists believe that the direction and obviation systems actually represent overt case marking. Some, most notably Déchaine and Reinholtz (1998), argue that the difference between the direct and inverse verb forms illustrated in (1.1) reflect overt case-licensing in Cree, which is an Algonquian language closely related to Odawa. Déchaine and Reinholtz analyze the direct form as a nominative/accusative case-assigning configuration, and the inverse as an ergative/absolutive case-assigning configuration. The basis for this argument is the fact that syntactic subjects of direct verbs as well as intransitive verbs are morphologically unmarked (proximate). Conversely, the subject of the inverse is marked (obviative), but the object is unmarked. Déchaine and Reinholtz consider this reminiscent of Dixon's observations on case marking in indigenous Australian languages (Dixon, 1994), which are more obviously analyzable as ergative or split-ergative systems.

A case-based analysis of the direct/inverse distinction has not been widely explored, however. Branigan and MacKenzie (2002) find case-driven movement to be inadequate to explain cross-clausal agreement (CCA) in Innu-aimûn, an Eastern Algonquian language. Instead, they posit that a formal feature connected to the obviation system described above is responsible for the necessary movement involved in CCA. This analysis is similar in several respects to that of Bruening (2001) for Maliseet-Passamaquoddy, another Eastern Algonquian language (see below for details). Bruening, however, points out that the formal obviation-related features that he posits do resemble case features in a number of ways. The difference is that the obviation features of Algonquian NPs in any transitive sentence are dependent for their values on the participant hierarchy rank(s) of the other NP(s) in the same sentence. Although theories of "dependent case" assignment have been proposed (e.g., Bobalijk, 1993; Harley, 1995; Marantz, 1991), there has not been a formal attempt to apply any of these analyses to direction and/or obviation in Algonquian.

More importantly for the present research, whether or not the direction system and/or obviation system reflects case-marking configurations has no real impact on the on-line parsing decisions of speakers. In any non-verb-initial sentence with one or two overt NPs, an Odawa listener must use the morphological marking on the verb and both NPs together to determine which NP is subject and which is object. This situation is different from the one in traditional case-marking systems, such as German, where a sentence-initial nominative NP can be unambiguously interpreted as the subject, and a sentence-initial accusative as object. (Dative marking in German is ambiguous, however, and appears to place a distinct burden on the parser; see Bader, Meng, and Bayer, 2000; Hopf, Bayer, Bader, & Meng, 1998).

1.1.4 Free word order

In Odawa, as in all Algonquian languages, a transitive sentence consisting of only two NPs and a verb can occur in any of the six logically possible orders, as shown in (1.4) in the direct form. The same flexibility holds in the inverse, as well. Shuffling the order around, according to all native speakers consulted for this study, does not necessitate altering prosody in any way. As far as is presently known, no prosodic cues correlate with the different word orders.[6]

(1.4) a. nini gii-jiim-aa-n kwew-an SVO

man 3.PAST-kiss-Dir.3-3'-Obv woman-Obv

'A/The man kissed a/the woman'

b. nini kwew-an gii-jiim-aa-n SOV

c. kwew-an nini gii-jiim-aa-n OSV

d. gii-jiim-aa-n kwew-an nini VOS

e. kwew-an gii-jiim-aa-n nini OVS

f. gii-jiim-aa-n nini kwew-an VSO

Putting off discussion of how this "freedom" of word order can be accounted for in a syntactic framework, I might simply note that certain restrictions in word order do arise in subordinate transitive clauses where both NPs are marked as obviative (see §1.1.6.1).

[6] This fact is reported by native speakers; however, I have begun research to determine if it is indeed accurate.

1.1.4.1 Adjuncts and free word order

"Free" ordering in Odawa is not limited to major constituents. Adverbial adjuncts, including temporal and locative adverbials, also exhibit freedom of placement in Odawa sentences. Although native speakers prefer such adverbials to occur at the peripheries of a clause (1.5), they are also acceptable in medial positions (1.6). The ordering of two adverbials is flexible, although it may be less so in sentence-medial positions.[7]

(1.5) a. **jiinaago** nini gii-jiim-aa-n kwew-an **mtig-ong**[8]

yesterday man 3.PAST-kiss-Dir.3-3'-Obv woman-Obv tree-Loc

'Yesterday a/the man kissed a/the woman **near the tree**'

b. **mtig-ong** nini gii-jiim-aa-n kwew-an **jiinaago**

c. **jiinaago mtigong** nini gii-jiim-aa-n kwew-an

d. **mtig-ong jiinaago** nini gii-jiim-aa-n kwew-an

e. nini gii-jiim-aa-n kwew-an **jiinaago mtig-ong**

f. nini gii-jiim-aa-n kwew-an **mtig-ong jiinaago**

---

[7] One native speaker voiced a preference for temporal adverbials to precede locative adverbials sentence-medially. She reported that the opposite ordering was not ungrammatical, simply uncommon. However, adverbials—especially multiple adverbials—occur sentence-medially so infrequently in general that it is hard to determine if this speaker was reacting to some syntactic restriction on such ordering or simply to the fact that she had rarely if ever before heard a sentence of the type in (1.6).

[8] Locative phrases in Odawa are generally formed by adding the suffix *–[i/o]ng* to an NP. The result is interpreted roughly as "near NP." It is still an open, and interesting, question to what extent the spatial properties of the NP and/or knowledge of the world bias interpretation. Native speakers seem to agree that, e.g., *dopawin-ing* 'table-Loc' is most likely understood as "on the table," secondarily as "under the table," and lest likely as "next to the table." Similarly, the nature of the other NPs and/or verb in a sentence might bias interpretation as well. For example, if describing the location of a robin as *mtig-ong* 'tree-Loc,' the most natural assumption is that the robin is in the tree. If describing a rock, however, the most natural assumption is that it is under the tree. A few Locative adverbials, such as *giidaake* 'on the hill' and *jiigibiik* 'on the beach,' are exceptions.

(1.6) a. nini **jiinaago** gii-jiim-aa-n kwew-an

man **yesterday** 3.PAST-kiss-Dir.3-3'-Obv woman-Obv

'Yesterday a/the man kissed a/the woman'

b. nini **mtig-ong** gii-jiim-aa-n kwew-an

man **tree-Loc** 3.PAST-kiss-Dir.3-3'-Obv woman-Obv

'A/the man kissed a/the woman near a/the tree'

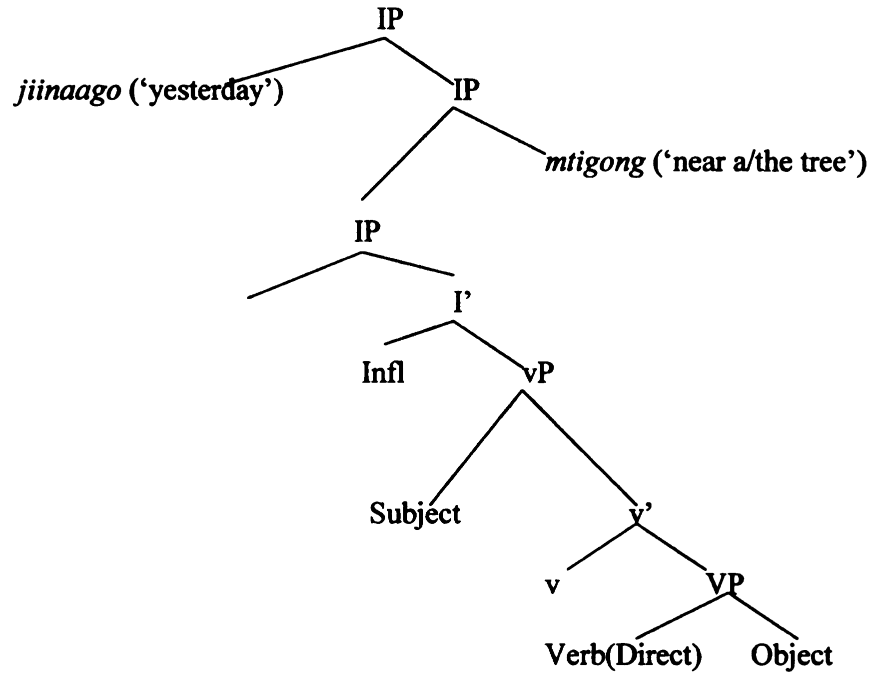
c. nini **jiinaago mtig-ong** gii-jiim-aa-n kwew-an

d. ?nini **mtig-ong jiinaago** gii-jiim-aa-n kwew-an

I will adopt Ernst's (2002) extensive analysis of the syntax of such adjuncts, as this analysis accounts for the Odawa data in (1.5-1.6) without having to rely on complex movements that would have to be posited under alternative accounts in which all adjunction is necessarily left-adjunction (e.g., Kayne, 1994). Ernst proposes that adjuncts map onto base structure in the positions in which they ultimately appear in the sentence. Whether they are left- or right-adjoined depends on a set of "Directionality Principles" that are determined by [+F] features (associated with functional heads) and [+C] features (associated with complements). Put most simply, adjuncts attaching above VP are unspecified for direction, and can thus adjoin either to the right or to the left. Whether a given adjunct attaches to the right or left depends in large part on its phonological weight relative to the rest of the sentence (Ernst, pp. 171-175). As such, adjuncts such as *jiinaago* ('yesterday') and *mtigong* ('near a/the tree') in (1.5-1.6), which I take to be adjoined higher than VP in Odawa (just as they are—or can be—in English), can be represented schematically as in (1.7) for Odawa (adapted from Ernst's (4.43), p. 168) (see

§1.1.4.2 for the syntactic assumptions made in what follows, and §1.1.6 for more a detailed structural analysis).

(1.7)



This analysis accounts for the interchangeability of temporal and locative adjuncts in Odawa. It also explains the clause-peripheral preference these adjuncts appear to display. It also circumvents positing massive NP and VP movement in sentences where the adjunct or adjuncts come at the end. Interestingly, locatives of this sort appear to be restricted to high attachment, as opposed to, say, NP attachment. According to native speakers, the sentence in (1.8) is unambiguous, unlike at least one of its English translations.

(1.8) (mtig-ong) waashkesh (mtig-ong) gii-gnowaabm-aa-n maashtaanish-wan (mtig-ong)

(tree-Loc) deer (tree-Loc) 3.PAST-watch-DIR.3>3'-Obv goat-Obv (tree-Loc)

'(Near a/the tree) A/The deer watched a/the goat (near a/the tree)'

1.1.4.2 Syntactic assumptions

In discussing the syntax of Odawa, I adopt a generative theory of syntax based primarily on Chomsky's Minimalist Program (1995). Although I do not wish to get bogged down in technical—and potentially controversial details—a few basic assumptions should be made clear.

As illustrated in (1.7), I adopt the widely accepted assumption (based on Sportiche [1998]) that subjects are not base-generated in the specifier position the sentence (IP), but rather derived via movement out of a thematic-role receiving position within the verbal complex ((1.7) shows the subject in its base position). Furthermore, following Chomsky (1995) and Hale & Keyser (1993) (among many others), I assume that the subject is introduced by a light verb (*v*) that heads a phrasal projection labeled in (1.7) as vP. The object serves as the complement of the main verb, which heads VP.

As detailed in Chomsky (1995), lexical items are inserted into the syntactic structure fully inflected and with uninterpretable features (including, as described below, ones related to the obviation system of Odawa); if these features are "strong," they must be erased or "checked" before the structure can be passed along to the conceptual-intentional system for interpretation (the so-called theory of feature-checking). In order to be checked, uninterpretable features of lexical items must enter into an Agree relation (Chomsky, 1998). In Odawa—and Algonquian languages in general—the Theme Sign or Direction Marker signals both subject and object agreement in a simple transitive clause of the sort used in the experiments reported here. Thus, following Bruening (2001), I assume that *v* agrees with both subject and object.

Syntactic movement in a derivation is driven, according to this theory, by the presence of strong features that attract lexical items into Agree relations with functional heads higher in the derivation. In the analysis of Odawa syntax adopted here and based on Bruening's (2001) account of the related Algonquian language Maliseet-Passamaquoddy, I take [+PROXIMATE] to be this sirt of strong NP feature that drives a particular type of movement in inverse constructions. I postpone the details of this analysis until §1.1.6).

1.1.4.3 *pro*-drop

As mentioned already, and as I discuss at length in §1.2, the freedom of word order in Odawa combined with the lack of case marking (or at least the lack of unambiguous case marking) and the verbal direction system have some interesting consequences for sentence processing. Further complicating processing predictions, however, is the fact that Odawa, like all Algonquian languages, displays in the words of Bruening & Rackowski (2001) "rampant *pro*-drop."[9] Each and every argument NP can be elided in any type of clauses, depending on the context. In fact, according to the Algonquian literature, *pro*-drop is the norm; transitive sentences with two overt NPs are comparatively rare in connected speech (recall that Odawa is not traditionally a written language) (see also Dryer [1997] on Ojibwa; Wolfart [1996] on Cree). To take an example from the Algonquian language Fox (Mesquakie), Lucy Thomason (p.c.) reports that in a randomly selected Fox text containing 149 transitive verbs, only nine contained both an overt subject and overt object. As such, sentences can—and often do—consist of only a verb (1.9). More precisely, sentences often consist of a more or less

[9] Note that Pronominal Argument Hypothesis accounts of Algonquian languages (see §1.1.5.) do not consider there to be any *pro*-drop in these languages.

morphologically rich verbal complex, comprising the verb stem, tense, person, number, and direction, among other potentially affixable elements, such as manner adverbials. Implications of this system for sentence processing will be discussed in detail in §1.2.

(1.9) gii-digishkow-aa-n

pro 3.PAST-kick-Dir.3>3'-Obv *pro*

'S/he kicked him/her'

1.1.5 Pronominal Argument Hypothesis (PAH)

Odawa, like other Algonquian languages, displays a number of "nonconfigurational" characteristics, most of which have been described thus far: "free" word order, optional overt NP arguments, discontinuous constituents, and apparent lack of weak crossover effects (cf. Chomsky, 1986).[10] The Pronominal Argument Hypothesis (PAH), first proposed by Jelinek (1984), was developed to account for similar characteristics in the Athabaskan language Navajo. In Jelinek's formulation of the PAH, the inflectional morphemes attached to the verb serve as the syntactic arguments, absorbing both case and thematic roles assigned by the verb. In Baker's (1996) version of the PAH, based on data from the Iroquoian language Mohawk, phonetically null *pro*s are

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[10] Discontinuous constituents and apparent binding violations in Odawa are illustrated in (i-ii), and are documented for other Algonquian languages (e.g., Dahlstrom, [1987] on Fox, Bailin &Grafstein [1991], Grafstein [1981, 1986], Kathol & Rhodes [1999] on Ojibwa; Reinholtz [1999] and Sveinson [2001], on Cree). However, since their occurrence in Odawa does not come to bear on the issues dealt with in this dissertation, I will not discuss them further here.

(i) Discontinuous NP

maaba gii-(y)aakoozi gwiizens
this 3.PAST-be.sick boy
'This boy was sick'

(ii) (Apparent) weak crossover (WCO) violation:

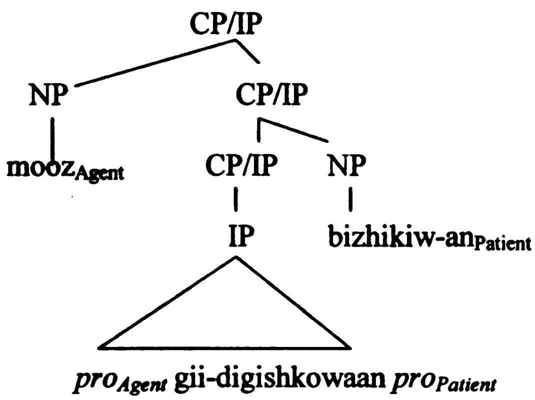
Wenesh agashw-an e-jiismaabin-igoo-d
who 3.An.sg.mother-POSS(Obv) 3.PAST.Conj-pinch-Inv.3'>3-Obv.Conj
'Who$_{i/j}$ did her/his$_i$ mother pinch?'

posited as filling the argument positions of the verb, and are made visible for case/thematic role assignment via coindexation with the inflectional morphemes in the verbal complex. Under both formulations of the PAH, all overt NPs are freely adjoined to the clause at CP or IP, and simply referentially coindexed with the morphemes/*pro*s with which they are associated. In this way, these NPs (and all the parts of discontinuous DPs/NPs) are simply adjoined to the clause at or near CP. Consequently, the NPs can be ordered freely without having to undergo any movement, apparently avoiding both binding violations and crossover effects (e.g., Dahlstrom, 1986; Grafstein, 1986). The inclusion of overt NPs in a sentence is completely dependent on the speaker's judgment of whether or not the context is rich enough for the hearer to identify the null NP arguments of the verb, such that they know who is doing what to whom (see §1.1.6.2 for further discussion). (1.10) is a schematic representation of the structure of a direct Odawa clause with two overt NPs within Baker's (1996) conceptualization of the PAH (omitting irrelevant details). Under a PAH analysis, the obviative marking on the overt NP referentially linked to the *pro* in direct object position serves simply as an obligatory marking of disjoint reference (Grafstein, 1981, 1986).

(1.10) mooz gii-digishkow-aa-n bizhiki-wan

moose 3.PAST-kick-Dir.3>3'-Obv cow-Obv

'A/The moose kicked a/the cow'



A number of Algonquinists have sought to extend the PAH in one form or another to Algonquian languages, including Odawa, which also display most of the typical "nonconfigurational" characteristics. Brittain (2001) reworked the PAH within the framework of Chomsky's Minimalist Program (1995) in order to account for the behavior of the conjunct verb in Western Naskapi. Junker analyzed quantification in Algonquian (1994) and certain word order restrictions in East Cree (2000) assuming the PAH. And Déchaine (submitted), Déchaine and Reinholtz (1998), Russell and Reinholtz (1995), and Reinholtz (1999) all assume some version of the PAH in their analyses of various dialects of Cree.

Despite these applications of the PAH to issues in Algonquian linguistics, a growing body of literature argues that the PAH cannot hold in Algonquian languages, and, furthermore, that it may not actually hold in any language. For example, Branigan and MacKenzie (1998, 2002) note word order constraints in embedded and double object constructions in Innu-aimûn where the PAH would predict no such constraints, due to the adjoined positions of overt NPs in the PAH.

LeSourd (submitted) also argues that the PAH cannot hold for Maliseet-Passamaquoddy. LeSourd points out that in certain constructions, some NP arguments are not represented by any inflectional morpheme in the verbal complex, as both major formulations of the PAH dictate that they must be. Similarly, in one type of comitative construction, affixes in the verb that index subject and object actually overlap in reference. Again, this situation is not predicted by the PAH. Notably, the so-called "theme signs" seen in the Odawa sentences in (1.1)-(1.2), which make the verb either direct (*-aa-* 3>3'; *-Ø-* 2>1) or inverse (*-igoo-* 3'>3, *-ig-* 3>2, 3>1; *-in-* 1>2), depend on both subject and object together to determine their form. In either version of the PAH sketched above, the assumption is a one-to-one mapping of agreement morphemes/*pro*s to grammatical functions and thematic roles. It is difficult to see, however, which case and thematic role assignments would depend on which morphemes, given the overlapping reference of the theme signs.

And finally, LeSourd points out that the discontinuous constituents common in Maliseet-Passamaquoddy (and other Algonquian languages, including Odawa) do not conform to expectations derived from the PAH. The relative order of the segments of these discontinuous constituents (generally a demonstrative determiner or quantifier and an NP) are rigidly constrained, which would be unexpected if all segments of the overt discontinuous constituent are generated and adjoined independently to the clause.

Davis (1997) disputes the existence of a PAH "macro-parameter." Baker's (1996) *Polysynthesis Parameter* proposed just this sort of parameter to account for the distribution of nonconfigurational characteristics of the Iroquoian language Mohawk (and other "nonconfigurational" languages). Davis argues that this sort of macro-parameter would in fact be unlearnable. The logic of his argument is that the usual assumption of the "principles and parameters" framework of syntax (Chomsky, 1981, 1986) is that the independent settings of numerous smaller parameters interact to produce larger syntactic patterns within a given language. Children are provided with positive evidence for these parameter settings. The larger syntactic constraints which emerge from these multiple parameter settings arguably could not be deduced from the input, however. Davis maintains that a macro-constraint, such as the PAH, is inconsistent with this view of language acquisition in that children would have to deduce from multiple and not at all obviously related phenomena in the input that the language is a pronominal-argument language. Additionally, not all of the characteristic non-configurational aspects of purportedly pronominal-argument languages are present in all languages, a situation that would lead to widespread and irreparable overgeneralizations given the lack of overt evidence to the contrary in the input. Mellow (1989) makes a similar point in his discussion of the learnability of Cree: If configurational structures occur in free word order languages, learnability considerations suggest that all languages are configurational.

Finally, Legate (2002) argues convincingly that nonconfigurationality deriving from a single macro-parameter is inadequate to explain even the facts of Walpiri, the proto-typical "nonconfigurational" language of Hale (1983). Legate provides examples for two distinct topic constructions (Hanging Topic Left Dislocations and regular Topicalization) and two focus constructions (Focus and WH-focus) at the left periphery of the Walpiri phrase, each of which displays strict ordering with respect to the other three: Hanging Topics > Topicalized Phrases > Focused Phrases > WH-Focused Phrases. At least one of these—WH-Focused Phrases—is derived from movement. The analysis offered by Legate falls within a "discourse configurational" framework (cf. Kiss, 1995; Puskas, 2000). In addition, Legate finds evidence in Walpiri applicative constructions for configurational structure within the verb phrase.

Bruening and Rackowski (2000) argue against the PAH analysis of the extinct Algonquian language Wampanoag (and by extension of the Eastern Algonquian languages of Delaware, Western Abenaki, and Mahican) based primarily on object shift constructions observed in the Wampanoag translation of the *Bible*. Their argument is that object shift in Wampanoag closely resembles object shift in German and other languages with respect to the specificity of shifted and non-shifted objects. Specific objects shift in Wampanoag out of the VP to a pre-verbal position, just as they do in German. The standard explanation for this movement is either because of the need to escape existential closure in the VP (Diesing, 1996) or to satisfy a specificity feature somewhere above the VP (Sportiche, 1996). Additionally, there are morphemes that appear in the Wampanoag verbal complex that signal the specificity or non-specificity of the object. The morpheme agreeing with a specific object NP is always triggered by *pro* NPs, and the one agreeing with non-specific object NPs can only be triggered by a non-specific overt NP. If all argument NPs are *pro*s, as stated by the PAH, this contrast would be difficult to capture. The pattern of data argues for a configurational structure whereby overt NPs—which unlike *pro* are able to bear [+/- SPECIFIC] features—do indeed occupy argument positions and trigger agreement relations.

Bruening (2001) elaborates this configurational analysis of Wampanoag and extends it to Maliseet-Passamaquoddy (hereafter just Passamaquoddy). His evidence against a PAH analysis of Passamaquoddy consists of a number of structurally dependent word order and binding phenomena, most if not all of which I have also found to hold in Odawa. In the next section I report a number of these configurationally dependent facts of Odawa, and argue that a configurational, non-PAH analysis of Odawa should be the starting point for predictions regarding the parsing of the language (despite the title of this dissertation).

1.1.6 Configurational phenomena in Odawa

Bruening (2001) sought to explain certain subject-object asymmetries in the Eastern Algonquian language of Passamaquoddy in terms of the ideas proposed by Chomsky in the Minimalist Program (1995). Of greatest interest to the present research on sentence processing in Odawa is the Passamaquoddy data Bruening uses both to question the validity of the PAH as a plausible explanation of the assorted "nonconfigurational" phenomena in Passamaquoddy and to propose an account of the direction system (direct/inverse verb forms) and underlying word order in that language. To summarize, Bruening posits a formal feature [+PROXIMATE], which resides at the head of some functional head (which Bruening calls "H") higher than vP but lower than CP. This feature attracts a non-obviative (proximate) NP into an Agree relation. In the direct form, this proximate NP is the subject (and thematic agent). In the inverse form, it is the object (and thematic patient).[11] The mechanics of this A-movement are illustrated

[11] It is not clear how this strong [+PROX] feature operates in subordinate or conjoined clauses when both NPs are marked as obviative. Word order restrictions in such clauses—as well as in possessive constructions, which require the possessed NP to be obviative—show that the feature is still present. But the relation between the obviation morpheme and syntactic obviation is not yet well understood. Bruening

in (1.11) (Bruening's [278], ignoring the somewhat more complex analysis of local argument—1st and 2nd person—interactions).

(1.11) a. **Direct**

$[_{HP}\text{Subject}^{[+PROX]}\ H^{[\Phi]}\ [_{vP}\ t\ [_{v}\ v\ [_{VP}\ \text{Verb Object}\ ]]]]$

b. **Inverse**[12]

$[_{HP}\text{Inverted Object}^{[+PROX]}\ H^{[\Phi]}\ [_{vP}\ t\ \ [_{vP}\ \text{Subject}\ [_{v}\ v\ [_{VP}\ \text{Verb}\ \ t\ ]]]]]$

Of greatest interest to the present research in Odawa are not the technical details of Bruening's analysis (only a portion of which are discussed here). It is instead the subject-object asymmetries and constraints on word orders and the interpretation of sentence-peripheral NPs that Bruening notes in Passamaquoddy that are of interest because these same phenomena hold in Odawa as well[13], as illustrated in §1.1.6.1 and 1.1.6.2. The inference I take away from these cross-linguistic similarities is that the underlying syntax of Odawa is configurational.

1.1.6.1 Word order in transitive subordinate clauses

The most basic piece of syntactic evidence for configurationality of Odawa is the fact that in subordinate direct clauses, word order is limited to SVO when the two NPs are both marked as obviative (1.12). As shown in (1.13), this restriction does not hold

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(p.c.) and I both routinely encounter unexpected obviation patterns in both Passamaquoddy and Odawa, respectively.

[12] The term "inverted object" refers to the argument that is the thematic patient. The claim is not that the logical object A-moves to the subject position, but that its movement is like the A-scrambling found in Japanese, to a position above the logical subject, perhaps a second specifier position of vP (Bruening, p.c.; McGinnis, 1999). I have attempted to maintain a consistent terminology throughout for the patient of inverse clauses (patient), but occasionally refer to it as object or object/patient, when context dictates.

[13] A variety of other Passamaquoddy asymmetries also appear to hold in Odawa, e.g., variable binding and raising to object constructions. I do not discuss these data here, however, since they are not directly related to the processing experiments that serve as the focus of this dissertation.

when one NP is obviative and one is proximate. The addition of the second obviation marker in the subordinate clause has the effect of demoting the agent of *kiss* to a more peripheral place in the discourse/context (cf. Richards, 2000; Aissen 1997, 1999a, b, 2001).

(1.12) a. [Maanii gii-kend-aan [nini-wan gii-jiim-aa-d kwew-an]]

Mary 3.PAST-know-TI man-Obv 3.PAST-kiss-Dir.3-3'-Conj woman-Obv

'Mary knew (it) the man kissed the woman'

b. *[Maanii gii-kend-aan [nini-wan kwew-an gii-jiim-aa-d]]

c. *[Maanii gii-kend-aan [kwew-an nini-wan gii-jiim-aa-d]]

d. *[Maanii gii-kend-aan [gii-jiim-aa-d kwew-an nini-wan]]

e. *[Maanii gii-kend-aan [kwew-an gii-jiim-aa-d nini-wan]]

f. *[Maanii gii-kend-aan [gii-jiim-aa-d nini-wan kwew-an]]

(1.13) a. [Maanii gii-kend-aan [nini gii-jiim-aa-d kwew-an]]

Mary 3.PAST-know-TI man 3.PAST-kiss-Dir.3-3'-Conj woman-Obv

'Mary knew (it) the man kissed the woman'

b. [Maanii gii-kend-aan [nini kwew-an gii-jiim-aa-d]]

c. [Maanii gii-kend-aan [kwew-an nini gii-jiim-aa-d]]

d. [Maanii gii-kend-aan [gii-jiim-aa-d kwew-an nini]]

e. [Maanii gii-kend-aan [kwew-an gii-jiim-aa-d nini]]

f. [Maanii gii-kend-aan [gii-jiim-aa-d nini kwew-an]]

With respect to the PAH, it is difficult to see how one could easily incorporate a word order restriction such as this into an account that depends on the free adjunction of overt NPs—irrespective of obviation status—at the clausal level. Nothing in the PAH literature explains what sort of constraint would need to be imposed to stipulate that the overt NPs would have to be adjoined in positions mirroring the structural positions of the *pros*/agreement morphemes coindexed with them.

The rigid SVO order observed in (1.12) strongly suggests an underlying SVO word order for all clauses. Dryer (1995, 1997) argues based on text analyses that the basic word order in Ojibwa is SVO, though little strictly syntactic evidence is provided. Tomlin & Rhodes (1979) propose an underlying VOS order for Ojibwa, but both Dryer's textual counts for Ojibwa and the above Odawa data suggest that SVO may be the basic underlying word order for both languages. Adding to this claim, Branigan and MacKenzie (2002) note a similar restriction in Innu-aimûn. Bruening (2001) also documents the same SVO restriction in Passamaquoddy, and uses the fact to argue for basic SVO word order for that language. The data from Experiment 1 (Chapter 2) below also show a strong preference for SVO word order in direct clauses containing two overt NPs.

In the inverse form, there is also a rigid order imposed on constituents in subordinate clauses when two overt NPs are marked as obviative. In this case, however, the order, according to native speakers, must be OSV.[14]

[14] For some speakers, subordinated Inverse clauses with two obviative NPs were simply bad no matter which order was used. For those who allowed them at all, OSV was the only order possible.

(1.14) a. [Maanii gii-kend-aan [nimosh-an gaazhag-wan gii-tikom-igo-d]]

Mary 3.PAST-know-TI dog-Obv cat-Obv 3.PAST-bite-Inv.3'>3-Conj

'Mary knew (it) the cat bit the dog'

b. *[Maanii gii-kend-aan [gaazhag-wan nimosh-an gii-tikom-igo-d]]

c. *[Maanii gii-kend-aan [gii-tikom-igo-d gaazhag-wan nimosh-an]]

d. *[Maanii gii-kend-aan [gii-tikom-igo-d nimosh-an gaazhag-wan]]

e. *[Maanii gii-kend-aan [nimosh-an gii-tikom-igo-d gaazhag-wan]]

f. *[Maanii gii-kend-aan [gaazhag-wan gii-tikom-igo-d nimosh-an]]

Significantly, this basic OSV order in the nverse is predicted by Bruening's (2001) account of A-movement sketched in (1.11). Perhaps one could cobble together a PAH-based analysis of why the overt NPs should have to be adjoined to either side of the verbal complex in the direct case, based on some sort of minimal link condition on the required coindexation. But it is difficult to imagine how that sort of explanation could work for the inverse, given that even by most conceptualizations of the PAH, the overt agent and patient NPs (whatever they may be) occupy equivalent adjunct positions.

One final question arises, as to how we can derive the observed freedom in word order in Odawa within a non-PAH, fully configurational syntactic account. One promising framework in which to further study the Odawa word order phenomena is that of "discourse configurationality," which has been proposed to account for the freedom in word order observed in, most notably, Slavic and Finno-Ugric languages (see Kiss, 1995; 2000, and the papers collected in Kiss, 1995). Proponents of discourse configurationality posit that both the discourse/semantic functions of "topic" and "focus" are realized through particular structural positions, and word order permutations arise as NPs move into these positions. Either topic, focus, or both functions can be realized through overt movement in any given language. It is not agreed upon whether the NP movement into these structural positions is driven by the need to check [+FOCUS] or [+TOPIC] features (Kiss, 1995), or by case requirements (Horvath, 1995), or where, if feature-checking is the issue, the features reside in any given language. Nevertheless, the idea of discourse configurationality appears to be a promising direction to pursue with respect to Odawa, just as Legate (2002) proposes with respect to Walpiri.

1.1.6.2 Left Dislocation

As pointed out in Bruening (2001) and Christianson (2001c), if the PAH were correct for Odawa, it would mean that all Odawa sentences containing overt non-WH NPs to the left of the verbal complex (1.10a-b) are structurally equivalent to Left Dislocation (LD) structures in English (1.15a-b). Furthermore, all sentences containing overt NPs to the right of the verbal complex would be equivalent to something like an epithet, appositive, or "right dislocation" (RD) (1.15c-d).[15] Baker (1996) makes the same point with respect to Mohawk. The PAH treats English LD structures, as illustrated in (1.15) and all Odawa sentences with overt NPs as equivalent in structure in the relevant respects, the only difference being that Odawa contains *pro*s and English requires overt pronouns.

[15] Such NPs, located on the left and right peripheries of sentences, are similar to appositives; however, appositives can also appear in the middle of a sentence (i). I will argue below that the LD'ed and RD'ed or epithetical NPs must occur outside mandatory sentence-initial and final elements, and thus they may differ at least in this respect from appositives.

(i) Their dog, *a mangy poodle*, has dug up my petunias again.

(1.15) a. That man$_i$, he$_i$ kissed Mary by the tree.

b. That big moose$_i$, Alex shot it$_i$ near the river.

c. He$_i$'s no good for Sally, that Jim$_i$.

d. For some reason, I just don't trust him$_i$, the guy who tried to sell me insurance$_i$.

(1.16) a. Maaba nini$_i$ *pro*$_i$ gii-jiim-aa-n *pro*$_k$ Maanii-wan$_k$ mtig-ong

that man *pro* PAST-kiss.VTA-Dir3>3'-Obv *pro* Mary-Obv tree-Loc

'That man (he) kissed (her) Mary by the tree'

b. Ziibii-ying maaba kchi-moozw-an$_i$ Niksan$_k$ *pro*$_k$ gii-bashkezow-aa-n *pro*$_i$

river-Loc that big-moose Alex *pro* PAST-shoot.VTA-Dir.3>3'-Obv *pro*

'Near the river Alex (he) shot (it) that big moose'

The resemblance between overt NPs in Odawa (and Algonquian in general) and LD'ed (and appositive or epithetical) NPs is, as pointed out by Bruening (2001), specious. It appears to be a language universal that LD'ed NPs must appear to the left of WH-words (observed in Romance languages, Modern Greek, and English) (1.17a-b). This restriction also holds in Odawa (1.18a-b), where WH-words must appear in the left-most position just they do in other Algonquian languages and, for that matter, Mohawk (Baker, 1996). If the PAH were correct for Odawa, and all overt NPs were simply adjoined to CP in the same way as LD'ed NPs are in English, then *all* overt NPs should be required to precede the WH-element. (1.18c), without PAH-posited *pro*s, shows that this is not the case; the indirect object in (1.18c) cannot appear to the left of the WH-word.

(1.17) a. That man, who kissed him yesterday?

b. *Who, that man, kissed him yesterday?

(1.18) a. Maaba nini$_i$, wenesh$_k$ t_k gaa-jiimi-go-d *pro$_i$* jiinaago

that man-Obv who PAST.Conj-kiss-Conj.Dir.3>3'-3Conj *pro* yesterday

'That man, who kissed him yesterday?'

b. *Wenesh$_k$ nen niniw-an$_i$ t_k gaa-jiimi-go-d *pro$_i$* jiinaago

who that man-Obv PAST.Conj-kiss-Conj.Dir.3>3'-3Conj *pro* yesterday

'That man, who kissed him yesterday?'

(OK as a simple interrogative: 'Who kissed that man yesterday?')

c. Nen niniw-an$_j$, wenesh$_k$ nimosh-an t_k gaa-miin-aa-d t_j

that man-Obv who dog-Obv PAST.Conj-give-Dir.3>3'-3Conj

'That man, who gave him a dog?'

The PAH not only implies that all Odawa sentences with overt NPs (coindexed with agreement morphemes/*pros*) should have similar structure to English LD constructions, but it also implies that such sentences should be *interpreted* like English LD (or RD/epithet) constructions. Under this account, speakers add overt NPs to a sentence only if they are uncertain that the hearer will be able to identify the referents associated with the empty categories filling the argument positions in the sentence. Accordingly, the PAH predicts at the very least a strong bias toward interpreting any overt NPs as either highly focused or contrastively focused elements if left-peripheral, or epithets, "afterthoughts," "parentheticals," or appositives if right-peripheral. Of course, this bias would be moderated by context, prosody, and even gestures.

According to native speakers, however, interpretations of overt NPs in non-canonical orders (i.e., non-SVO [direct] or non-OSV [inverse]) only become natural-sounding as focused elements or "afterthoughts" under rather unusual circumstances. For example, in V-initial sentences with only two NPs and a VP, it is possible to get both a standard indicative interpretation and a pragmatically marked interpretation, as in (1.19b-c).

(1.19) a. gii-jiim-aa-n mashkikininikwew-an gtegenini

3.PAST-kiss-DIR.3>3'-OBV nurse-OBV farmer

b. A/The farmer kissed a/the nurse OR

c. ##He$_i$ kissed a/the nurse, the farmer$_i$

The pragmatically marked interpretation in (1.19c), however, is quite difficult for some speakers to get (as noted with the ## sign), and must be facilitated with an elaborate context and exaggerated prosody. Interestingly, this interpretation is substantially ameliorated if the sentence is made non-canonical in other respects. Adding two adverbial adjuncts (as will be done in some of the stimuli sentences in Experiment 2 below) between the VP and the NPs makes the pragmatically marked interpretation far more plausible, although prosodic cues and context still aid the interpretation.

(1.20) a. gii-jiim-aa-n jiinaago jiigibiik mashkikininikwew-an gtegenini

3.PAST-kiss-DIR.3>3'-OBV yesterday beach-LOC nurse-OBV farmer

b. A/The farmer kissed a/the nurse yesterday on the beach **OR**

c. He$_i$ kissed her$_k$ yesterday on the beach, the nurse$_k$, the farmer$_i$

If, as in (1.21), the adverbials come between the two NPs, only the NP at the edge of the clause is considered as the "afterthought"

(1.21) a. gii-jiim-aa-n mashkikininikwew-an jiinaago jiigibiik gtegenini

3.PAST-kiss-DIR.3>3'-OBV nurse-OBV yesterday beach-LOC farmer

b. A/The farmer kissed a/the nurse yesterday on the beach **OR**

c. He$_i$ kissed a/the nurse yesterday on the beach, the farmer$_i$

As far as I know, this sort of ambiguity is not documented elsewhere in the Algonquian literature. And as far as I can determine, although the PAH may predict the ambiguity, it can only account for the strong dispreference of the "afterthought" interpretation in the VOS string, or the increased preference for the same interpretation in the V-adverb-adverb-OS string, by relying completely on discourse context. But holding context constant, the PAH seems unable to predict the increased availability of the reading in sentences with two adverbs (e.g., [1.21]). As it turns out, this potential ambiguity plays a central role in the interpretation and discussion of the results of Experiment 2 (Chapter 3). To preview those results and discussion, I argue that the frequency of *pro*-drop in Odawa and "shallow processing" (Barton & Sanford, 1993; Ferreira, Bailey, & Ferraro, 2002) or "good enough parsing" strategies (Christianson, Hollingworth, Halliwell, & Ferreira, 2001; Ferreira, Christianson, & Hollingworth, 2001; Ferreira & Henderson, 1999) employed by the human sentence parsing mechanism (HSPM) lead people to pursue LD/epithet-like interpretations of certain Odawa sentences, speeding response times and improving task accuracy in some conditions. Crucially, the HSPM resorts to this sort of interpretation not due to contextual influences—since context in Experiments 2 and 3 was kept constant across conditions (in fact, there was no context)—but rather due to the computational complexity associated with certain word orders.

1.1.7 Summary

To summarize, Odawa is an Algonquian language spoken natively today by approximately 3,000-4,000 people in the Great Lakes region of North America. It displays linguistic characteristics shared by other Algonquian languages, including: "free" word order, optionally occurring overt NP arguments, discontinuous constituents, and an apparent lack of several well-known syntactic restrictions. These characteristics are often associated with languages termed as "nonconfigurational." One account of such languages, the Pronominal Argument Hypothesis (PAH), was first proposed by Jelinek (1984). The PAH, first applied to the Athabaskan language Navajo, says that all overt NPs occupy non-argument positions, being adjoined freely to some projection above IP. These NPs are referentially linked with either the agreement morphemes affixed inside the VP (Jelinek) or to *pro*s occupying argument positions (Baker, 1996 [for Iroquoian languages]; Brittain, 2001 [for Algonquian languages]). The optionality and lack of movement associated with the adjoined overt NPs explain a wide range of "nonconfigurational" phenomena cross-linguistically.

Although the PAH has been rather widely extended to Algonquian languages, evidence has accrued for a more traditional, configurational account of Algonquian syntax. In Odawa, this evidence includes rigid word order restrictions in subordinate clauses when both NPs are marked as obviative. The restrictions—SVO in direct clauses, OSV in inverse clauses—correspond to the word orders predicted by Bruening's (2001) syntactic account of the Algonquian language of Passamaquoddy. Furthermore, in Odawa as in Passamaquoddy, overt NPs do not appear to behave in the same way as Left Dislocated NPs in English (or other languages). For one thing, LD'ed NPs in perhaps all languages must be dislocated to some position above CP. If, as the PAH predicts, overt NPs in Algonquian languages are simply adjoined at or above CP, they should pattern in the same way as Left-Dislocated NPs. Contrary to this prediction, overt NPs in Passamaquoddy and Odawa can remain below overt WH-phrases, which obligatorily move to Spec,CP, as they do in English. Furthermore, in Odawa, the interpretation of non-canonical word orders (i.e., non-SVO direct and non-OSV inverse clauses) can be either as standard indicative sentences (with no special prosodic cues or contextual circumstances required), or as LD'ed or epithetical sentences (with appropriate prosodic cues and contextual circumstances). This ambiguity can be accentuated by adding adverbial adjuncts into non-peripheral positions within a sentence. Although this ambiguity may be consistent with the PAH, all sentences should display it to some degree, irrespective of prosody and context. And the PAH does not present any obvious account of why adding more adjuncts to a sentence should make the dislocated interpretations more available even without contextual or prosodic cues, as native speakers report they are.

Finally, the proximate/obviative distinction in the verbal and nominative morphology and the direct/inverse verb forms in Odawa are typical of Algonquian languages, but relatively unique among the world's languages (unless Déchaine & Reinholtz [1998] are correct and these features are indicative of a split-ergative case system). It is important to keep in mind that in independent, direct clauses, the subject/agent NP (be it overt or *pro*) is the proximate NP, and unmarked morphologically, and the object/patient NP is the obviative NP, and marked morphologically. In an independent, inverse clause, the opposite holds: The subject/agent is morphologically marked and is obviative; the inverted object/patient is morphologically unmarked and is the proximate NP. Roughly speaking, the proximate NP can be thought of as the "central" (Richards, 2000) or more topical (Christianson, 2001a) NP, and the obviative NP can be thought of as the "peripheral" (Richards, 2000) or more focused (Christianson 2001a) NP. This split between direct and inverse, and the associated shift of obviation marking on the NPs will feature prominently in all three experiments in Chapters 2-4. Before proceeding to the experiments, however, we need to devote considerable attention to the implications and questions arising in a language like Odawa with respect to sentence production and comprehension. As far as I am aware, this dissertation represents the first experimental psycholinguistic research ever done on an indigenous American language, and one of only a handful of studies conducted outside of the Indo-European language family, Chinese, or Japanese. In the remainder of Chapter 1, I address rather broadly certain issues within psycholinguistics relevant to this study, along with the reasons why Odawa can prove useful in broadening psycholinguistic horizons. In the first section of each chapter devoted to the three experiments, I discuss issues specific to each of the experiments in more depth.

1.2 Why Odawa is interesting: Human sentence processing

The attention of psycholinguists has traditionally been concentrated on a small subset of human languages (generally Indo-European) and a subset of data (online measures). After a brief enumeration of studies representing these foci, I raise some questions specific to Odawa which (a) have not been adequately addressed in previous research, and (b) are investigated in varying levels of detail in the experiments reported in Chapters 2-4.

1.2.1 Cross-linguistic psycholinguistic research

The vast majority of psycholinguistic research (both production and comprehension research) over the past thirty years has been conducted in English and, to a lesser extent, a few other Indo-European languages, despite the fact that Indo-European languages represent just over 3% of the total languages spoken in the world today (Hawkins, 1983). And even Indo-European languages are not broadly represented, with the majority of research conducted in only a fraction of the approximately 150 members of the family. Aside from English, psycholinguists have tended to concentrate their efforts on (in no particular order): Dutch (e.g., Brysbaert & Mitchell, 1996; Desmet, de Baecke, & Brysbaert, 2002; Mitchell & Brysbaert, 1998), German (e.g., Bader, et al., 2000; Hemforth & Konieczny, in press; Hopf, et al., 1998; Konieczny, Hemforth, Scheepers, & Strube, 1997), Spanish (e.g., Carreiras & Clifton, 1999; and the papers collected in Carreiras, García-Albea, & Sebastián-Gallés, 1996), Italian (e.g., De Vincenzi & Job, 1993; MacWhinney, Bates, & Kliegl, 1984), Russian (e.g., Sekerina, 2000), Hindi (e.g., Vasishth, 2002). Breaking with the Indo-European tradition, investigations into processing in Hungarian (e.g., Gergely, 1991; Pléh, 1990), Japanese (e.g., Babyonyshev & Gibson, 1995; Hagstrom & Rhee, 1997 [also dealing with Korean]; Lewis & Nakayama, 2001; Yamashita, 1995, 1997, 2000; the papers collected in Mazuka & Nagai, 1995), and various Sino-Tibetan languages (mainly "dialects" of Chinese: e.g., Ping, Bates, & MacWhinney, 1993; several of the papers collected in Nakayama, 2002). And a few research projects have had broader cross-linguistic scope, including De Vincenzi (2000), De Vincenzi & Lombardo (2000), MacWhinney & Bates (1989), Nakayama (2002), Sridhar (1988), and Tomlin (1995).

In essence, there has been next to no psycholinguistic research done in any language displaying the properties of Odawa (see §1.1). What may be the solitary instance aside from the present research is the body of work done in Walpiri by Bavin & Shopen (1985, 1989). These studies were primarily concerned with children's comprehension of sentences. In Bavin & Shopen (1989) the authors investigated children's comprehension of the possible Walpiri word orders as compared to that of adults. The research questions of that study were limited to ones specifically pertaining to Bates & MacWhinney's "competition model" (1982). As such, they sought to determine what sort of "cues" were more salient to children in comprehending sentences, and which were more salient to adults. To this end they compared case marking, word order, animacy, and probability (plausibility) to determine which was (were) more salient to various age groups (three years to adult). Bavin & Shopen's main findings were that case marking was not a strong predictor of accurate comprehension until after the age of five. Prior to that age, animacy and pragmatic cues had a stronger affect on young children's comprehension. Word order was the weakest cue, compared to animacy and probability. If these two cues were controlled for, however, word order became a stronger predictor of responses. Without going into irrelevant details, I will simply note that this study included conditions that were in fact ungrammatical, e.g., the stimuli sentences were lacking required overt case marking or described inanimates acting upon animates in such a way that is impossible in Walpiri grammar (or because of an interaction between the grammar and universal characteristics of the HSPM; for discussion see Minkoff, 1994, 2000, 2001). Since little or nothing is known about how speakers of any language go about comprehending and/or interpreting ungrammatical sentences, interpretations of these Walpiri results must be somewhat speculative. In Experiment 3 (Chapter 4), I investigate some of the same "cues" in Odawa as Bavin & Shopen did in Walpiri.

This is not to say that psycholinguists are not interested in developing theories and models that apply to and hold across data from diverse language families. For example, Hawkins (1994) makes it a central claim of his *Early Immediate Constituents* theory of performance and constituency that processing constraints and mechanisms should be considered as universal and genetically determined cognitive systems. Hawkins goes to admirable lengths to address data from a wide range of language types, arguing that innate parsing principles are in fact as much responsible for certain grammatical universals (or at least universal tendencies) as are proposed principles of Universal Grammar (cf. Chomsky 1981, 1986). He even briefly discusses the implications for his theory of "languages with flat structures" (e.g., p. 39), referring to Hale's (1983) original description of Walpiri, the prototypical "nonconfigurational" language. (Recall, however, that Legate [2001] argues that Walpiri syntactic structure displays some very hierarchical behavior. So while Hawkins's theory accounts for nonconfigurational patterns in a "nonconfigurational" language, it would need to be re-examined to determine if it accounts for nonconfigurational patterns in a configurational language.)

The reality is that conducting psycholinguistic experiments in multiple languages—and especially in rapidly disappearing and lesser known languages such as Odawa—is prohibitively costly, particularly with respect to time: Native-speaking populations of many of these languages are disappearing faster than researchers can familiarize themselves with the languages and design and run experiments. Subject pools of native speakers are small, often scattered or remote geographically, forcing researchers interested in undertaking such projects to develop methods suitable to "field psycholinguistics," which might be far removed from and considerably less controlled than typical laboratory settings. Native-speaking communities are often reluctant to allow outsiders—especially those conducting "experiments"—access to their facilities and populations. All of these obstacles were encountered and generally overcome during the course of conducting the present research; however, I feel that the results, despite certain shortcomings to be discussed in Chapters 2-4, make a strong case that psycholinguists need to further expand their cross-linguistic horizons. In §1.2.1.1 and1.2.1.2, I provide an example of how the study of languages like Odawa could inform the study of human sentence processing in general.

1.2.1.1 "Nonconfigurational" production

Ever since Kathryn Bock and colleagues began publishing results of their seminal sentence production experiments (Bock, 1982, 1986, 1987; Bock & Griffin, 2000; Bock & Levelt 1994; Bock & Loebell, 1990; Bock & Warren, 1985), a central issue in sentence production has been the role of attention and/or concept accessibility and its effect on lexical access and syntactic structure. In his comprehensive book *Speaking* (1998), Levelt drew heavily on Bock's research in developing a highly incremental model of sentence production. Levelt's thesis is an adaptation of what he calls Wundt's principle (1900): "Each processing component will be triggered into activity by a minimum amount of its characteristic input." According to Levelt, Wundt suggested that word order results from the "successive apperception of the parts of a total conception," but that this only holds "to the extent that word order is free in a language" (Levelt, 1998, p. 26). Odawa and other Algonquian languages, with their extremely variable word order, come immediately to mind as one fertile testing ground for this view of incremental production.

Bock and colleagues have compiled the largest set of results pertaining to incremental production. The view of production that they propose based on these results is that the syntactic form of utterances derives from conceptual and lexical accessibility. Bock & Warren (1985), for instance, concluded, "Highly accessible concepts will become the subjects of sentences; if these conceptually accessible forms are also represented by highly accessible words, there may be a tendency for them to occur early in sentences" (p. 62). Bock's (1986, 1987) subsequent exploration this predicted tendency produced evidence that both semantic and phonological primes can influence the syntactic structure of sentences. Specifically, semantic priming speeded sentence production, and phonological priming appeared to slow sentence production. Collapsing over the differences between the two types of primes, however, since Bock (1987), the conclusion drawn from this line of research has been that accessible words/concepts tend to come earlier in sentences than inaccessible ones: "...speakers tended to place more accessible word forms earlier in sentences than less accessible forms, changing the syntax of their sentences as needed in order to do so" (Bock, 1987. p. 133).

A sentence production system driven by accessibility is appealing in several respects. If we concede that the topic of a given conversation is by nature highly accessible (by virtue of having been mentioned at least once or being highly salient in the physical context), then we can explain why discourse topics tend to be syntactic subjects (Asudeh, 2000; Christianson, 2001a; Ferreira, 1994), and consequently why syntactic subjects usually precede syntactic objects in the world's languages (Hawkins, 1983), and why discourse topics (or "given"/"old"/"salient" information) tend to precede discourse foci ("new"/less "salient" information) (cf. Gergeley, 1991; Hoeks, Vonk, & Schriefers, 2002; Lambrecht, 1994; Tomlin, 1997). In addition, since active, highly animate, initiators of actions tend to grab peoples' attention (Ferreira, 1994; Tomlin, 1995, 1997), it makes sense that entities with these properties—which are central properties of thematic agents (Dowty, 1991)—tend to serve as discourse topics and syntactic subjects (and be thematic agents, as well). Entities with these attention-grabbing properties are more likely to be contextually salient not only to speakers, but also to listeners, and thus perceived earlier by interlocutors than entities with fewer of these attention-grabbing properties. In this way, then, they become topical. According to an access-driven model of production, accessible concepts are in essence forced into early production. These concepts, as just discussed, tend to be discourse topics, thematic agents, and syntactic subjects.

If, however, the topic of discussion (thus most highly accessible concept) is a thematic patient, the consequent desire on the part of the production system to place it in an early position in the sentence. In the SVO language English, this requires making the thematic patient the syntactic subject, which can be accomplished by using a passive sentence. By a strictly incremental account, with which Bock's various data and Levelt's Wundt's principle are consistent, passive sentences are produced because a speaker is pushed into producing a highly accessible non-agentive concept, and the syntax of a passive in some sense saves the sentence by allowing an accessible non-agent to act as a syntactic subject. In other words, lexical choice takes place (and articulation may begin) prior to any syntactic planning; the syntax simply responds to the features of the most accessible concept.

"Nonconfigurational" languages like Odawa provide a unique test of "strict incrementality," as described above. If the human sentence production system (HSPS) operates in large part (at least with respect to constituent ordering and message formulation) according to non-linguistic (by which I mean non-syntactic) constraints imposed by conceptual accessibility, it would seem that "nonconfigurational" languages are in a very practical sense the best suited for sentence production. Strict incrementality essentially states that we tend to say first what first comes into our heads. (This would be the claim at least with respect to the beginnings of sentences, where syntactic limitations imposed by already-uttered words/phrases do not constrain the choice of subsequent words.) A language like Odawa allows *any* word (just about) to be uttered first in, e.g., a transitive clause: noun, verb, adverb, quantifier, determiner, etc.

Take for example the sentence in (1.22a) (adapted from Valentine, 2001, p. 571), which could begin licitly any of the ways illustrated in (1.22b-e), given an appropriate context for each[16]:

[16] The order of the non-initial elements in the sentences in (1.22) is also relatively flexible, although the constraints of this flexibility are not entirely clear to me at this point.

(1.22) a. zhaagnaash wewiib gii-ns-aa-n nswi dkonweniniw-an

white.person quickly 3.PAST-kill-Dir.3>3' three police.officer-Obv

'A/The white person quickly killed three police officers'

b. wewiib zhaagnaash gii-ns-aa-n nswi dkonweniniw-an

c. gii-ns-aa-n nswi zhaagnaash wewiib dkonweniniw-an

d. nswi gii-ns-aa-n dkonweniniw-an zhaagnaash wewiib

e. dkonweniniw-an gii-ns-aa-n nswi zhaagnaash wewiib[17]

The Odawa speaker thus has the freedom to begin a sentence like (1.22a) with whichever concept is most accessible (with conceptual accessibility presumably determined by the relative contextual saliency of each item). If Odawa and other "nonconfigurational" languages are structurally so well suited to the universal mechanism of the HSPS, the obvious question is: Why have all human languages not evolved in such a way as to allow for this sort of flexibility?

In Chapter 2, I present the results of a sentence production experiment in Odawa that are relevant to the issue of strict incrementality in sentence production. In the discussion of those data, I argue that conceptual accessibility does come to bear on the structure of utterances; however, I propose that the effect is realized at a higher level than that suggested by either Wundt's Principle or Bock's interpretation of English production data.

1.2.1.2 "Nonconfigurational" comprehension

One potential consequence for a "nonconfigurational" language that is perfectly suited to incremental production (in the way discussed above) is that such a language

[17] According to Valentine (2001), a quantifier can follow the NP over which it quantifies in Anishnabemwin (roughly Odawa), given the proper context, contra the observations on the very closely related Ojibwe made by Kathol & Rhodes (1999).

might be more problematic with respect to comprehension than, say, a language with relatively rigid word order, like English. According to certain "constraint-based" theories of sentence comprehension, the parse of an input string of words is greatly influenced by the frequency with which words and syntactic structures occur in a language, along with numerous (and often vaguely defined) other constraints (cf., Frazier, 1995; MacDonald, 1993, 1994; MacDonald, Pearlmutter, & Seidenberg, 1994; Gibson & Schütze, 1999; Mitchell, Cuetos, Corley, & Brysbaert, 1995; Spivey-Knowlton & Sedivy, 1995; Trueswell, 1996; Trueswell, Tanenhaus, & Garnsey, 1994; Trueswell, Tanenhaus, & Kello, 1993). In a language like English, syntactic restrictions on word order have the effect of limiting frequency statistics. For instance, an utterance-initial NP (or sentence-initial NP, if we consider written input) in English is, statistically speaking, extremely likely to be the syntactic subject of the following utterance/sentence (minus prosodic or orthographic marking to the contrary). It is somewhat less certain, but still highly likely, that that same NP will not only be a syntactic subject but also a thematic agent or experiencer (or at least higher on the thematic hierarchy [Fillmore, 1968; Jackendoff, 1972] than any other NP that may occur later in the clause). Even more certain in English is that, e.g., an NP will precede a modifying relative clause, or that a demonstrative or quantifier will not be separated from the NP which it modifies. In these ways, the frequency statistics that some researchers believe the human sentence processing mechanism (HSPM) maintains are limited in English by the syntactic properties of the language. In a "nonconfigurational" language like Odawa, the HSPM must maintain significantly more frequency statistics, or at minimum, statistics of a more fragmented nature.

Let us compare equivalent Odawa and English expressions of what will ultimately turn out to be a two-place predicate (1.23) as they progress word by word, just as they would be encountered by the HSPM. In this way, we can count the number of ways each might be completed. If the HSPM is indeed sensitive to frequency statistics (both lexical [Trueswell, 1996] and non-lexical [Mitchell, et al., 1996] along with perhaps dozens of other constraints, such as animacy, definiteness, context, selectional restrictions of verbs, etc.), then the HSPM will need to take into account all of the potential completions consistent with an input string at each of the various stages of the parse. For the purposes of this simple exercise, we will not consider completions that have highly marked prosodic patterns (e.g., *Fish, Bill likes*) or multi-clausal completions. And for the sake of simplicity, we will use only proper names (since Odawa has no definite or indefinite determiners), and we will not consider adverbial/adjectival/prepositional adjunction. It is important to keep in mind that whereas the (prosodically unmarked) English version of (1.23) can only begin in one way—i.e., with the syntactic subject/thematic agent—the Odawa version can begin in considerably more ways.

(1.23) Complete message: 'Mary chased Alex' = *chase*(Mary, Alex)

(1.24) a. English: *Mary...*

i. Mary VERB-transitive NP

ii. Mary VERB-passive (BY-phrase)

iii. Mary VERB

iv. Mary VERB-middle (FOR-phrase)

v. Mary VERB-ditransitive NP NP

vi. Mary BE-existential

b. *Mary chased...*

i. Mary chased NP

c. *Mary chased Alex*

(1.25) a. (Odawa): *Maanii...*

i. (all of the possible completions for English)[18,19]

ii. Maanii NP VERB-Direct

iii. Maanii *pro* VERB-Direct

iv. Maanii VERB-Direct *pro*

v. *pro* Maanii VERB-Direct

vi. Maanii VERB-Inverse NP

vii. Maanii NP VERB-Inverse

viii. Maanii *pro* VERB-Inverse

vii. Maanii VERB-Inverse *pro*

viii. *pro* Maanii VERB-Inverse

b. *Maanii gii-mnashkowaan...*

i. Maanii gii-mnashkowaan NP

ii. Maanii gii-mnashkowaan *pro*

iii. Maanii *pro* gii-mnashkowaan

iv. *pro* Maanii gii-mnashkowaan

c. *Maanii gii-mnashkowaan Niksan*

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[18] Odawa contains no BY or FOR phrases, and thus if any syntactic subject is present in passive or middle constructions, it is never realized (see Christianson (2002) and Stroik (1999) for relevant discussions).
[19] Any or all of the NPs in a ditransitive Odawa clause could be *pro*-dropped as well, so the ditransitive completion also contains more options in Odawa than in English, even if we add the non-object-shifted option to the English list.

As we can see, at the point where the completion of the English sentence is completely predictable (ignoring complications like adjuncts or subordinate clauses), the completion of the Odawa sentence is still uncertain. I have included *pro* in the Odawa options for a simple reason: According to most models of human sentence parsing, one of the basic functions of the HSPM is to match thematic role assigners (typically verbs) to thematic role assignees (typically NPs) (e.g., Ferreira & Henderson, 1990, 1991, 1998; Frazier, 1979; Frazier & Clifton, 1996; Garnsey, Pearlmutter, Myers, & Lotocky, 1997; Gibson, 1998, 2000; Grodner, Gibson, & Tunstall, 2002; Ni, Crain, & Shankweiler, 1996; Trueswell, et al., 1994; Warren, 2001). In a *pro*-drop language with flexible word order, the parser cannot know that the thematic slots of a verb have been filled—or by what they have been filled—until the clause has ended. Thus the HSPM has to wait until the end of a clause (or at least until material is encountered that usually signals the end of a clause) to reasonably predict that no more overt thematic assignees will need to be incorporated. The point of this exercise is simply to demonstrate that whereas the HSPM can make some fairly robust frequency-based predictions as to the eventual completion of a simple transitive clause in English prior to the actual end of the input string, its task in Odawa is considerably more complex. Therefore, whereas producing a sentence in a "nonconfigurational" language like Odawa may be in some sense "optimal" (if we choose to accept a strictly incremental model of production), comprehending that same language may be far more complex a task (and thus far less "optimal") than comprehending a language with more rigid word order.

The issue of frequency statistics, along with other potential "constraints" in comprehension, play a central role in the predictions for and interpretation of the results of the Odawa comprehension experiments that I present in Chapters 2 and 3. The conclusion I draw there is that even though some effects of frequency are observed, frequency information alone is inadequate to predict the relative ease or difficulty associated with comprehending even simple, mono-clausal Odawa sentences.

1.2.1.3 Summary

I have attempted to briefly summarize and illustrate two specific issues with respect to sentence production and comprehension (incrementality and the role of frequency information, respectively) that may be fruitfully addressed within the context of a "nonconfigurational" language such as Odawa. These issues are by no means the only ones that the study of Odawa may inform, nor are they the only ones dealt with in the experiments reported here. The point is simply that any claims as to the universal nature of mechanisms at work in sentence production or comprehension can be at best tentative until experimentation has been performed in a much wider range of typologically diverse languages than has been to date.

1.2.2 Investigating interpretations of sentences

As discussed in Ferreira (in press) and Ferreira, et. al. (2001), psycholinguists have generally been preoccupied with obtaining online measures of sentence comprehension. These measures include fixation duration and regressive eye-movements as monitored on eye-tracking apparatus, button-press latencies in self-paced reading/listening paradigms, "make sense" tasks, click-detection tasks, and phoneme-monitoring tasks. The focus in these studies is to determine the effect on processing difficulty of syntactic and non-syntactic information. Furthermore, the assumption shared by nearly all researchers no matter their theoretical bent is that the ultimate interpretations that people derive from sentences are based on correct, complete, accurate analyses of input sentences. If an analysis terminates before it is completed (due to time constraints, for example), or becomes so difficult as to bog down (as with multiple center embeddings in English), the general assumption in the literature is that no interpretation is derived from the sentence beyond some vague recognition of the words themselves, i.e., no interpretation can be derived from the syntactic structure of the sentence. Thus, in this sort of situation, hearers/readers are assumed to recognize their lack of comprehension. Their responses in commonly employed off-line tasks, such as grammaticality judgments (cf. Ferreira & Henderson, [1991], where subjects rated grammatical but difficult to parse sentences as "ungrammatical"), are offered as evidence for subjects' failure to interpret such sentences and their recognition of their failure. Little direct evidence for these assumptions has ever been gathered, however (Ferreira, in press).

Exceptions to this general trend are experiments reported in papers by Christianson, et al. (2001), Ferreira (in press), Ferreira, et al (2002), and Sanford (2002). In these studies, subjects were asked questions specifically intended to tap their interpretations of garden path sentences. The questions differed substantially from those usually asked by researchers and intended simply to make sure subjects are staying on task. (1.27a) gives an example of a garden path sentence of the type used in Christianson, et al. (2001). (1.27b,c) are the comprehension questions used to tap subjects' interpretations in that study, and (1.27d) is an example of a of typical "comprehension" question, the answer to which lends no insight into the theoretically interesting aspects of the ambiguity in (1.27a).

(1.27) a. While Bill hunted the deer that was brown and graceful ran into the woods.

b. Did Bill hunt the deer?

c. Did the deer run into the woods?

d. Was the deer brown?

The ambiguity in (1.27a) begins at *the deer*, which is initially attached (and interpreted) as the direct object and thematic patient of the subordinate verb *hunted*. This ambiguity persists throughout the relative clause *that was brown and graceful*, with the object/patient interpretation gaining strength as the ambiguous regions increases in length (first observed as "the head-position effect" in Ferreira & Henderson, 1990, 1991). Upon encountering *ran*, the initial analysis has to be revised, and *the deer* must be reanalyzed as the subject/agent of the main verb *ran*. Ultimately, the correct interpretation of (37a) should be: "At the time that Bill was hunting some unspecified quarry, a brown and graceful deer ran into the woods." However, subjects in Christianson et al. (2001) were remarkably poor at arriving at this interpretation. They incorrectly answered YES to the question in (1.27b) 51.2% of the time, compared with 31% of the time in non-garden-path sentences (Christianson, et al.'s Experiment 1). In addition, subjects were surprisingly confident in their responses, both correct and incorrect, as demonstrated by the results from confidence ratings they provided after each response. For sentences like (1.27b), the mean confidence rating in Christianson et al.'s Experiment 1 was 3.12, where 1 equaled "not at all confident" and 4 equaled "very confident."

Christianson et al. conceded that there was an inferential bias at work, whereby *the deer* was inferred as the likely or at least a reasonable quarry (perhaps according to

Grice's [1975] maxim of relevance). However, they presented results from a series of experiments that pinpointed the syntactic ambiguity and subsequent *failure to completely reanalyze* the sentence as the source of a very specific *mis*interpretation of sentences like (1.27a). This misinterpretation was tested in several ways. One measure was the extent to which subjects responded correctly to the question in (1.27c). If subjects had been totally unable to reanalyze the garden path sentences, and left with "an empty (and unbound) subject for the matrix clause" (as predicted by the parsing model set forth in Stevenson, 1998 [see also Lewis, 1998; Pritchett, 1992]), the prediction would have been for comparably poor performance in answering the question in (1.27c). Contrary to this prediction, subjects responded incorrectly to this sort of question only 15% of the time (Christianson, et al.'s Experiment 2)

Another, and perhaps the most convincing, test of misanalysis in Christianson et al. (2001) was the inclusion of stimuli containing "reflexive absolute transitive" (Trask, 1993), or RAT, verbs (e.g., *dress*, *wash*, *bathe*, *shave*) exemplified in (1.28).

(1.28) a. While Anna dressed the baby spit up in the crib.

b. While Anna$_i$ dressed Ø$_i$ the baby spit up in the crib.

Despite the fact that RAT verbs require their subject to be referentially coindexed with their null object in the absence of a referentially distinct overt syntactic object (illustrated schematically in (1.28b), subjects responded incorrectly to questions such as *Did Anna dress the baby?* 65.6% of the time (Experiment 3a). In a separate experiment where commas were used to disambiguate sentences such as (1.27a), the percentage of incorrect responses dropped to 11.5%. The authors took the results from the four experiments presented in the 2001 paper as evidence that the locus of the misinterpretations was syntactic rather than inferential. Moreover, they concluded that the misinterpretation was caused by a failure on the part of subjects (more precisely on the part of their HSPMs) to fully reanalyze the input as required by syntactic principles. Alternatively, since no direct evidence could be gathered to show that the syntactic reanalysis was faulty, it was suggested that if a licit syntactic structure had in fact resulted from complete reanalysis, the subsequent semantics of this reanalyzed structure were not consulted in deriving a final interpretation for the input.

In both Christianson, et al. (2001) and Ferreira, et al. (2001), the authors suggested that the results summarized above point toward a principle of human sentence processing loosely termed as "good enough" processing (Ferreira & Henderson, 1999), whereby the HSPM carries out its work automatically as far as time and computational constraints allow. In cases where time is short and/or computational load is heavy, the processor is happy to terminate its work as long as the resultant interpretation is plausible according to world knowledge (see Christianson, et al., 2002, Experiment 1) and consistent with context. A "good enough" interpretation is derived under such circumstances based on incomplete or "shallow processing" (see also Ferreira, et al. [2002] and Ferreira [in press]). Under this view, the HSPM is a least effort mechanism, that does only as much work as is necessary to derive a meaningful interpretation from input, even if that interpretation ends up to be inconsistent with the actual content of the input. Diverse evidence for "good enough" processes in other areas of cognition are found in visual cognition (e.g., Grimes, 1996; Henderson & Hollingworth, 1999a, b; Irwin, 1996; Simons & Levin, 1997), text and discourse comprehension (Anderson, Lepper & Ross, 1981; Barton & Sanford, 1993; Erickson & Mattson, 1981; Johnson &

Seifert, 1998; Kamas, Reder, & Ayers, 1996; Sanford, 2002), and theories of reasoning (e.g., Gigerenzer, 2000; Gigerenzer, Todd, and the ABC Research Group, 1999).

In Experiments 2 and 3, I present results from comprehension experiments in Odawa that suggest some sort of "good enough" interpretation is employed by Odawa speakers even in mono-clausal sentences when certain computational complexities are introduced. The explanation I propose for the pattern of results obtained there highlights the need for including some sort of flexible, "good enough"-like mechanism within any model of sentence processing. I argue that without such a mechanism, real-time communication in any language—"nonconfigurational" or configurational—would be far more burdensome than it actually is. Furthermore, I suggest that non-syntactic influences on parsing, such as frequency statistics and context, affect "good enough" processing, but can still remain unconnected to automatic parsing operations that are governed solely by the syntax.

1.3 Summary

I have discussed two areas of inquiry that have been under-examined by psycholinguists to date: cross-linguistic research outside of the Indo-European language family, and the actual interpretations derived from sentences that place certain strains on the HSPM. These strains may force the HSPM into a "shallow processing" or "good enough" mode, such that heuristic-based analyses are used as the bases for interpretations, rather than exhaustive algorithmic parsing procedures. The three Odawa processing experiments reported on in the remainder of this dissertation each address one or both of these areas. By conducting research of this type in Odawa, it is my hope to at least demonstrate that psycholinguistics as a discipline must widen the scope of its interests, especially with respect to the inventory of languages in which experimental research is conducted. If we are going to make claims about universal properties of the human sentence processing mechanism (HSPM) and human sentence production system (HSPS), then we must collect more evidence that these properties actually exist across languages and sentence types.

Chapter 2 consists of the background, methods, results and discussion of a sentence production experiment in Odawa, with specific reference to the nature of incrementality in sentence production. Chapter 3 consists of the background, methods, results, and discussion of a sentence comprehension experiment in Odawa, with special attention paid to predictions derived from word order and verb form frequencies in the language as compared to purely syntactic predictions. I also highlight evidence that a "good enough" mechanism is responsible for the off-line interpretation of certain constructions. Chapter 4 consists of the background, methods, results, and discussion of a second sentence comprehension experiment in Odawa. The purpose of this experiment was to determine the influence of non-syntactic information sources in parsing and interpreting sentences in Odawa containing null pronominals (*pro*s). The results also demonstrate heuristic-based comprehension mechanisms in the HSPM.

CHAPTER 2

Odawa Sentence Production

2.0 Experiment 1

One major motivation for the production experiment reported in this chapter is the lack of corpus data in Odawa. Such corpus data are needed to provide frequency counts for the various verb forms and word orders in the language. Over the last 15 years, it has become recognized that frequencies within a language influence parsing in systematic ways. Researchers might not agree whether lexical and/or structural frequencies affect on-line parsing procedures as one of many constraints on sentence parsing (cf. MacDonald, et al., 1994; Trueswell, 1996), or whether the effects of frequency act to direct reanalyses (cf. Frazier, 1995; Gibson & Schütze, 1999). It has become standard, however, for researchers from both sides of this debate to include frequency data based on available corpora in their work.

The problem with Odawa is that it is not traditionally a written language. Furthermore, written texts that do exist (for example, those printed in *Oshkaabewis Native Journal*), as well as transcribed oral texts, tend to be mythological stories or historical accounts of events handed down from one generation to the next. As such, they do not reflect the sort of speech heard in every day conversation; thus, as in any language, there is a disconnect between written and oral language. Considering the importance of establishing at least some basic idea of structural and lexical frequencies within the language, I designed a production experiment to elicit descriptions of simple line drawings. The descriptions were elicited with one of three question prompts, which also allowed me to explore the issue of incrementality in sentence production, as was described in some detail in §1.2.1.1. In the sections that follow, I attempt to provide both descriptive generalizations about lexical and structural frequencies in Odawa, as well as evidence for a higher-level analysis of the influence of lexical accessibility on sentence production.

2.1 Background and predictions

2.1.1 Frequency data in related Algonquian languages

One of the two primary motivations for conducting the present production experiment was to collect some basic frequency data for Odawa. Previous research in related Algonquian languages provide some hint of how the Odawa data might come out, despite the fact that the frequency data in related languages have been based on written texts.

Bruening (2001) examined seven Passamaquoddy texts and found that in sentences with just one NP (i.e., in transitive sentences with one *pro*-dropped NP), the subject preceded the verb 71% (286/402) of the time, and the object of a transitive followed the verb 81% (191/297) of the time. Bruening noted that few sentences occurred with more than one overt NP, but when they did, 79% (49/62) occurred in SVO order. The other orders occurred with the following frequency: SOV (5%, 3/62), VSO (6%, 4/62), VOS (5%, 3/62), OVS (3%, 2/62), OSV (2%, 1/62). Regarding the inverse, Bruening found that it was used far less frequently than the direct, so much so that frequency counts were unreliable. Nevertheless, he found that the subject of the verb in inverse clauses followed the verb 56% of the time (9/16), and the object preceded the verb 80% of the time (4/5). Both the direct and inverse counts supported Bruening's syntactic analysis of the language (see Chapter 1 for a summary).

Dryer (1995, 1997), based on frequency counts taken from the Ojibwa texts in Nichols (1988), also noted that transitive sentences containing two overt NPs were uncommon. When they did occur, however, SVO was also the most common three-constituent order, accounting for 48% (12/25) of the total. The other word orders occurred with the following frequencies: VOS (20%, 5/25), VSO (16%, 4/25), OVS (12%, 3/25), and SOV (4%, 1/25). For transitive clauses containing only one overt NP, the subject followed the verb 72% of the time (186/258), and the object followed the verb 84% of the time (130/155). Proulx (1991, p. 200) provided a similar count of three-word orders based on texts in Bloomfield (1956): 17 SVO, 7 VSO, 2 OVS, and 1 VOS. Based on these counts, Dryer concluded that the basic word order for Ojibwa is SVO. This claim contradicted Tomlin & Rhodes (1979), who argued that VOS was the basic order; however, Tomlin & Rhodes's definition of basic word order differed from that used here. Tomlin & Rhodes argued that SVO sentences, with both NPs overt, occur in pragmatically marked contexts, but VOS sentences occur in pragmatically neutral contexts. Since pragmatically neutral contexts of the sort conducive to VOS order are relatively uncommon, that order is actually less frequent than SVO order. Nevertheless, according to their argument, VOS order, since it occurs in contexts where one usually finds verb-only sentences (with *pro*-dropped NPs), is unmarked. As Dryer (1995) pointed out, however, the fact that contexts in which VOS order occurs are more similar to those in which the subject and object NPs are null is not a sufficient argument to claim that the basic syntactic configuration of a transitive Ojibwa clause is VOS.

Lucy Thomason (p.c.) reports that in Fox (Mesquakie) similar frequencies are observed. Based on a count of transitive clauses occurring in a text pulled at random from her database, Thomason found that only 6% (9/149) of the transitive sentences contained both overt NPs. And the inverse was much less frequent than the direct: The same text contained only 15 inverse verbs, compared to 134 direct. With respect to word order frequencies, particularly in direct sentences with a proximate subject and one obviative object, SVO was the most common order, followed by VOS, SOV, VSO, and OVS/OSV, in that order.

Finally, in Western Naskapi, frequency counts based on texts are difficult to acquire, due to the copyright exercised on the texts by the Naskapi Nation. Julie Brittain (p.c.) provided me with the following general count of verb forms. From one story chosen at random, Brittain counted 66 direct clauses, and 18 inverse.[20]

Based on the information available from these related languages, I expected participants in the present production experiment to use more direct sentences than inverse, even though the balanced elicitation conditions (described below) could have elicited equal numbers of each. Since I was interested in discovering what if any three-word order is more frequent in the language, instructions were given to "describe the drawings as if you were describing them to someone who could not see them" (see §2.2.3). Nevertheless, I expected that participants would often omit one or more arguments. When sentences containing two overt NPs were used, however, I expected that SVO would be the most common order, at least in direct sentences. Predictions as to the effect of the accessibility of lexical items or concepts on production are considered in the next section.

[20] Thanks to the Naskapi Development Corporation at Kawawachimach, Quebec, for use of the story *kwâkwâchâw kiyâ sîsîpich* as told by John Peastitute in 1968 and translated by Silas Nacinaboo and Alma Chemaganish.

2.1.2 Incremental production in Odawa

In the study of sentence production, the psychological notion of conceptual accessibility is ascribed three effects: One, accessible concepts are produced earlier in the string than less accessible concepts (Bock 1987). Two, accessible concepts tend to be topics (old or given information) (Lambrecht, 1994). Three, accessible concepts tend to be syntactic subjects (Bock & Warren, 1985; see also Tomlin 1995 for a cross-linguistic investigation of which generalizations hold in a sampling of languages). The problem is, all three effects tend to intersect in English and most other Indo-European languages. Researchers in this area are limited by the languages with which they work: Word order constraints, case marking, limited inventories of verb forms, and intonational features conspire to obfuscate the effects of accessibility on the surface features of an utterance. The second main goal of the present experiment was to tease apart these separate but related factors in order to better understand the extent to which accessibility affects sentence production. In particular, are the effects of accessibility limited to order of mention (string position of accessible entity) or pragmatic considerations (such as topicalization)? Or, as I will argue based on the data presented below, does accessibility affect the syntactic features of a sentence, which in turn have consequences for word order and information packaging? In order to explore this question from a new perspective, I present production data from Odawa, whose relatively rich inventory of verb forms, free ordering of syntactic constituents, pervasive *pro*-drop, and lack of case marking allow for a view into the mechanisms of sentence production which is clearer than that afforded by languages that are more commonly used in psycholinguistic studies.

In the vast majority of languages (84%, according to Hawkins, 1983), including nearly all of those investigated over the decades by psycholinguists, syntactic subjects appear sentence-initially (or at least prior to the object), coinciding with topic position in the string (Reinhart, 1982). Work by Carroll (1958), Bock (1986, 1987), Bock & Levelt (1994), Bock & Warren (1985) and others show that when an NP is made accessible via showing a picture of a semantically related item, asking a question, or establishing a context, speakers tend to begin their sentences with that same introduced NP. Bock and Warren's (1985) work on the production of passives in English led them to conclude that the most accessible entity claims not only an early position in the string, but also a more prominent syntactic function (i.e., subject, or non-oblique dative in ditransitive structures). This conclusion was based on the fact that the ordering effects of accessibility observed for NP arguments were not observed for NP conjuncts in semantic priming tasks. For example, if participants read the word *preach*, and then were shown a picture of lightning striking a church, they were more likely to use a passive to describe the picture (*The church is being struck by lightning*) than if they were showon an unrelated semantic prime. Levelt and Maassen (1981), however, found that conjoined NPs were not at all sensitive to the same sorts of manipulations that affected entire sentences, and thus the phrasal conjunct condition used by Bock & Warren as a control may not have been appropriate. Due to the rigid word order of English, though, no other control was available. Therefore, evidence from these and other studies do not clearly answer the basic question: Does accessibility affect only "surfacey" linearization phenomena, in which case speakers may begin a sentence with an extremely accessible NP, only to have to repair the subsequent utterance to accommodate a non-canonical initial NP (cf.

Schriefers, Teruel, & Meinshousen, 1998, p. 612)? Or, alternatively, can accessibility drive "deeper" syntactic decisions such as verb form choice, which consequently determine linearization?

What is needed to begin to more clearly identify the relationship between accessibility and production is a language that exhibits "free" surface word order (unlike English) with sentential stress in simple transitive utterances unaffected by permutations of the word order (also unlike English). In such a case, an NP bearing any grammatical function could occur sentence-initially without forcing the speaker to resort to extremely infrequent prosodic patterns (e.g., *Fish, Bill likes*). Furthermore, it would be helpful to examine production in a language that contains one verb form for when the subject (and thematic agent) is designated as the topic, another for when the object (and thematic patient) serves as topic, and yet another form for when the patient serves as both topic and subject. Odawa is just such a language.

The syntax of Odawa is ideally suited to the task at hand, since it displays all of the characteristics listed above. These characteristics allow for extreme flexibility in the way any given speaker may choose to encode a sentence in a given context and provide a fertile testing ground for current assumptions about the nature of language production. The experiment reported here sought to investigate the extent to which conceptual accessibility determines how a speaker of such a language decides how to encode a given message in a given context. The free word order of Odawa, illustrated in Chapter 1, allows speakers to begin any sentence with whatever concept is most accessible. Any NP, then, can be assigned sentence-initial position without much associated syntactic work (no overt case marking [but cf. Déchaine & Reinholtz, 1998] or intonational re-phrasing, e.g., topic-clefting), and without even having to resort to a less frequent verb form, as is the case with the English passive.

As discussed in detail in Chapter 1, the version of Odawa syntax adopted here (Bruening, 2001) posits A-movement of the proximate (morphologically unmarked) NP in both direct and inverse clauses to the specifier of a functional phrase above vP. In the direct, the proximate NP is the syntactic subject and thematic agent, while the syntactic object and thematic patient is morphologically marked as obviative. In the inverse, the proximate NP is the thematic patient and the *inverted* object, while the obviative is the syntactic subject and thematic agent. The choice of which verb form to use, and (in independent clauses, at least) which NP to mark as proximate and which to mark as obviative, apparently depends on a number of factors. Taken together, these factors determine the relative "centrality" (cf. Richards, 2000) of each, with the more central NP assigned proximate status. In Chapter 4, I explore the factors contributing to this choice (see also Aissen, 1997, 1999a, b, 2001; Christianson, 2001a, b, in press). One of the main findings in Chapter 4 is that Odawa speakers have difficulty comprehending sentences where the proximate NP is overt and the obviative NP has been *pro*-dropped. I argue that this result supports the idea that the proximate-obviative distinction essentially encodes the discourse status of the NPs, with the proximate NP more topical (or "given" [Chafe, 1976]) and the obviative NP less topical (or "new"). And where discourse context is lacking, the relative topicality of the NPs can be derived from features of the NPs themselves, including animacy and thematic role. As such, the inverse—in which the inverted object and themtic patient is proximate, and according to Bruening's (2001) account of Algonquian syntax, A-moves to sentence-initial position—represents a sentence type not found in any language examined to date by psycholinguists interested in sentence production. The inverse differs from an English passive, for example, in both the flexibility of its word order and, more importantly, the morphological marking of the discourse status of both its arguments. Along with the direct and passive sentence types found in Odawa, it provides an opportunity to examine the interaction of syntax, discourse, and conceptual accessibility in sentence production.

Several comments on the verb types and morphology are required before proceeding to the experiment. First, the passive form (termed "lexical passive" in Valentine, 2001) (2.1a) is, it will be assumed here, analogous to its English counterpart except as follows: As in English, the passive does not assign an external theta-role. But, since the language contains no oblique case or theta-role assigners, no external NP is licensed (see for a full discussion Bailin & Grafstein, 1991; Christianson, 2002; Rhodes, 1990; Valentine, 2001). Furthermore, since the Odawa passive appears to be unable to license agentive adverbs (Roberts, 1987), as in (2.2b), I assume that there is no thematic agent at all syntactically present.

(2.1) a. Kwe-zens gii-gnajiibin-igaazo

woman-Diminutive PAST-tickle-Passive

'A/The girl was tickled'

b. ??/* Kwe-zens gii-gnajiibin-igaazo wewiib

woman-Diminutive PAST-tickle-Passive quickly

'A/The girl was tickled quickly'

The direct form is transitive and active. There is a general consensus among linguists who work with indigenous languages of the Americas that the inverse form is also transitive and active (Aissen, 1997, 1999b; Bruening, 2001; Jelinek, 1990; Richards, 2000; but see Rhodes, 1994). The difference between the two verb forms is the way in which each maps its obviation morpheme onto the nominal obviation morpheme. In a direct clause, the verbal obviation morpheme agrees with the "peripheral" argument, where "peripheral" is determined by the NP's lower rank on a one or more hierarchies (discussed in detail below and in Chapter 4; see also Christianson, 2001a, b, in press) relative to that of the other argument in the clause. In an inverse clause, the verbal obviation morpheme agrees with the "central" argument, where "central" is determined by the NP's higher rank on the same hierarchies relative to the other NP in the clause (see also Aissen, 1997, 2001). The rather confusing interaction of subject/object, agent/patient, and central/peripheral argument has led some to translate inverse clauses as passives (cf. Rhodes [1994], who argues that the syntactic object of inverse clauses is the agent, contra Aissen [1997, 2001] and Richards [2000]). The facts of Odawa, however, along with cross-linguistic observations on the uniformity of thematic role assignment (Baker, 1988), support transitive, active readings of both direct and inverse sentences, with their respective argument statuses as represented in (2.2).

(2.2) a. Direct: Subject = Agent = Central argument (*like English*)

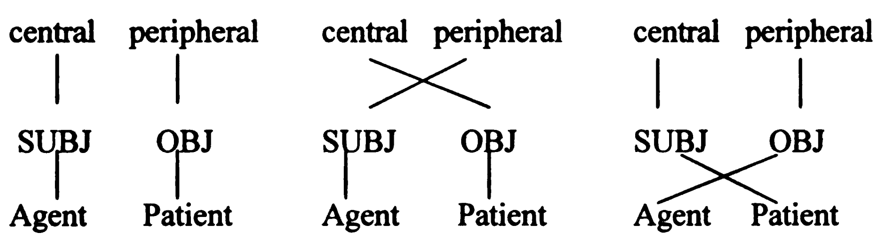
Object=Patient=Peripheral argument

b. Inverse: Subject=Agent=Peripheral argument

Inverted Object=Patient=Central Argument

Various hierarchies appear to play a crucial role in both the surface and underlying syntax in many languages. Strictly speaking, a "participant hierarchy" (Silverstein, 1976) ranks the participants in a sentence according to person. In Odawa, along with at least some other Algonquian languages (e.g., Ojibwa [McGinnis, 1995]; Ojibwa, East Cree [Junker, 2000]), the ranking is *second > first > proximate (central) third > obviative (peripheral) third.* A second type of participant-related hierarchy is an animacy hierarchy where participants are ranked roughly according to the "proto-agent" characteristics they display (Dowty, 1991; Minkoff, 2001), i.e., *human >animal > inanimate*. The exact characterization of the animacy hierarchy as it is manifested in any given language may be quite flexible. Aissen (1997, 1999a, b) aligned both hierarchies within the framework of Optimality Theory (Prince & Smolensky, 1993) to account for the syntactic and semantic properties of inverse clauses. Aissen's basic claim was that, although transitive, inverse and passive verbs share the property of matching the central (proximate) argument with the object/patient and the peripheral (obviative) argument with the subject/agent, as illustrated in (2.3) (adapted from Aissen, 1997), albeit at a different representational tier. (Note that [2.3a, b] = [2.2a, b].)

(2.3) a. direct/active b. inverse c. passive



If this syntactic characterization of the functional parallel between the inverse and passive is correct, we should see some parallels between the inverse and passive in Odawa production.

Importantly, the contrast between direct and inverse verb forms can be analyzed as a grammaticalization of topicality, as argued by Givón (1994) and Cooreman (1994). A "central" argument is central by virtue of its rank on the participant hierarchy and/or animacy hierarchy (as discussed above). However, when the two arguments in a sentence are equal on these scales, topicality can affect verb form choice (Christianson, 2001a, b, in press). In cases where the patient is more topical, an inverse verb highlights this state of affairs without changing the grammatical functions of the arguments, as would be the case in a passive sentence. However, it is important to note that verb form change is not the only possible way that topicality can be manifested: Without changing the verb form (in contexts where arguments maintain their respective statuses as "central" and "peripheral" but, for example, the central argument is new rather than given information), the topical constituent can be placed sentence-initially or dropped altogether (*pro*-drop). In this case, the direct verb form is maintained while word order and/or NP elision encode the relative topicality of the arguments.

The three verb forms—direct, inverse, passive—allow us to make some strong predictions regarding the effects of accessibility on order of mention, topicality, and subjecthood. Specifically, if accessibility affects order of mention, we would expect to see scrambled orders with the direct form (which is by far most frequent in the language) used almost exclusively when the patient is more accessible. If accessibility affects the topicality of the accessible NP, we should see an increase in inverse use in conditions where the patient is more accessible than the agent. And if accessibility influences choice of the syntactic frame, thus determining the choice of syntactic subject, we should see more passives used in the same situations. These predictions are elucidated in §2.2.4.

2.2 Methods

2.2.1 Participants

Twenty-one native speakers of Odawa (sixteen women and five men) took part in the experiment. All participants were between the ages of 35 and 75 (five over age 65) and lived in or adjacent to the First Nations Reserve of Wikwemikong, Manitoulin Island, Ontario. All participants described themselves as native speakers of Odawa as established by the following criteria: 1) Odawa was the language they had used in the home when they were growing up. 2) Their first (and only) exposure to English as a pre-teen was at school or elsewhere outside of the home. 3) Odawa is their language of choice when speaking with others in the community who also speak the language. 4) All participants were deemed "native speakers" by the native-speaker Odawa language teacher who conducted the interviews. Each participant was paid $20 Canadian for their participation, which lasted an average of 45 minutes. Experimental sessions took place in a variety of locations (see §3.4.7 for issues associated with "field psycholinguistics"). Table 2.1 contains the subjects' age, gender, and the location of their experimental sessions.

Table 2.1: Subjects' approximate age, gender, and location of session

Part. #	Gender	Age	Residence	Location of Session
1	F	72	Wikwemikong	participant's kitchen
2	F	52	Wikwemikong	same as #1
3	M	47	Wikwemikong	participant's kitchen
4	F	76	Wikwemikong	participant's kitchen
5	F	46	Wikwemikong	participant #1's kitchen
6	F	75	Wikwemikong	participant's kitchen
7	F	69	Wikwemikong	participant's kitchen
8	F	70	West Bay	participant's kitchen
9	M	55	Wikwemikong	participant's basement
10	F	42	Wikwemikong	participant's kitchen
11	F	56	Wikwemikong	participant's office
12	M	56	Wikwemikong	participant's kitchen
13	M	35	Wikwemikong	participant's kitchen
14	F	49	Wikwemikong	participant's kitchen
15	F	50	Wikwemikong	Band Office meeting room
16	F	46	Wikwemikong	Band Office meeting room
17	F	38	Wikwemikong	Band Office meeting room
18	M	39	Wikwemikong	Band Office meeting room
19	F	38	Wikwemikong	Band Office meeting room
20	F	42	Wikwemikong	Band Office meeting room
21	F	53	Wikwemikong	participant's kitchen

2.2.2 Materials

Participants were shown 153 black and white line drawings of various actions and depictions of everyday objects in certain spatial configurations. 33 of these drawings were of experimental interest, while the remaining 120 were fillers. The 33 drawings of interest depicted transitive actions for which a common verb occurs in the language (as determined with the help of native speakers). The drawings (see Appendix B) were similar—and in many cases identical—to those used in Experiments 2 and 3 below.[21] The drawings were done on white paper, and each was inserted into a clear plastic sleeve in a large three-ring binder. An example of the line drawings is provided in Figure 2.1.

Figure 2.1: Example line drawing from Experiment 1

Three lists were developed in which descriptions of each of the 33 test drawings were elicited with one of three questions. The questions were asked at the same time each page was turned in the binder, such that the questions and the drawings were presented more or less simultaneously. These questions served as the three experimental conditions.

(2.4) a. Aaniish e-zhiwebag zhinda? General Question (GQ)
what PRES.Conj-happening here *What is happening here?*

b. Aaniish e-nanikiid gwiizens? Agent Question (AQ)

[21] Thanks to Alan Beretta and Zenzi Griffin for sharing some of their line drawings for use in Experiments 1, 2, and 3. Thanks also to Aaron Tomak, who drew so many of the drawings used in Experiments 2 and 3.

what PRES.Conj-doing boy *What is the boy doing?*

c. Aaniish e-zhiwebizid kwezens? Patient Question (PQ)

what PRES.Conj-happening.to girl *What is happening to the girl?*

Questions such as these have been used to elicit sentence tokens in production experiments since Carroll (1958). Notice that in Odawa, the three questions are parallel in terms of word order and verb type. The NPs in the AQ and PQ questions are last, unlike the English translations. The verb type is also identical in each question: direct forms with conjunct agreement, due to the fact that they are used in WH-questions.[22] Also important is the lack of overt case marking in Odawa. In a language such as German, there exists the possibility that elicitation questions of the sort described here could serve to prompt active responses with non-nominative NPs in non-canonical order because a German PQ could have the NP in question in dative case. Odawa presents no such confound, since the NPs in the AQ and PQ questions display no overt case marking (or, more importantly for Odawa, no obviation marking).

Each condition occurred 11 times on each list, and rotated from list to list. The test drawings and their questions were randomized among the fillers within certain constraints: All but two test drawings were separated by at least one filler, usually two or more. The two that occurred sequentially (due to an error on my part) did not appear to interact with one another in any significant way.

Finally, the 33 experimental items were divided into three subgroups: One with human agents and human patients (H-H, $n = 22$), one with human agents and animal patients (H-A, $n = 5$), and one with animal agents and human patients (A-H, $n = 6$). The

[22] In Algonquian languages, verbs in independent clauses display agreements paradigms different from those in subordinate or conjoined clauses (cf. Brittain, 2001; Valentine, 2001), as mentioned in Chapter 1. Verb forms in WH-questions pattern with verbs in subordinate clauses.

number in the H-A subcondition was unintentionally reduced from six to five due to an unfortunate omission. The motivation for including these subgroups of drawings was in part the intuitive suspicion on my part (as a non-native speaker of the language) that the relative animacy of the characters in the drawings could affect verb choice, despite the fact that two native Odawa speakers independently reported prior to data collection that it should not. In a great number of the world's languages, the relative animacy of subject and object appear to affect both sentence processing and grammar (e.g., Ferreira, 1994; Minkoff, 1994, 2000, 2001). As explained fully in Chapter 4, Odawa appears to distinguish in certain ways between humans and animals, even though both are grammatically animate according to the grammatical gender system of the language (Corbett, 1991). Thus my suspicion was that drawings with human agents and animal patients might be described differently from drawings with animal agents and human patients.

2.2.3 Procedure

Each list of questions was administered to seven of the 21 participants, so each drawing was presented with each of the three questions an equal number of times. Participants saw any one drawing only once. Instructions were given in either Odawa or English, whichever the participant preferred. Practice trials (generally eight in number), and elicitation questions were administered exclusively in Odawa by a native speaker assistant. I was present at all times to monitor the administration of the questions, appropriateness of the responses, and the function of the tape recorder. Participants were instructed (in English and Odawa) to respond as fully as possible "as if describing the picture for someone who could not see it." They were asked at the outset, and reminded through the practice trials to name all of the "actors" in the drawings. Nevertheless, elisions were common during the actual experimental trials, and it was deemed more important to not interrupt the speakers and experimental process than to insist that speakers conform to instructions.

Data were collected under rather unusual circumstances (see also §3.4.7): Most sessions took place around the kitchen tables in the homes of participants in Wikwemikong. All sessions were recorded on a Marantz PMD222 tape recorder with an external microphone. Due to the varied locations of the sessions, a substantial amount of background noise (dogs, babies, friends, telephones, televisions, etc.) can be heard on the tapes. Fortunately, only a small number of responses had to be discarded as unintelligible. A native speaker who attended approximately one-half of the experimental sessions (but not the interviewer herself) assisted me in transcribing the tapes.

2.2.4 Predictions

If conceptual accessibility affects order of mention only, then speakers of Odawa might be expected to produce direct clauses independent of conditions affecting the topicality or syntactic function of a given constituent. Recall that there are two ways in which topic-focus relations can be encoded in Odawa: via word order, in which topicalized constituents can be placed sentence-initially (and/or "topic-dropped" [cf. Grimshaw & Samek-Lodovici, 1998]), and via verb form, using direct, inverse, or passive form.

Consider first a situation in which accessibility affects only "surfacey" features of the string, and it is assumed that "deeper" syntactic features of the utterance (verb form and associated assignment of syntactic functions and thematic roles) depend on the relative initial activation levels of the elements that play a part in the message. It is straightforward to extend results from other languages to Odawa. In the GQ and AQ conditions, the direct form should be as highly favored as the active form in languages like English.

Now, imagine a response to a PQ question about the drawing in Figure 2.1, in which the concept "girl" is made accessible via the question: *kwezens* 'girl' is activated essentially concurrently with the participant's apprehension of the scene. After a categorical procedure combines the accessible lemma *kwezens* with the obviation morphology *–an* (Levelt, 1989, pp. 236-46), the speaker begins with *kwezens-an,* the most accessible NP, but one which is initially marked as neither topic nor syntactic subject. If the NP is so accessible in the context that the speaker feels it is not necessary to mention, s/he leaves the lexeme unpronounced (and a *pro* does the syntactic work for the full NP). It must be stressed that the string-initial position (and/or elision of *kwezensan*) in this example signals the NP's topicality. However, such surface features are derivable directly from the accessibility of the concept, and, importantly, are fully consistent with the use of the direct verb form. Unlike English, preposing the patient in a direct Odawa clause does not interfere with normal intonational phrasing, nor does it require expletive insertion. Since the direct form is by far the most frequently used in the language, it should be highly favored in a strictly incremental model of production, the model most consistent with the idea that accessibility affects only the string position of constituents, with syntactic considerations following exclusively from the string position of an NP, which in turn depends on the relative accessibility of the concepts involved. On this accessibility-based story of production, passives are used in English more often in response to PQ-type questions because once a speaker has uttered the Patient NP, he or she is committed to using a verb form that allows for a patient subject (while maintaining intonational and lexical normalcy), since the sentence-initial NP in English sentences is almost always the syntactic subject. Due to its flexible word order, Odawa is not constrained by this requirement.

In a model of sentence production where the effects of accessibility bear directly on pragmatics, or "information structure" (Lambrecht, 1994), we would expect speakers of Odawa to utilize an increased number of inverse verbs in response to PQ questions. Givón (1994) argues that the inverse is used to morphologically signify pragmatically marked sentences in which the patient is more topical than the agent. Note that the grammatical functions of the arguments of an inverse verb do not change: The subject is still the agent and the inverted object is still the patient (Aissen, 1997, 1999b and references cited therein; but cf. Rhodes, 1994). Nor are Odawa sentences with inverse verbs more limited in terms of word order options than those with direct verbs. The only difference, according to Givón, is that the topic status of the patient is greater than that of the agent, thus the patient is proximate. In the account of Algonquian syntax adopted here, this proximate marking on the patient results in it moving to a position higher than the logical subject. So if accessible concepts are initially assigned topic status, we should see large numbers of inverse clauses in the PQ condition, where the question serves to topicalize the patient. Specifically, once *kwezens* is made accessible by the PQ question *Aaniish e-zhiwebizid kwezens* ('What is happening to the girl?'), the Odawa speaker can begin immediately with *kwezens* (by-passing even any categorical procedure attaching the obviation morpheme) and continue with either the obviative agent NP or the verb in inverse form.

Finally, the existence of a passive verb in Odawa allows us to observe the full potential range of accessibility effects. The only NP licensed by the passive verb in Odawa is the patient, and, in contrast to the inverse case, the patient in a passive is the syntactic subject as well as the (default) topic. Therefore, if the increased accessibility of an NP influences its syntactic status, above and beyond order of mention (or elision) or topicality, we should observe a significant bias for passive verbs in the PQ condition.[23] It is this contrast between the passive and the inverse verbs in Odawa (a distinction not found in Indo-European languages) that allows us to observe the manner in which accessibility differentially affects the pragmatic vs. syntactic properties of an utterance.

2.3 Results

After discarding 10.5% of the descriptions of the experimental drawings for various reasons (unintelligibility, lack of an answer, wrong question asked), 620 tokens were transcribed and translated into English by the author and a native speaker of Odawa.[24] The total number of responses by verb form and question condition and overall proportions are provided in Table 2.2.

[23] Since passives only have one NP, our instructions to "mention both actors" implicitly prohibited their use.
[24] Responses to filler drawings—which depicted transitive, intransitive, ditransitive, and locative situations—have yet to be transcribed and analyzed. The total number of tokens exceeds 3,200.

Table 2.2: Responses by verb form and question condition

(Dir=Direct, Inv=Inverse, Pass=Passive, Intr=Intransitive; GQ=General Question; AQ=Agent Question; PQ=Patient Question)

Question	GQ				AQ				PQ			
verb form	Dir	Inv	Pass	Intr	Dir	Inv	Pass	Intr	Dir	Inv	Pass	Intr
Word Order												
V	5	0	8	14	13	0	4	31	2	0	81	14
SV	6	4	5	8	0	1	0	1	6	16	14	3
VS	3	1	19	20	1	1	2	7	1	9	19	4
OV	8	0	--	--	15	0	--	--	2	0	--	--
VO	13	0	--	--	91	0	--	--	5	0	--	--
VSO	6	1	--	--	3	0	--	--	5	0	--	--
VOS	5	1	--	--	2	0	--	--	0	0	--	--
SVO	63	2	--	--	29	0	--	--	15	2	--	--
OVS	2	3	--	--	0	0	--	--	0	3	--	--
SOV	6	3	--	--	3	0	--	--	1	1	--	--
OSV	4	2	--	--	0	0	--	--	0	1	--	--
Tot.	**121**	**17**	**32**	**42**	**157**	**2**	**6**	**39**	**37**	**32**	**114**	**21**

The overall results in Table 2.2 displayed a remarkable variability in responses, even under the controlled conditions of the experiment. At the same time, the responses showed a high degree of systematicity and predictability: Verb form varied predictably according to question type, and one word order (SVO) occurred far more frequently than would be predicted by question type alone. Overall, despite the "exotic" appearance of Odawa surface syntax, the sentences elicited in this experiment resemble those elicited in similar experiments in "configurational" languages, such as English. The overall frequencies of the six possible three-constituent orders in the present Odawa data are quite similar, for example, to frequencies in Polish (Siewierska, 1993, p. 235, reported in Dryer, 1997, p. 87), which is underlyingly SVO but with quite free word order (Table 2.3).

Table 2.3: Three-constituent word order frequencies from a Polish corpus (Siewierska, 1993) and the present Odawa data

	SVO	SOV	OVS	OSV	VSO	VOS
Polish	72.5%	2.4	7.4	1.5	6.5	9.5
Odawa	74.3%	6.9	1.4	2.8	9.7	4.9

The data obtained in this experiment strongly suggest that conceptual accessibility influences not simply order of mention, or the topicality of the accessible NP, but instead the higher-level choice of syntactic frame. What appears to be important to the sentence production system is to make the most accessible NP the syntactic subject of the sentence. An accessible concept seems to prime a syntactic frame that allows the accessible NP to serve as the syntactic subject, a conclusion also reached by V. Ferreira & Dell (2000) based on English data. Before elaborating on this interpretation of the data, I take a moment to report the relevant descriptive and inferential statistics, which further support this view.

The first particularly noteworthy aspect of the data is that they were so consistent with the picture of Odawa syntax adopted in Chapter 1 and of the arguments regarding the basic SVO (direct) word order, also discussed in Chapter 1 and in §2.1.1. First, as observed in other Algonquian languages, the verb form was far more common than the inverse (315 direct vs. 51 inverse tokens), even when one of the three conditions (the Patient Question condition) was particularly conducive to inverse use. Second, Odawa not only appears to be an SV language and a VO language (cf. Dryer, 1997), it is clear that SVO is by far the most frequent word order, at least in the direct form. In direct sentences, the subject preceded the verb 133 times, and followed it just 32 times. In inverse sentences, the subject preceded the verb 32 times, and followed it 19 times. Both ratios are consistent with the syntactic account of Passamaquoddy by Bruening (2001), which I adopted in Chapter 1 for Odawa, in which the base and final positions for the subject in both direct and inverse clauses are pre-verbal.

SVO was argued in Chapter 1 to be the basic word order for direct clauses, and OSV for inverse. By far the most frequent three-constituent order (i.e., order with a verb and two overt NPs) was SVO, at least in the direct form. SVO was considerably more frequent than any other two-NP word order in every one of the question conditions. The number of two-NP descriptions in the inverse was small (as observed in textual counts in other Algonquian languages), and no one order emerged as most common. However, one related trend in the data point toward a basic OSV inverse order. Recall that the obviation system has been analyzed as a grammaticalization of the topichood of one of the NPs, with the more topical NP being proximate and the less topical obviative (Aissen, 1997; Christianson, 2001a, b, in press; Givón, 1994; Cooreman, 1994). Following Grimshaw & Samek-Lodovici (1998), among others (cf. Choi, 1999; Lambrecht, 1994), we can assume that in languages that allow *pro*-drop (including, perhaps English, cf. Harvie, 1998), the more topical NP(s) is (are) the one(s) to be *pro*-dropped. Since syntactic subjects also tend to be topical, they tend to be more prone to *pro*-drop than objects. If the obviation system in Odawa is a grammaticalization of topicality (among other things, perhaps), we would expect to see proximate agents *pro*-dropped in direct clauses, and proximate patients *pro*-dropped in inverse clauses. This prediction was borne out in the data from Experiment 1. In direct clauses, the agent was *pro*-dropped in 216 tokens, compared to the patient in just 17 tokens. In the inverse, despite infrequent use, the expected pattern emerged as well: The patient was *pro*-dropped in 32 tokens, whereas the agent—which is obviative in inverse clauses, recall—was not *pro*-dropped even once. This last result is quite striking, actually, since the only sentence types that were not produced in the experiment were inverse V, VO, and OV sentences, which form a natural class of inverse clauses with a *pro* obviative (less topical) and overt proximate NP. In Experiment 3 (Chapter 4), we see that Odawa speakers also have trouble comprehending sentences—direct and especially inverse—with *pro* obviative and overt proximate NPs.

Mention should be made of two additional trends observed in the data that support related analyses of Odawa syntax, which will not be elaborated on here, however. First, both passive and intransitive sentences occurred more often with post-verbal subjects than with pre-verbal subjects. In the passive, there were just 19 SV tokens compared to 40 VS tokens, despite the fact that most passive responses came in the Patient Question

(PQ) condition, which topicalized the patient (and subsequent subject of the passive). These numbers fail to support the prediction of accessibility-based, strictly incremental production, which would predict that the patient of the passive would be highly accessible and should therefore occur string-initially. (However, since one could argue that the 81 verb-only passive sentences used in the PQ condition represent SV strings with *pro*-dropped subjects, the low number of SV passives in the PQ condition is at best weak evidence against strictly incremental production.).[25] These VS passive data also support the analysis of the Odawa passive in Christianson (2002), in which the patient NP remains post-verbal until after spell-out (cf. Chomsky, 1995), arguably due to a weak subject (EPP) feature associated with the tense phrase in Odawa. Similarly, intransitive VS constructions also outnumbered intransitive SV constructions, 31 to 12. It appears as though these numbers might reflect the two types of intransitives in Odawa: unergative intransitives (also termed "actor" [cf. Davies, 1986 on Choctaw], or "agentive" [cf. Haspelmath, 1994] intransitives), whose subjects are VP-external (and receive an agent theta role), and unaccusative intransitives (also termed "undergoer" [cf. Davies, 1986] intransitives), whose subjects are VP-internal (and receive a patient theta role). These two varieties of intransitives are well attested throughout the world's languages, and have received some attention in the psycholinguistic literature (De Vincenzi, 1991; Gahl, 1998), but their syntax and behavior in Odawa have yet to be thoroughly investigated.

I turn now to a more formal analysis of the data, dealing first with the effect of question type on verb form. A within-subjects, single-factor multiple analysis of variance

[25] One intriguing question regarding models of strictly incremental production is how to account for *pro*-drop at all. If accessible concepts are in a sense required to be produced early, there must be some inhibition mechanism at work to suppress the production of highly accessible concepts in *pro*-drop languages. What this mechanism is has not, to my knowledge, been discussed in the literature.

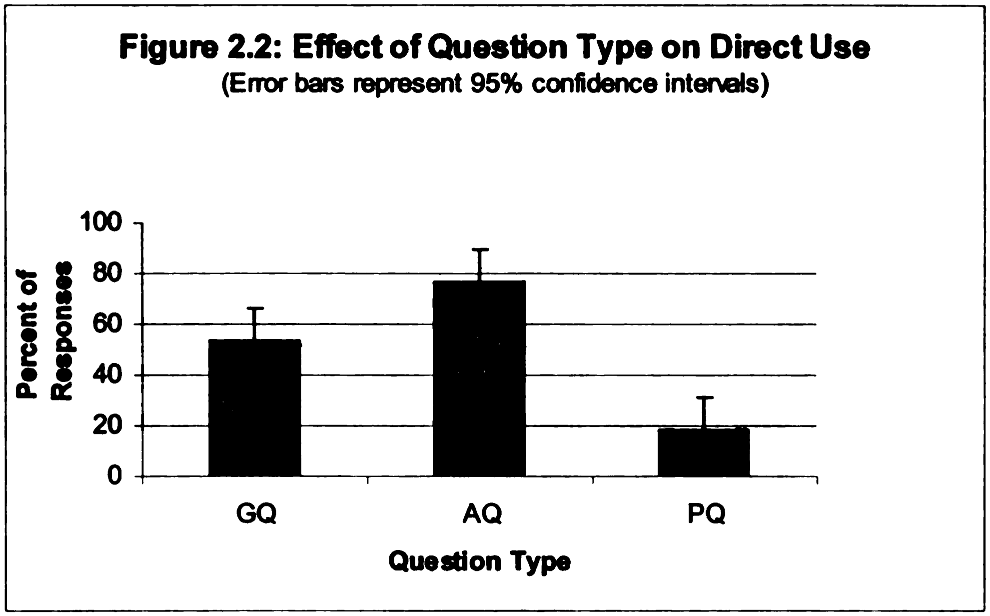
(MANOVA) was conducted, due to the fact that there were multiple dependent variables (four different verb forms: direct, inverse, passive, intransitive). The one independent variable—Question Type—had three levels: General Question (GQ), Agent Question (AQ), and Patient Question (PQ). One analysis was performed considering subjects as a random effect (F_1) and one was performed considering items as a random effect (F_2) (Clark, 1973). Means and standard deviations for the four verb forms by question type are given in Table 2.4.

Table 2.4: Means and Standard Deviations for Verb Forms Used

question	Direct	Inverse	Passive	Intransitive
GQ				
M	57.37%	8.24	14.92	19.47
SD	22.40%	18.35	20.26	23.30
AQ				
M	76.43%	9.38	2.92	19.72
SD	27.45%	3.76	6.34	25.04
PQ				
M	18.17%	15.66	55.95	10.22
SD	17.84%	27.27	29.33	15.76

The MANOVA revealed a significant effect by both subjects and items of question type on the verb form used in the direct ($F_1(2,20) = 45.564$, $MSE = .040$, $p < .001$; $F_2(2,32) = 55.501$, $MSE = .052$, $p < .001$), inverse ($F_1(2,20) = 13.809$, $MSE = .008$, $p < .001$; $F_2(2,32) = 4.899$, $MSE = .036$, $p = .009$), and passive ($F_1(2,20) = 69.991$, *MSE*

= .023, $p < .001$; $F_2(2,32) = 58.392$, $MSE = .044$, $p < .001$), but not intransitive ($F_1(2,20) = 2.57$, $MSE = .024$, $p = .085$; $F_2(2,32) = 2.044$, $MSE = .047$, $p = .135$). The data for direct, inverse, and passive forms are plotted in Figures 2.2, 2.3, and 2.4, respectively.



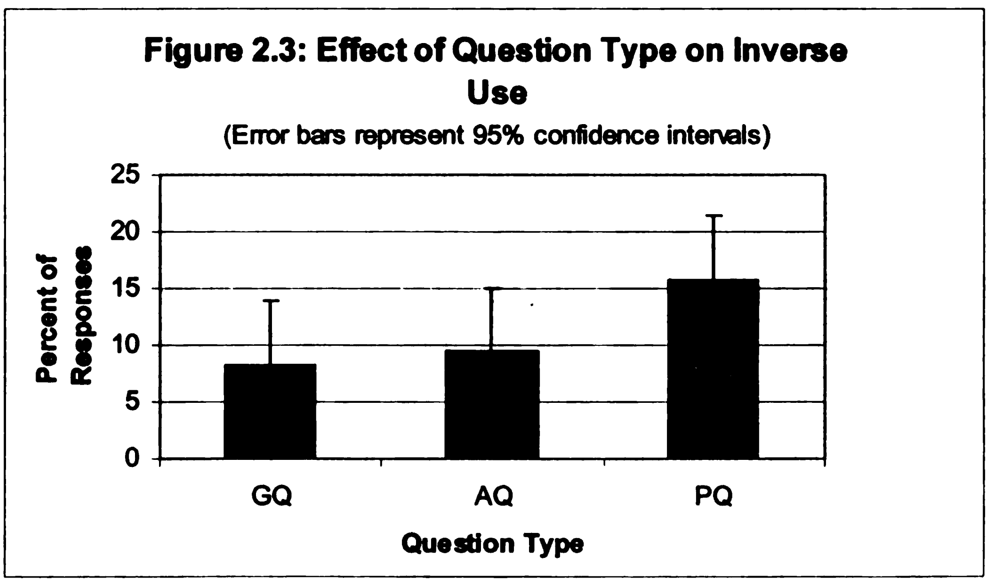
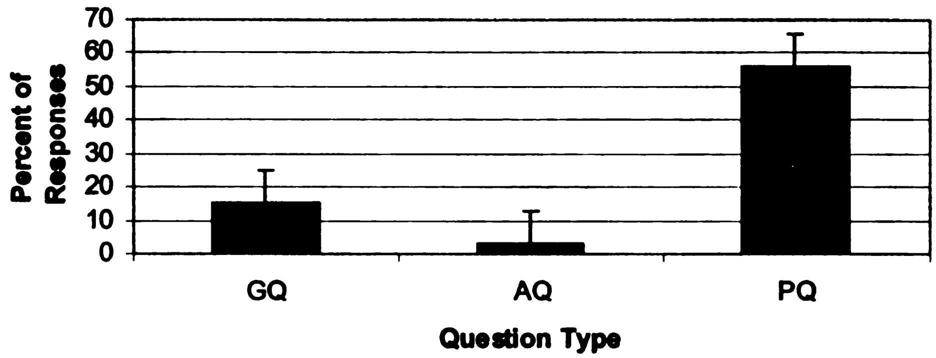


Figure 2.4: Effect of Question Type on Passive Use
(Error bars represent 95% confidence intervals)



The figures show that while direct was most frequently used in the GQ and AQ conditions, it was the passive form that dominated the crucial PQ condition, just as it does in English (cf. Bock & Warren, 1985). Whatever the reason for the preference for passive when the patient NP was more accessible, it cannot easily be attributed to an incremental process whereby the accessible concept grabs a string-initial position and the syntax of the remaining sentence is adjusted to accommodate a thematic patient in first position (cf. Schriefers, Teruel, & Meinshousen, 1998, p. 612). The much more common direct verb form would have quite naturally accommodated a patient in string-initial position.

The pattern of data for the inverse verb was similar to that of the passive, suggesting that, although less frequent, the PQ question had the effect of topicalizing the patient NP, such that accessibility may have led to the topicalization of the accessible concept. If this were the case, strictly incremental production could account for the fact that topical or "given" information tends to precede focused or "new" information (Chafe, 1976; Choi, 1999; Lambrecht, 1994). Such a result would suggest that accessibility thus results in the accessible concept becoming the topic. Since topics usually precede non-topics and subjects tend to precede objects cross-linguistically, accessibility governs subject choice and linearization indirectly under this view via topicalization (cf. Levelt, 1989, pp. 260-271). This small but reliable effect in the PQ condition for the inverse verb appears, however, to be driven by the descriptions of the eleven drawings included in the test materials that depicted actors of mixed animacy, specifically drawings depicting animal agents and human patients. Table 2.5 gives the number and proportion of direct, inverse, and passive responses broken down by the three animacy categories of human-agent/human-patient (H-H), human-agent/animal-patient (H-A), and animal-agent/human-patient (A-H) (from Christianson, in press).

Table 2.5: Number of responses and proportion of responses by verb type in each picture subgroup (H-H, H-A, A-H) in each condition (GQ, AQ, PQ)

	Direct			Inverse		
	H-H	H-A	A-H	H-H	H-A	A-H
GQ	75	24	22	2	0	15
%	**97**	**100**	**59**	**2**		**41**
AQ	98	21	35	0	0	1
%	**100**	**100**	**97**			**3**
PQ	27	5	5	6	0	26
%	**81**	**100**	**16**	**18**		**84**

If we remove the descriptions of the A-H drawings from the data set, the effect of question type on verb form disappears for inverse verbs by subject, $F_1(2,20)$= 1.338, *MSE*

= .035, p = .27. The effect is also significantly weakened by items, $F_2(2,26)= 3.350$, MSE = .072, p = .04. The reliable effects for the direct and passive forms were not altered by removing the A-H responses, and neither was the non-significant effect for the intransitive verb. The effect of animacy on production is the topic of Christianson (2001a, b, in press), and the effect of animacy on comprehension is one of the issues addressed in Experiment 3 (Chapter 4).

Next, since *pro*-drop is so common in the language and in the data—despite the instructions—it is difficult to establish with certainty what effect the prompt questions (and the conceptual accessibility to the agent and patient it was assumed that the AQ and PQ questions, respectively, provided) had on order of mention. It was decided that a series of paired t-tests would be the most direct method to determine how the question type affected the relative order of NPs in descriptions containing two NPs. The major result of these tests is that an overt subject/agent was more likely to precede an overt object/patient in all three question conditions,[26] contrary to the prediction that a strictly incremental, accessibility-driven model of sentence production would make. In the GQ condition, the subject/agent was 10.62% more likely to precede the object/patient ($t(20) = 5.853$, $p < .001$). In the AQ condition, the subject/agent was 5.16% more likely to precede the object/patient ($t(20) = 3.537$, $p = .002$). And in the PQ condition, the subject/agent was 3.44% more likely to precede the object/patient ($t(20) = 3.923$, p = .001). Of secondary interest is the comparison between the frequencies of responses containing two overt NPs and responses with either *pro*-dropped argument NPs or all together syntactically null NPs (i.e., passives and intransitives). Because tests of the

[26] A repeated measures ANOVA with a single, three-level factor (question type) also yielded no reliable effect of question type on the relative order of subject and object in any condition, as reported in Christianson & Ferreira (2001).

effects of question type on *pro*-drop follow immediately below, I only mention in passing that the present t-tests revealed that three-constituent responses—those with two overt NPs—were significantly less frequent than responses with one or fewer overt NPs in AQ and PQ conditions. In the GQ condition, responses with one or fewer NPs were no more frequent than three-constituent responses with subject before object, but responses with one or fewer NPs were significantly more frequent than three-constituent responses with object before subject.

Finally, to test whether question type actually did affect *pro*-drop in the predicted way, I computed paired t-tests within question types on the mean presence vs. absence of both subject/agent NPs and object/patient NPs. The t-tests revealed that subject/agent NPs were 18.16% more likely to be overt in the GQ condition ($t(20) = 6.138, p < .001$), but 16.68% less likely to be overt in the AQ condition ($t(20) = -4.178, p < .001$). The difference in the PQ condition was not significant ($p > .8$).

With respect to the presence of an overt object/patient, a third category—not applicable (n.a.)—was included, since a large number of passive and intransitive responses were given, and these do not contain syntactic object/patients. The t-tests revealed that the object/patient was 16.70% more likely to be overt in the GQ condition ($t(20) = 6.847, p < .001$), and 20.61% more likely to be overt in the AQ condition ($t(20) = 11.292, p < .001$). In the GQ condition, it was also 7.39% more likely for the object/patient to be overt than for it to be syntactically null (i.e., transitive sentences were more frequent than passive or intransitive) ($t(20) = 2.402, p = .026$), but it was 9.31% more likely for a passive or intransitive response to be used than for a transitive with no overt object ($t(20) = 7.597, p < .001$). In the AQ condition, transitive responses with overt object/patient NPs were 15.86% more frequent than passive/intransitive responses ($t(20) = 5.155, p < .001$), but passive/intransitive responses were 4.76% more frequent than transitives with *pro*-dropped object/patient NPs ($t(20) = 3.031, p < .001$).

The preference for overt object/patient NPs disappeared in the PQ condition, though, where there was no preference in transitive responses for either overt or *pro*-dropped object/patient NPs ($p > .9$). Responses lacking syntactic objects all together (mainly passives) were 15.50% more frequent than transitives with overt objects/patient NPs ($t(20) = 6.398, p < .001$), and 15.45% more frequent than transitives with *pro*-dropped object/patient NPs ($t(20) = 6.495, p < .001$). These results clearly show that question type was a significant determining factor in whether participants used overt or *pro* NPs. A detailed interpretation of the results appears in the next section.

2.4 Discussion

The motivation for Experiment 1 was twofold. First, it was hoped that the frequency data collected would tell us something about Odawa speaker preferences and structural frequencies in the language. This frequency information had heretofore been unavailable for Odawa, since it is not historically a written language, and existing written texts tend to be stylized and not indicative of everyday speech. Second, since Odawa is different in several respects—most notably with respect to verb form inventory and case-marking—from the languages with which psycholinguists typically work, it was hoped that the experiment might provide insight into a central issue in sentence production research, namely, the extent to which sentence production is strictly incremental.

The frequency data obtained in this experiment are straightforward, and are consistent with and supportive of several observations in the Algonquian literature about related languages. First, the most frequent word order in direct clauses was SVO, as would be expected if Bruening's (2001) analysis of Passamaquoddy and Dryer's (1995, 1997) observations regarding Ojibwa are to be extended to Odawa. Nevertheless, all possible permutations of three-constituent orders (containing two overt NPs) were used in both direct and inverse sentences, although some of these orders were used very infrequently. Second, the obviation system does appear to encode the relative topicalization of NPs, with the proximate NP being more topical than the obviative NP. This was evidenced by the overwhelmingly more frequent *pro*-drop of proximate NPs than obviative NPs, irrespective of the syntactic function or thematic role of the elided NP.

With respect to the architecture of the sentence production system, the three different verb forms—direct, inverse, and passive—occurring in Odawa allowed me to test whether the effects of conceptual accessibility were limited to order of mention, or extended to pragmatics and/or syntax. If the effect of conceptual accessibility is on order of mention alone, and syntactic structure is then driven by lexical accessibility (cf., the work of Bock and colleagues cited in §2.1; Levelt, 1989), it was predicted that sentences with the extremely common direct verb form would occur throughout the data, irrespective of question condition, and that the questions would affect NP order in the direct clauses. Thus, in the condition in which the patient NP was made accessible via the PQ question, the quick lexical access of the patient NP could simply be accommodated even in the direct form with an OSV/OVS order, especially since the same accessibility-driven system would tend to choose the extremely common direct form over the infrequent inverse or somewhat less frequent passive (use of which also entailed not following instructions). If conceptual accessibility has the effect of topicalizing the accessible NP, rather than simply making it string-initial, Odawa's inverse form allows for this to happen without being confounded by simultaneously making the topical NP the syntactic subject (as usually happens in English). And if conceptual accessibility in fact drives speakers to choose a syntactic structure or frame in which the accessible concept can serve as syntactic subject (in addition to topic and, perhaps, string-initial NP), it was predicted that Odawa speakers, like English speakers, would use more passive sentences when a patient NP was made more accessible.

The syntactic view of sentence production was strongly supported by the Odawa data obtained here. In the crucial condition in which the patient NP was made more accessible via the question, speakers chose to describe the stimuli drawings using passive sentences significantly more often than either direct or inverse sentences. In addition, when three-constituent direct or inverse sentences were used in the PQ condition, the relative accessibility of the patient NP did not result in a higher number of OS order sentences; SO orders were still significantly more frequent.

Taken together, the Odawa data failed to support strictly incremental, lexically driven sentence production. Instead, the data were consistent with conclusions drawn by V. Ferreira & Dell (2000), who suggested that "high activation of a patient argument may influence syntactic mechanisms to produce a passive structure...." (p. 327). V. Ferreira & Dell based this conclusion on a series of experiments in which participants were faced with a choice between producing or omitting the optional complementizer *that* in sentences such as *The coach knew (that) you missed practice*. They found, among other things, that mention of the complementizer was "sensitive to the availability of the material that is spoken" (p. 326). However, since purely functional elements, such as complementizers are arguably not produced in the same way as lexical elements, such as pronouns or full NPs (see Garrett [1988]; also data on aphasic production, e.g., Menn & Obler, 1989), V. Ferreira & Dell argued that the lexically driven picture of production—in which the most accessible lexical item wins a figurative "race" out of the mouth—might not be sufficient to accurately describe their results. Instead, they proposed that speakers choose a syntactic structure without necessarily first deciding between alternative lexical items. The structure, then, is what is really primed by pictures, sentences, questions, etc., and there is an interplay between the lexical item—mainly in the present case the speakers' desire to make the accessible NP a syntactic subject—and the structure or syntactic frame that allows them to accomplish this goal.

2.5 Summary

The data obtained in this Odawa production experiment are significant for two reasons. With respect to investigations of Odawa syntax, the data presented here support the claim that Odawa—and possibly related Algonquian languages—have a basic word order of SVO, at least in direct clauses. Also, the general assumption that the obviation status of an NP is reflective of the NP's discourse status—with proximate NPs more topical than obviative NPs—is correct. With respect to language production, the data obtained here do not support a strictly incremental view of language production. Despite the fact that Odawa's flexible word order would seem ideally suited to allow speakers to begin sentences with the most accessible concept available without subsequently using a less frequent verb form, Odawa speakers appear to exhibit the same production patterns that English speakers do. Specifically, the production system appears to prefer to make accessible concepts syntactic subjects, rather than simply place them in sentence-initial position. The inference drawn here based on the Odawa data is that accessible concepts prime entire syntactic frames, or verb forms, which allow these concepts to appear in subject position. This conclusion contrasts with views of production in which speakers begin with accessible concepts with little or no advanced planning as to the verb form that will eventually be produced.

CHAPTER 3

Odawa Sentence Comprehension

3.0 Experiment 2

The experiment reported in this chapter was conducted as a first step in the investigation of how speakers of Odawa deal with temporary ambiguity in mono-clausal sentences in real-time. Aside from the fact that the experiment was conducted in Odawa and represents the first such experiment in an indigenous North American language, it is noteworthy in certain other respects. First, the stimuli were all mono-clausal sentences (not counting the wrap-up clause at the end of each sentence included to control for end-of-sentence effects [Just & Carpenter, 1976]), yet displayed varying degrees of ambiguity with respect to the basic information of thematic role assignment. Second, online measures were collected—specifically button-press latencies during performance of an auditory moving window task (Ferreira, Henderson, Anes, Weeks, & McFarlane, 1996); however, an off-line measure of sentence interpretation—specifically a picture verification task—was included in order to determine the extent to which predicted computational difficulties resulted in misinterpretation of the stimuli (cf. Christianson et al., 2001). Of central interest is the fact that frequency-based biases within the language (as determined based on the results of Experiment 1) make predictions about performance that differ from those made according to structural assumptions based on Bruening's (2001) account of Algonquian syntax. The structure of Odawa assumed here also predicts a different pattern of results than the Pronominal Argument Hypothesis (PAH) analysis of Algonquian languages (see Chapter 1). In addition, conditions were included in the experimental design with the aim of testing specific aspects of current theories of human sentence parsing, most prominently Gibson's Syntactic Prediction Locality Theory (SPLT) (1998), Hawkins's Early Immediate Constituents (EIC) theory (1994), Lewis's various Retrieval Interference Theories (RIT-01 and RIT-02) (Lewis, 1998; Lewis & Nakayama, 2001; Vasishth, 2002), Vasishth's Abductive Inference Model (AIM) (2002), and Townsend & Bever's Late Assignment of Syntax Theory (LAST) (2001). After detailed description and discussion of the experiment and its results, I argue that the numerous data, although a bit noisy, and somewhat unstable, are consistent with a configurational syntactic account of Odawa, as well as the existence of a "good enough" mechanism in the HSPM whereby complete structural reanalyses are abandoned under certain conditions in favor of less costly heuristic-based processing (cf. Ferreira & Henderson, 1999).

3.1 Background

Studies of how people process sentences lacking attachment ambiguities are relatively scarce in the sentence processing literature. Attachment ambiguities trigger the classic "garden path" effects that have preoccupied psycholinguists for over three decades. Some influential models of both initial parsing (Frazier, 1978; Frazier & Fodor, 1978; Frazier & Clifton, 1996) and reanalysis (Fodor & Inoue, 1998; Frazier & Clifton, 1996) are concerned almost exclusively with garden path sentences.[27] Equating temporary ambiguity with garden path-type attachment ambiguities and building entire parsing models in order to account for such ambiguities demonstrates the rather narrow focus of traditional psycholinguistic investigation. Garden path phenomena are easily observed in languages like English, where limited morphological inflection and relatively

[27] Exceptions to this generalization are Gibson and colleagues' SPLT (Gibson, 1998) and DLT (Grodner et al., 2002; Warren, 2001), and Lewis and colleagues' RIT (Lewis, 1998; Lewis & Nakayama, 2001; Vasishth, 2002). These are discussed below.

rigid word order combine to create attachment ambiguities. In "nonconfigurational," *pro*-drop languages like Odawa, the classic multi-clausal garden path sentences are not, on the whole, ambiguous, due to the rich verbal and nominal morphology, which serves to disambiguate most garden path sentence types found in English. In Odawa, it is precisely the sentence types often ignored by researchers where ambiguities are pervasive, namely in mono-clausal sentences. To see how these ambiguities arise, consider the word-by-word parsing options for the six possible orders of a simple Odawa sentence, consisting of just two NPs and a verb (assuming Bruening's [2001] account of transitive direct and inverse Algonquian phrase structure and ignoring irrelevant details). The parsing options that exist for each step of each of the six word orders for the direct and inverse sentences given in (3.2a-b), respectively, are listed under each constituent. The options are ordered roughly according to the following assumptions, without making any commitment at this time with respect to the relative weight or importance of each of the assumptions[28]: (3.3) through (3.14) illustrate the potential ambiguities associated with the word-by-word parses of the six logically possible word orders in both direct and inverse forms. I walk through and example of the progression of these parses for (3.3). For the sake of brevity, I ignore potential non-transitive continutations in the non-verb-initial orders.

[28] For the sake of simplicity, I limit this exercise to Direct and Inverse options, ignoring the other options listed in (1.26).

(3.1) General assumptions about parsing preferences

a. The parser does not postulate more nodes than required at any given point (cf. De Vincenzi, 1991; Frazier, 1978;Weinberg, 1993; but cf. Marcus, 1980, for a "look ahead" mechanism).

b. The parser tries to assign thematic roles to NPs as soon as they become available; maintaining unfilled roles or unassigned NPs is costly (cf. Ferreira & Henderson, 1991, 1998; Fodor & Inoue, 1998; Grodner, et al., 2002; Gibson, 1998; Lewis, 1998; Lewis & Nakayama, 2001)

c. Processing referential chains is costly (De Vincenzi, 1991). If a canonical argument position is encountered and it is not filled with an overt NP (and no appropriate NP has yet been encountered in the input string), the parser assumes that the position is filled with a *pro*.

d. The processor prefers to assume a base-generated analysis of a declarative sentence, all else being equal (Bever, 1970; Minkoff, 2000).

e. If ranked parallel parses are possible (cf. Gibson, 1998; MacDonald et al., 1994), frequency statistics are one source of information used to rank the alternative parses in terms of activation.

(3.2) a. nimosh gii-tikom-aa-n gaazhag-an

dog 3.PAST-bite-Dir.3>3' cat-Obv

'A/The dog bit a/the cat'

b. nimosh-an gii-tikom-igoo-n gaazhag

dog-Obv 3.PAST-bite-Inv.3'>3-Obv cat

'A/The dog bit a/the cat'

(3.3) **VSO (Direct)**

a. *gii-tikomaan...*

i. $[_{HP}\, \mathit{pro}_i^{[+PROX]}\ [_{vP}\ t_i\ [_{v}\ v\ [_{VP}\ \text{gii-tikomaan}\ \mathit{pro}^{[-PROX]}\ ]]]]]$

ii. $[_{HP}\, \mathit{pro}_i^{[+PROX]}\ [_{vP}\ t_i\ [_{v}\ v\ [_{VP}\ \text{gii-tikomaan...}$

iii. $[_{XP}\, \text{gii-tikomaan ...}\ [_{v}\ v\ [_{VP}\ t_v\ ...$

b. *gii-tikomaan nimosh...*

i. $[_{XP}\, \text{gii-tikomaan}\ [_{HP}\, \text{nimosh}_i^{[+PROX]}\ [_{vP}\, t_i\ [_{v}\ v\ [_{VP}\ t_v\ \mathit{pro}^{[-PROX]}\ ]]]]]$

ii. $[_{XP}\, \text{gii-tikomaan}\ [_{HP}\, \text{nimosh}_i^{[+PROX]}\ [_{vP}\, t_i\ [_{v}\ v\ [_{VP}\ t_v\ ...$

c. *gii-tikomaan nimosh gaazhagan*

i. $[_{XP}\, \text{gii-tikomaan}\ [_{HP}\, \text{nimosh}_i^{[+PROX]}\ [_{vP}\, t_i\ [_{v}\ v\ [_{VP}\ t_v\ \text{gaazhagan}^{[-PROX]}\ ]]]]]$

In (3.3a), the first word in the input string is the verb. It is direct, so a hearer knows that the agent will be proximate and the patient will be obviative. Assume that the configurational view of Odawa syntax adopted in Chapter 1 is correct. The hearer should also, based on the frequency of *pro*-drop observed in the language (and supported in Experiment 1), along with the preferences for base-generated structures expressed in (3.1c, d), assume that the subject has been *pro*-dropped (3.3ai, ii). As discussed below, it is unclear which of (3.3ai, ii) should be favoried initially, however. In (3.3b), the proximate NP (subject, agent) is encountered. The hearer now knows that the verb has been raised to a sentence-initial adjunction position, and there is no *pro* in subject position. These revisions are made in (3.3bi, ii). It is again unclear, though, whether (3.3bi) or (3.3bii) should be preferred. Finally, in (3.3c), the obviaitve (object, patient) NP is encountered, and the thematic assignment domain of the transitive verb can be closed off. (3.4) through (3.14) should now be relatively straightforward to follow.

(3.4) **VOS (Direct)**

a. *gii-tikomaan...*

i. $[_{HP}\, pro_i^{[+PROX]}\ [_{vP}\ t_i\ [_{v}\ v\ [_{VP}$ gii-tikomaan $pro^{[-PROX]}$]]]]]

ii. $[_{HP}\, pro_i^{[+PROX]}\ [_{vP}\ t_i\ [_{v}\ v\ [_{VP}$ gii-tikomaan...

iii. $[_{XP}$ gii-tikomaan ... $[_{v}\ v\ [_{VP}\ t_v$ ...

b. gii-tikomaan gaazhagan...

i. $[_{HP}\, pro_i^{[+PROX]}\ [_{vP}\ t_i\ [_{v}\ v\ [_{VP}$ gii-tikomaan gaazhagan$^{[-PROX]}$]]]]]

ii. $[_{XP}$ gii-tikomaan $[_{XP}$ gaazhagan$_k$ $[_{HP}\, pro_i^{[+PROX]}\ [_{vP}\, t_i\ [_{v}\ v\ [_{VP}\ t_v\ t_k^{[-PROX]}$

]]]]]

iii. $[_{XP}$ gii-tikomaan $[_{XP}$ gaazhagan$_k$ ... $[_{vP}\, t_i\ [_{v}\ v\ [_{VP}\ t_v\ t_k$]]]...]

c. *gii-tikomaan gaazhagan nimosh*

i. $[_{XP}$ gii-tikomaan $[_{XP}$ gaazhagan$_k^{[-PROX]}$ $[_{HP}$ nimosh$_i^{[+PROX]}$ $[_{vP}\, t_i\ [_{v}\ v\ [_{VP}\ t_v$

t_k]]]]]

(3.5) **VSO (Inverse)**

a. *gii-tikomigoon...*

i. $[_{HP}\, pro_k^{[+PROX]}\ [_{vP}\ t_k\ [_{vP}\, pro^{[-PROX]}\, [_{v}\ v\ [_{VP}$ gii-tikomaan t_k]]]]]

ii. $[_{XP}$ gii-tikomigoon ... $[_{v}\ v\ [_{VP}\ t_v$ ...

b. *gii-tikomigoon nimoshan...*

i. $[_{XP}$ gii-tikomigoon $[_{HP}\, pro_k^{[+PROX]}\, [_{vP}\, t_k\ [_{vP}$ nimoshan$^{[-PROX]}$ $[_{v}\ v\ [_{VP}\ t_v\ t_k$

]]]]]]

ii. $[_{XP}$ gii-tikomigoon $[_{XP}$ nimoshan$^{[-PROX]}{}_i$ $[_{HP}\, pro_k^{[+PROX]}\, [_{vP}\, t_k\ [_{vP}\, t_i\, [_{v}\ v$

$[_{VP}\ t_v\ t_k$]]]]]]

c. *gii-tikomaan nimoshan gaazhag*

i. $[_{XP}$ gii-tikomigoon $[_{XP}$ nimoshan$_i$ $[_{HP}$ gaazhag$_k^{[+PROX]}$ $[_{vP}\ t_k\ [_{vP}\ t_i^{[-PROX]}\ [_v\ v\ [_{VP}\ t_v\ t_k\ ]]]]]]]$

(3.6) **VOS (Inverse)**

a. *gii-tikomigoon...*

i. $[_{HP}\ pro_k^{[+PROX]}\ [_{vP}\ t_k\ [_{vP}\ pro^{[-PROX]}\ [_v\ v\ [_{VP}$ gii-tikomaan $t_k\ ]]]]]$

ii. $[_{XP}$ gii-tikomigoon ... $[_v\ v\ [_{VP}\ t_v$ ...

b. *gii-tikomigoon gaazhag...*

i. $[_{XP}$ gii-tikomigoon $[_{HP}$ gaazhag$_k^{[+PROX]}$ $[_{vP}\ t_k\ [_{vP}\ pro^{[-PROX]}\ [_v\ v\ [_{VP}\ t_v\ t_k\ ]]]]]]$

ii. $[_{XP}$ gii-tikomigoon $[_{HP}$ gaazhag$_k^{[+PROX]}$ $[_{vP}\ t_k\ [_{vP}...\ [_v\ v\ [_{VP}\ t_v\ t_k\ ]]]]]]$

c. *gii-tikomaan gaazhag nimoshan*

i. $[_{XP}$ gii-tikomigoon $[_{HP}$ gaazhag$_k^{[+PROX]}$ $[_{vP}\ t_k\ [_{vP}$ nimoshan$^{[-PROX]}$ $[_v\ v\ [_{VP}\ t_v\ t_k\ ]]]]]]$

(3.7) **SVO (Direct)**

a. *nimosh...*

i. $[_{HP}$ nimosh$_i^{[+PROX]}$ $[_{vP}\ t_i\ [_v\ v\ [_{VP}$ (DIRECT) ...

ii. $[_{HP}$ nimosh$_k^{[+PROX]}$ $[_{vP}\ t_k\ [_{vP}...\ [_v\ v\ [_{VP}$ (INVERSE) t_k ...

b. *nimosh gii-tikomaan...*

i. $[_{HP}$ nimosh$_i^{[+PROX]}$ $[_{vP}\ t_i\ [_v\ v\ [_{VP}$ gii-tikomaan ...

ii. $[_{HP}$ nimosh$_i^{[+PROX]}$ $[_{vP}\ t_i\ [_v\ v\ [_{VP}$ gii-tikomaan $pro^{[-PROX]}]]]]$

c. *nimosh gii-tikomaan gaazhagan*

i. $[_{HP}$ nimosh$_i^{[+PROX]}$ $[_{vP}\ t_i\ [_v\ v\ [_{VP}$ gii-tikomaan gaazhagan$^{[-PROX]}]]]]$

(3.8) **OVS (Direct)**

a. *gaazhagan...*

i. [$_{XP}$ gaazhagan$_k^{[-PROX]}$ [$_{HP}$ *pro*$_i^{[+PROX]}$ [$_{vP}$ t_i [$_v$ *v* [$_{VP}$ (DIRECT) t_k...

ii. [$_{XP}$ gaazhagan$_k^{[-PROX]}$ ... [$_v$ *v* [$_{VP}$ (DIRECT) t_k...

iii. [$_{XP}$ gaazhagan$_i^{[-PROX]}$ [$_{HP}$ *pro*$^{[+PROX]}$$_k$ [$_{vP}$ t_k [$_{vP}$ t_i [$_v$ *v* [$_{VP}$ (INVERSE) t_k...

iv. [$_{XP}$ gaazhagan$_i^{[-PROX]}$. [$_{vP}$ ... [$_{vP}$ t_i [$_v$ *v* [$_{VP}$ (INVERSE)...

b. *gaazhagan gii-tikomaan...*

i. [$_{XP}$ gaazhagan$_k^{[-PROX]}$ [$_{HP}$ *pro*$_i^{[+PROX]}$ [$_{vP}$ t_i [$_v$ *v* [$_{VP}$ gii-tikomaan t_k]]]]]

ii. [$_{XP}$ gaazhagan$_k^{[-PROX]}$ ... [$_v$ *v* [$_{VP}$ gii-tikomaan t_k]]...

iii. [$_{XP}$ gaazhagan$_k^{[-PROX]}$ [$_{XP}$ gii-tikomaan [$_{HP}$ *pro*$_i^{[+PROX]}$ [$_{vP}$ t_i [$_v$ *v* [$_{VP}$ t_v t_k]]]]]]

iv. [$_{XP}$ gaazhagan$_k^{[-PROX]}$ [$_{XP}$ gii-tikomaan ... [$_v$ *v* [$_{VP}$ t_v t_k...

c. *gaazhagan gii-tikomaan nimosh*

i. [$_{XP}$ gaazhagan$_k^{[-PROX]}$ [$_{XP}$ gii-tikomaan [$_{HP}$ nimosh$_i^{[+PROX]}$ [$_{vP}$ t_i [$_v$ *v* [$_{VP}$ t_v t_k]]]]]]

(3.9) **SVO (Inverse)**

a. *nimoshan...*

i. [$_{XP}$ nimoshan$_k^{[-PROX]}$ ... [$_v$ *v* [$_{VP}$ (DIRECT) t_k...

ii. [$_{XP}$ nimoshan$_k^{[-PROX]}$ [$_{HP}$ *pro*$_i^{[+PROX]}$ [$_{vP}$ t_i [$_v$ *v* [$_{VP}$ (DIRECT) t_k...

iii. [$_{XP}$ nimoshan$_i^{[-PROX]}$ ... [$_{vP}$ .t_i. [$_v$ *v* [$_{VP}$ (INVERSE) ...

iv. [$_{XP}$ nimoshan$_i^{[-PROX]}$ [$_{HP}$ *pro*$_k^{[+PROX]}$ [$_{vP}$ t_k [$_{vP}$ t_i [$_v$ *v* [$_{VP}$ (INVERSE) t_k...

b. *nimoshan gii-tikomigoon...*

i. $[_{XP}$ nimoshan$_i^{[-PROX]}$ $[_{HP}$ *pro*$_k^{[+PROX]}$ $[_{vP}$ t_k $[_{vP}$ t_i $[_v$ v $[_{VP}$ gii-tikomigoon t_k]]]]]]

ii. $[_{XP}$ nimoshan$_i^{[-PROX]}$. $[_{HP}$... $[_{vP}$...$[_{vP}$ t_i $[_v$ v $[_{VP}$ gii-tikomigoon...

iii. $[_{XP}$ nimoshan$_i^{[-PROX]}$ $[_{XP}$ gii-tikomigoon $[_{HP}$ *pro*$_k^{[+PROX]}$ $[_{vP}$ t_k $[_{vP}$ t_i $[_v$ v $[_{VP}$ t_v t_k]]]]]]]

iv. $[_{XP}$ nimoshan$_i^{[-PROX]}$ $[_{XP}$ gii-tikomigoon ...$[_{vP}$ t_i . $[_v$ v $[_{VP}$ t_v ...

c. *nimoshan gii-tikomigoon gaazhag*

i. $[_{XP}$ nimoshan$_i^{[-PROX]}$ $[_{XP}$ gii-tikomigoon $[_{HP}$ gaazhag$_k^{[+PROX]}$ $[_{vP}$ t_k $[_{vP}$ t_i $[_v$ v $[_{VP}$ t_v t_k]]]]]]]

(3.10) **OVS (Inverse)**

a. *gaazhag...*

i. $[_{HP}$ gaazhag$_i^{[+PROX]}$ $[_{vP}$ t_i $[_v$ v $[_{VP}$ (DIRECT) ...

ii. $[_{HP}$ gaazhag$_k^{[+PROX]}$ $[_{vP}$ t_k $[_{vP}$ ... $[_v$ v $[_{VP}$ (INVERSE) t_k ...

b. *gaazhag gii-tikomigoon...*

i. $[_{HP}$ gaazhag$_k^{[+PROX]}$ $[_{vP}$ t_k $[_{vP}$ *pro*$^{[-PROX]}$ $[_v$ v $[_{VP}$ gii-tikomigoon t_k]]]]]]

ii. $[_{HP}$ gaazhag$_k^{[+PROX]}$ $[_{vP}$ t_k ... $[_v$ v $[_{VP}$ gii-tikomigoon t_k...

iii. $[_{XP}$ gaazhag$_k^{[+PROX]}$ $[_{XP}$ gii-tikomigoon $[_{HP}$ t_k $[_{vP}$ t_k $[_{vP}$ *pro*$^{[-PROX]}$ $[_v$ v $[_{VP}$ t_v t_k]]]]]]]

iv. $[_{XP}$ gaazhag$_k^{[+PROX]}$ $[_{XP}$ gii-tikomigoon $[_{HP}$ t_k $[_{vP}$ t_k ... $[_v$ v $[_{VP}$ t_v t_k...

c. *gaazhag gii-tikomigoon nimoshan*

i. $[_{XP}$ gaazhag$_k^{[+PROX]}$ $[_{XP}$ gii-tikomigoon $[_{HP}$ t_k $[_{vP}$ t_k $[_{vP}$ nimoshan$^{[-PROX]}$ $[_v$ v $[_{VP}$ t_v t_k]]]]]]]

(3.11) **SOV (Direct)**

a. *nimosh...*

i. [$_{HP}$ nimosh$_{i}^{[+PROX]}$ [$_{vP}$ t_{i} [$_{v}$ v [$_{VP}$ (DIRECT) ...

ii. [$_{HP}$ nimosh$_{k}^{[+PROX]}$ [$_{vP}$ t_{k} [$_{vP}$ ... [$_{v}$ v [$_{VP}$ (INVERSE) t_{k}...

b. *nimosh gaazhagan...*

i. [$_{XP}$ nimosh$_{i}^{[+PROX]}$ [$_{XP}$ gaazhagan$_{k}^{[-PROX]}$ [$_{HP}$ t_{i} [$_{vP}$ t_{i} [$_{v}$ v [$_{VP}$ (DIRECT) t_{k}]]]]]]

ii. [$_{HP}$ nimosh$_{k}^{[+PROX]}$ [$_{vP}$ t_{k} [$_{vP}$ gaazhagan$^{[-PROX]}$ [$_{v}$ v [$_{VP}$ (INVERSE) t_{k}]]]]]

c. *nimosh gaazhagan gii-tikomaan*

i. [$_{XP}$ nimosh$_{i}^{[+PROX]}$ [$_{XP}$ gaazhagan$_{k}^{[-PROX]}$ [$_{HP}$ t_{i} [$_{vP}$ t_{i} [$_{v}$ v [$_{VP}$ gii-tikomaan t_{k}]]]]]]

(3.12) **OSV (Direct)**

a. *gaazhagan...*

i. [$_{XP}$ gaazhagan$_{k}^{[-PROX]}$ ... [$_{v}$ v [$_{VP}$ (DIRECT) t_{k}...

ii. [$_{XP}$ gaazhagan$_{i}^{[-PROX]}$ .. [$_{vP}$ t_{i}. [$_{v}$ v [$_{VP}$ (INVERSE)...

b. *gaazhagan nimosh...*

i. [$_{XP}$ gaazhagan$_{k}^{[-PROX]}$ [$_{HP}$ nimosh$_{i}^{[+PROX]}$ [$_{vP}$ t_{i} [$_{v}$ v [$_{VP}$ (DIRECT) t_{k}]]]]]

ii. [$_{XP}$ gaazhagan$_{i}^{[-PROX]}$ [$_{HP}$ nimosh$_{k}^{[+PROX]}$ [$_{vP}$ t_{k} [$_{vP}$ t_{i} [$_{v}$ v [$_{VP}$ (INVERSE) t_{k}]]]]]]

c. *gaazhagan nimosh gii-tikomaan*

i. [$_{XP}$ gaazhagan$_{k}^{[-PROX]}$ [$_{HP}$ nimosh$_{i}^{[+PROX]}$ [$_{vP}$ t_{i} [$_{v}$ v [$_{VP}$ gii-tikomaan t_{k}]]]]]

(3.13) **SOV (Inverse)**

a. *gaazhagan...*

i. [$_{XP}$ gaazhagan$_k^{[-PROX]}$ ... [$_v$ v [$_{VP}$ (DIRECT) t_k...

ii. [$_{XP}$ gaazhagan$_i^{[-PROX]}$... [$_{vP}$ t_i [$_v$ v [$_{VP}$ (INVERSE)...

b. *gaazhagan nimosh...*

i. [$_{XP}$ gaazhagan$_k^{[-PROX]}$ [$_{HP}$ nimosh$_i^{[+PROX]}$ [$_{vP}$ t_i [$_v$ v [$_{VP}$ (DIRECT) t_k]]]]]

ii. [$_{XP}$ gaazhagan$_i^{[-PROX]}$ [$_{HP}$ nimosh$_k^{[+PROX]}$ [$_{vP}$ t_k [$_{vP}$ t_i [$_v$ v [$_{VP}$ (INVERSE) t_k]]]]]]

c. *gaazhagan nimosh gii-tikomigoon*

i. [$_{XP}$ gaazhagan$_i^{[-PROX]}$ [$_{HP}$ nimosh$_k^{[+PROX]}$ [$_{vP}$ t_k [$_{vP}$ t_i [$_v$ v [$_{VP}$ gii-tikomigoon t_k]]]]]]

(3.14) **OSV (Inverse)**

a. *nimosh...*

i. [$_{HP}$ nimosh$_i^{[+PROX]}$ [$_{vP}$ t_i [$_v$ v [$_{VP}$ (DIRECT) ...

ii. [$_{HP}$ nimosh$_k^{[+PROX]}$ [$_{vP}$ t_k [$_{vP}$ ... [$_v$ v [$_{VP}$ (INVERSE) t_k ...

b. *nimosh gaazhagan...*

i. [$_{XP}$ nimosh$_i^{[+PROX]}$ [$_{XP}$ gaazhagan$_k^{[-PROX]}$ [$_{HP}$ t_i [$_{vP}$ t_i [$_v$ v [$_{VP}$ (DIRECT) t_k]]]]]]

ii. [$_{HP}$ nimosh$_k^{[+PROX]}$ [$_{vP}$ t_k [$_{vP}$ gaazhagan$^{[-PROX]}$ [$_v$ v [$_{VP}$ (INVERSE) t_k]]]]]

c. *nimosh gaazhagan gii-tikomigoon*

i. [$_{HP}$ nimosh$_k^{[+PROX]}$ [$_{vP}$ t_k [$_{vP}$ gaazhagan$^{[-PROX]}$ [$_v$ v [$_{VP}$ gii-tikomigoon t_k]]]]]

Based on the word order frequencies obtained in Experiment 1 (Chapter 2), and on textual counts culled from the literature, we are able to make the following generalizations regarding frequencies in Odawa:

First, direct verbs (315 total occurrences in the data from Experiment 1) were far more common than inverse verbs (51 total occurrences). This ratio reflects similar facts reported for the Algonquian languages of Passamaquoddy (Bruening, 2001), Western Naskapi (Julie Brittain, p.c.), and Fox (Mesquakie) (Lucy Thomason, p.c.). It has also been reported to me by native speakers of Odawa that the inverse is becoming increasingly less common among younger speakers (see Christianson [2002] for a detailed discussion). As such, I assume that speakers faced with ambiguity between the two verb forms will be biased toward assuming that the verb will be direct rather than inverse.

Second, in Algonquian languages in general, it is relatively rare for sentences containing two third-person arguments to contain two overt NPs, as reported regarding Cree by Wolfart (1996), for Fox (Mesquakie) by Thomason (p.c.), for and for Ojibwa by Dryer (1997). The Odawa data from Experiment 1 were consistent with this generalization: 163, or 44.53%, out of 366 total direct and inverse sentences contained both NPs. However, because the instructions given to subjects in Experiment 1 specifically directed them to "describe the pictures as if you were describing them to someone who could not see them" and to "name both actors" in the descriptions of the line drawings used there, the extent to which overt NPs were used is taken to be quite inflated compared to everyday speech. Further limited support for the infrequency of overt NPs in general can be seen in the numbers of passive and intransitive sentences occurring in the data from Experiment 1. Out of 254 total passive and intransitive sentences—which in Odawa can only contain a single NP[29]—102, or 40.16%, consisted of both the verb and overt NP. Thus, I assume for the purposes of this study that when parsing Odawa sentences, hearers will posit *pro*s in canonical NP positions unless or until overt NPs are encountered in non-canonical positions. (Further discussion of this point to follow.)

Third, based on the syntactic arguments presented by Bruening (2001) for Passamaquoddy and in Chapter 1 above, I take SVO to be the basic word order for direct Odawa clauses, and OSV to be the basic word order for inverse clauses. The results of Experiment 1 strongly support the SVO order for direct clauses: 107, or 74.31%, out of a total of 144 direct clauses containing two overt NPs were SVO, and 228, or 72.38%, out of 315 sentences containing a direct verb and any number of overt NPs were either SVO, VO, or SV. These figures are consistent with the few scattered textual counts existing for the closely related Ojibwa language. Tomlin & Rhodes (1979) concede that SVO is the most common word order in their Ojibwa corpus, even though they maintain that the basic word order is VSO (or VOS). Dryer (1995, 1997) argues that Ojibwa is an SV/VO language (according to his proposed six-way word order typology), specifically countering the opinion of Tomlin & Rhodes. And again, Bruening's (2001) textual counts of Passamaquoddy texts also support the SVO analysis for direct clauses. Marshalling frequency counts for inverse clauses is far more difficult, however, since inverse verbs are so much less frequent. Out of 19 total inverse sentences containing two overt NPs occurring in the data from Experiment 1, their relevant frequencies were statistically

[29] Christainson (2002) presents evidence that Odawa passive constructions of the sort exclusively produced in Experiment 1 contain no Agent NP.

indistinguishable: VSO 4, VOS 6, SVO 4, OVS 3, SOV 1, OSV 1. Clearly, the proposed OSV basic order finds no support in these numbers. Bruening (2001) also found a paucity of inverse clauses in his corpus of Passamaquoddy. Recall, however, that in Chapter 1 (1.14), I provided grammaticality judgments from native Odawa speakers showing that in subordinate inverse clauses with two overt, obviative NPs must occur in OSV order to be grammatical. Based on this evidence, I take OSV to be the basic order for inverse clauses.

This in mind, I assume that when faced with ambiguity, Odawa speakers will be biased toward positing basic SVO direct and OSV inverse parses (cf. Bever, 1970; Minkoff, 2000), unless explicit input to the contrary is encountered. This assumption follows evidence that German speakers prefer canonical over scrambled analyses when faced with ambiguity (Gorrell, 1998 and references cited therein). With respect to Odawa, this preference for canonical order combined with the relative infrequency of overt NPs leads to the prediction that subjects in the present experiment will prefer to posit *pros* in canonical positions unless explicit evidence to the contrary is encountered, just as De Vincenzi (1991) has reported with respect to processing in Italian.

3.2 Related Research

Psycholinguists have not generally paid much attention to how people parse sentences lacking attachment ambiguities. And even less attention (if any at all) to how speakers of "nonconfigurational" languages parse sentences containing the ambiguities illustrated in (3.3-3.14), where ambiguities with respect to word order, verb type, and *pro*-drop all occur in a very small input space. As such, many of the theories and models of human sentence parsing are not easily applicable to the Odawa simple sentences above.

Exceptions to this general rule include some of the discussions found in Gibson (1998, 2000), Hawkins (1994), Lewis (1998; Lewis & Nakayama, 2001), Townsend & Bever (2001), and Vasishth (2001). These researchers focus primarily on nesting complexity, i.e., the relative complexity of center-embedded constructions such as *The reporter (who) the senator (who) John met attacked disliked the editor* (Gibson, 2000, p. 96). Nevertheless, the parsing principles they put forth are relevant to the processing of Odawa simple sentences. I will briefly summarize these relevant points before proceeding to the details of the Odawa experiment.

3.2.1 Gibson's *Syntactic Prediction Locality Theory* (SPLT) (1998)

Gibson's SPLT represented a unique contribution to the sentence processing literature on two counts. First, Gibson did not concern himself primarily with ambiguous "garden path" sentences. Second, the theory integrated a syntactic complexity metric with an explicit proposal for how syntactic complexity interacted with memory during the online structure-building process (see Daneman & Carpenter [1980], Just & Carpenter [1992], and King & Just [1991] for evidence that memory resources used during linguistic processing are shared with non-linguistic processing demands.) According to this theory, processing cost is incurred in two ways: as the result of memory burden and as the result of integrating input into the existing syntactic structure. Processing difficulty increases as these two costs increase, with the difficulty of any given sentence being equal to the maximum point of difficulty in the input string. Sentences become difficult to process precisely at the points where memory cost and integration cost peak. Integration cost rises the longer a thematic role assigner (usually a verb) or assignee (an NP) is maintained in memory before it can discharge/receive its thematic role (via incorporation in the syntactic structure). For each lexical head intervening between a verb, for example, and the NP to which it will ultimately assign its thematic role, integration cost rises one "energy unit" (EU). Memory cost rises by one "memory unit" (MU) for each discourse referent that intervenes between said thematic assigner and assignee.

The SPLT makes an interesting prediction with respect to the Odawa sentences above: If NPs and verbs are separated by, for example, adverbial adjuncts such as *jiinaago* ('yesterday') or *mtigong* ('near a/the tree'), processing cost should increase. Furthermore, this increase should be proportional to the number of adverbs separating the NP(s) and verb.

3.2.2 Hawkins's *Early Immediate Constituents* (EIC) (1994)

Hawkins's EIC says that the HSPM wants lexical elements ordered in such a way as to maximize the speed of constituency recognition in real time, in order to ease overall processing burden. Of central interest here is the algorithm set forth by Hawkins to calculate the relative difficulty associated with parsing any given input string. The key concepts in doing so are Early Immediate Constituents (EIC), Constituent Recognition Domain (CRD), Mother Node Construction (MNC), and Immediate Constituent Attachment (ICA), the definitions of which are quoted from Hawkins (1994) in (3.15-3.18).

(3.15) Constituent Recognition Domain (CRD) (pp. 58-59)

> The CRD for a phrasal mother node M consists of the set of terminal and non-terminal nodes that must be parsed in order to recognize M and all ICs [immediate constituents] of M, proceeding from the terminal node in the parse string and

constructs the first IC on the left, to terminal node that constructs the last IC on the right, and including all intervening terminal nodes and the non-terminal nodes that they construct.

(3.16) Early Immediate Constituents (EIC) (pp. 78-79)

The human parser prefers linear orders that maximize the IC-to-non-IC ratios of constituent recognition domains. Orders with the most optimal ratios will be preferred over their non-optimal counterparts in the unmarked case; orders with non-optimal ratios will be more or equally preferred in direct proportion to the magnitude of their ratios. For finer discriminations, IC-to-non-IC ratios can be measured left-to-right.

(3.17) Mother Node Construction (MNC) (p. 62)

In the left-to-right parsing of a sentence, if any word of syntactic category C uniquely determines a phrasal mother node M, in accordance with the PS rules of the grammar, then M is immediately constructed over C.

(3.18) Immediate Constituent Attachment (ICA) (p. 62)

In the left-to-right parsing of a sentence, if an IC does not construct, but can be attached to, a given mother node M...then attach it, as rapidly as possible. Such ICs may be encountered *after* the category that constructs M, or *before* it, in which case they are placed in a look-ahead buffer.

As a concrete example of how all of these principles work together, consider the examples provided by Hawkins (1994, pp. 59-60), given here in (3.19). The ordering option in (3.19b) is preferred over that in (3.19a) because the CRD of the VP in (3.19b) contains just 12 terminal and non-terminal nodes (schematically shown between the | |), whereas (3.19a) contains 32.

(3.19) a. I | gave the valuable book that was extremely difficult to find to | Mary.

b. I | gave to Mary the | valuable book that was extremely difficult to find.[30]

Hawkins must be commended for considering and attempting to incorporate data from a wide range of languages into his framework. He even spends some time considering "nonconfigurational" languages such as Walpiri; however, these languages are referred to as "languages that do not have a VP" and "languages with flat structures" (1994, p. 39). As summarized in Chapter 1, a substantial body of syntactic evidence is accruing that suggests that languages with "flat structures" or lacking a VP probably do not exist. As such, Hawkins's treatment of data from these languages may require reworking. Nevertheless, Hawkins does address at least two points of interest in the context of parsing Odawa. First, he suggests that in discontinuous NPs (as an example of discontinuous constituents), such as the Odawa example in Chapter 1 (fn. 10), repeated here as (3.20), both the determiner and the NP project mother or grandmother nodes, which are later co-indexed in an unspecified fashion. This avoids a situation in which the parser would have to wait around to determine how much of the NP will eventually be included.

[30] Hawkins (1994) briefly discusses classic garden path sentences, but does not address the issue of reanalysis. As such, there appears to be no mechanism included in the theory by which incorrect initial structural analyses can be reanalyzed. For example it is not clear to me how the preposition *to* in the PP *to find* is not first assumed to be the start of the PP containing the oblique argument. And if it is, it is not clear to me how this misanalysis is subsequently revised upon encountering further input.

(3.20) Example of discontinuous phrase in Odawa

maaba gii-(y)aakoozi gwiizens

this 3.PAST-be.sick boy

'This boy was sick'

Second, and more importantly for the Odawa sentences examined here, Hawkins proposes that the agreement features on verbs of *pro*-drop languages allow the parser to immediately construct the appropriate NP node(s) and the clausal mother node(s) (1994, pp. 368-380).

The predictions of the EIC with respect to Odawa simple sentences are similar to those made by Gibson's SPLT, but perhaps stronger: First, adverbs intervening between verbs and arguments should cause processing difficulties, since they extend the CRD. And again, more adverbs should mean greater difficulty. Second, since Odawa is a *pro*-drop language, the EIC predicts that the parser should build structure as soon as possible, positing *pro*s in argument positions. Thus, in verb-initial orders, the parser, seeking to recognize and complete the VP CRD as quickly as possible, should construct a full sentence. Since Hawkins's theory makes no obvious predictions for reanalysis (see fn. 23), it is not clear how the NPs can or should be incorporated into the structure once they are encountered, but perhaps something similar to the case of discontinuous NPs could be predicted to take place. Namely, NP nodes would be constructed for both *pro*s and subsequent NPs, which would later be co-indexed in some manner.

3.2.3 Lewis's *Retrieval Interference Theory* (RIT) (1998; Lewis & Nakayama, 2001)

There are at least two versions of Lewis's RIT. Vasishth (2002) calls these versions RIT-01 (Lewis, 1998; Lewis & Nakayama, 2001) and RIT-02 (based on discussions between Vasishth and Lewis). I make little or no distinction between the two versions of the theory here; I only include aspects of the theory (whichever the version) that have relevance to the Odawa sentences used here.

RIT, as its moniker implies, envisions parsing as a working memory task. The retrieval of elements already encountered in the input string, which must be integrated into the ongoing structure-building process, is vulnerable to interference. The relative severity of this interference corresponds to the relative difficulty in comprehending any given sentence. Under this view parsing is essentiallya matching process between already realized material and predicted material. The individual elements comprising this material each have associated with them a feature bundle, which includes information such as major category, structural position in the current string, subcategorization features, and morphological composition (case, agreement, person, etc.). Interference increases as a function of the amount of featural similarity between any two or more elements. As a concrete illustration, consider the Japanese center-embedded sentences in (3.21a-b) (taken from Vasishth, p. 58). (3.21a) is predicted to be more difficult than (3.21b) because in (3.21a) the interference between the two nominative NPs (marked with *–ga*) is increased by both their morphological and positional similarity. In (3.21b), the accusative NP (marked with *–o*) comes between the two nominative NPs, so their positional similarity is decreased.

(3.21) a. Keikan-ga ryoosin-ga kodomo-o sagasu-to kangeta

policemen-Nom parents-Nom child-Acc look.for-Comp thought

'The policeman thought that the parents would look for the child'

b. Keikan-ga kodomo-o ryoosin-ga sagasu-to kangeta

A central difference between RIT-01 and RIT-02 is that RIT-02 incorporates a predictive mechanism, whereby the appearance of an NP triggers the prediction of a VP. In his investigation of the processing of self-center embeddings in Hindi, Vasishth (2002) included a condition in which an adverb was inserted between an NP and the VP of which it was an argument. Vasishth used this manipulation to test the predictions of the SPLT (actually, the DLT) and EIC with respect to the lengthening of critical thematic assignment domains. As discussed above, both theories predict that inserting an adverb in this way should result in processing difficulty. RIT-02, on the other hand, predicts that inserting an adverb should actually facilitate processing, for the following reason. An NP triggers a prediction of a VP, and this prediction has associated with it a certain activation level. When the adverb, which also predicts a VP, is encountered, the activation level of the prediction increases. As a result, when the verb is encountered, it takes even less time to integrate into the structure than it would have had the adverb not been present. The Hindi data collected by Vasishth were consistent with this prediction: Sentences containing adverbs had faster reading times at the relevant verb than did those without adverbs.

Whereas Vasishth included sentences with zero or one adverb in his Hindi stimuli, the Odawa stimuli used in the present experiment had zero, one, or two adverbs. The prediction with respect to RIT is exactly opposite those made by SPLT or EIC. Namely, RIT predicts that if one adverb is better than no adverb, then two might be better than one, since with each adverb, the prediction of the verb should increase. (However, there is also the possibility that the relationship between the strength of prediction and the number of adverbs is non-linear, with the predictive strength of two adverbs no greater than one.) Furthermore, a prediction regarding positional similarity can be made. In SOV and OSV orders, where one NP is proximate and one is obviative and one or two adverbs come between the two NPs, positional similarity should not cause much if any interference, since the two NPs are already highly differentiated by the obviation morphology (Lewis, p.c.). As such, the addition of one or two adverbs (as long as they are not morphologically similar [Lewis, p.c.]) should not increase the overall difficulty of either order, at least not in direct sentences (where any frequency-based prediction as to verb type would ultimately be correct). There may, however, be some increase in difficulty as the sentence is lengthened, given some constant rate of decay in the activation levels of elements in memory (Lewis, p.c.). Finally, it is not clear how RIT would handle verb-initial orders. Clearly, upon encountering a transitive verb, predictions for subject and object NPs would be triggered; however, if the predictions can be satisfied by positing *pro*s in argument positions, it is not obvious how these elements would be reactivated to revise the structure to include verb-scrambling and/or A'-movement of the NPs.

3.2.4 Townsend & Bever's *Late Assignment of Syntax Theory* (LAST) (2001)

Syntax has traditionally held a privileged place in parsing theories. In those models assuming the modularity of the cognitive architecture (in the sense of Fodor, 1983), an input string is first parsed according to proposed invariant, universal principles including Late Closure and Minimal Attachment (cf. Frazier, 1978; Frazier & Fodor, 1978; Frazier & Rayner, 1982). Only after the syntactic parse is the resultant structure (or parts thereof) passed on to the semantic/interpretive module, where context, lexical frequencies, plausibility, etc. are checked to see if the initial syntactic parse was indeed the best one given the input of these non-syntactic information sources. Approaches of this sort are often termed "two-stage" parsers. So-called "one-stage" parsers integrate syntactic processes with various non-syntactic information sources (e.g., MacDonald, et al., 1994; Tanenhaus et al., 1995; Trueswell, et al., 1993). The syntax in these "constraint-based" models serves as yet another constraint on the weighting of possible parses. If the ultimately correct parse has sufficient support from these constraints, it will be easy to achieve. If it is not supported by these information sources, it will be harder to achieve and the processing difficulty will be noticeable ("garden-path" effects).

Townsend & Bever's LAST theory of sentence comprehension (2001) distinguishes itself from both one- and (traditional, syntax-first) two-stage parsers in the following way: Whereas the syntax is accessed immediately in both one- and two-stage parsers—either as the first step or as one of many simultaneously applied constraints—LAST assumes that building a fully specified syntactic structure for a given input string is actually not the first parsing step. What is performed initially (or perhaps concurrently with the syntactic parse) on any given input string, according to this theory, is a "rough and ready" interpretation based on semantic associations, plausibility, and syntactic habits. This process is termed a "pseudo-parse" by Townsend & Bever. A complete syntactic parse runs in parallel with the pseudo-parse, but is slower. Only after the true parse has been completed—and only if it has time to run to completion—is the resultant interpretation checked against the actual syntactic structure.

Of critical importance is the pseudo-parse's reliance on superficial aspects of a language's syntax. Thus, for example, the "pseudo-parser" (as it is called by Ferreira [in press] in her summary of LAST) in English relies heavily on the fact that most English sentences contain the pattern Noun-Verb-Noun (more precisely, NP-V-NP). And furthermore, this NVN pattern strongly corresponds to the fact that the thematic agent tends to precede both the verb and the thematic patient (again, in English). Thus, the default for the pseudo-parser in English is to scan for an NVN string, and having once encountered such a string, to build a pseudo-parse in which the first N is the agent and the second N is the patient. If, as observed by Ferreira in the case of English passives, the thematic roles associated with the Ns in the pseudo-parse are inconsistent with additional non-syntactic information (e.g., the relative animacy of the Ns or the semantic associations of the verb), misinterpretations can result, assuming the actual syntactic parse is not completed (or at least not referenced to check the interpretation yielded by the pseudo-parse).

With respect to Odawa, LAST predicts that the SVO order, which was found to be by far the most common in Experiment 1 (Chapter 2), should be easiest to comprehend. And this prediction can perhaps be extended to all orders in which the subject precedes the object. Moreover, the predicted ease of processing—or at least interpreting—SVO sentences should not suffer greatly from the addition of adverbs between the subject and the verb, since the pseudo-parser should not be distracted by building structure required in a S-Adv-(Adv-)V-O sentence for the subject to scramble to an IP-adjoined string-initial position. Even with one or more adverbs, the critical NVN pattern should remain easy for the pseudo-parser to identify. It is not clear, however, what if any predictions LAST makes with respect to inverse Odawa sentences. Since the theory is based primarily on English data (and some limited Dutch and Spanish data), it is not obvious how the pseudo-parser would deal with conflicting "syntactic habits." Specifically, although word order is predominantly SVO and logical subjects are always thematic agents, it is also the case that agents are usually proximate, and proximate NPs thus also usually precede the verb. In the inverse, however, the agent is obviative and the patient is proximate, and BOTH precede the verb in the basic, unmarked order, with the patient preceding the agent. Thus the usual configuration of proximate-obviative holds in the inverse, but the other "surfacey" syntactic patterns are reversed. It would appear then that any formulation of rules for the operation of a pseudo-parser in Odawa will need to be more complex than in English.

3.2.5 Vasishth's *Abductive Inference Model* (AIM) (2002)

Vasishth's AIM shares a good number of properties with Lewis's RIT-02, but places more emphasis on the predictive properties of the HSPM. Essentially, AIM states that the HSPM generates one or more hypotheses about the ultimate structure of a sentence at each word on the incoming input string. Hypothesis generation at any given point is constrained by a principle that Vasishth terms "Minimal Consistency," which states that no words (perhaps better characterized as lexical heads) will be predicted at any given point without evidence for them. Working memory becomes strained—and processing difficulty increases—as the number of predictions stored at any given point increases. A sentence whose input string is at some point consistent with, say, five hypotheses is predicted to be more difficult than one whose input string is at some point consistent with at most three hypotheses. The key to the model is the concept of Minimal Consistency, of course, since, as Vasishth notes, "Although a nominative case marked NP is in principle consistent with an infinite set of possible continuations, the model allows for the selection of only those hypotheses ... that are *minimally consistent* with the nominative NP" (p. 192). If the first word of the input is an NP, the only minimally consistent continuation, according to Vasishth, is a verb with a one-place argument structure. If the first word of the input is a transitive verb, the minimally consistent continuation is the set {NP, NP} (with case marking, etc. being dependent on the precise verb type). This continuation is predicted as a function f_i(NP1,NP2).

Processing load is the result of a build up of several distinct costs. The first is "abduction cost," which consists of the sum of the number of NPs seen to a given point, the number of functions f_i that have been posited so far (i.e., the number of verbs consistent with the possible hypotheses), and the total number of individual hypotheses themselves. The second type of cost is "mismatch cost," which is incurred at any given point in the parse where it is determined that a verb in the input is inconsistent with one or more of the hypothesized functions; the more hypothesized functions inconsistent with the verb, the greater the mismatch cost.

Vasishth applies this algorithm to Japanese, Hindi, and Dutch center embeddings, predicting with consistent accuracy the relative difficulty of the various structures, as reported in the literature. Certain details about the actual application of the algorithm to other languages, constructions, or word orders are far from clear, however. For example, the principle of minimal consistency seems to require that, upon encountering a verb as the first word of a sentence in a *pro*-drop language like Odawa, the parser should hypothesize that no more overt elements will follow. Since both subject and object can be *pro*-dropped, a sentence consisting of a verb and two null pronominals would be the minimally consistent continuation of such a sentence. Yet "mismatch cost" is not associated with any NPs in Vasishth's examples. Presumably mismatch cost can be incurred upon encountering an unexpected NP, but it is not obvious that such cost should be equivalent to that incurred when an unexpected verb is encountered (and an entirely new prediction function must be hypothesized).

Specifically with respect to the types of sentences used as stimuli in the present Odawa processing experiment, AIM makes one clear prediction: including an adverb should simply act to strengthen the prediction of an upcoming verb, just as it is predicted to do under RIT-02. And two adverbs should add to the strength of the prediction (if the relationship between adverbs and strength of prediction is linear). Another prediction made by AIM for Odawa concerns the obviation morphology. Recall from Chapter 1 that a proximate NP is minimally consistent (under Vasishth's formulation of the term) with any of the following sentence types: intransitive,[31] passive, middle,[32] existential, or stative sentence (as is an English NP). An obviative NP, on the other hand, is minimally consistent with ONLY a transitive direct or inverse clause (lacking any prior context). Accordingly, at some point in the parse, there should be a substantial mismatch cost incurred in NP-proximate-initial sentences when either a transitive verb or an obviative NP is encountered. Vasishth predicts this cost to be at or immediately after the verb or second NP. This mismatch cost should not be evident in sentences that begin with an obviative NP.

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[31] I use "intransitive" both here and in Chapter 1 as an umbrella term for Odawa "true" intransitives (unergative and unaccusative) and detransitives built by adding a detransitivizing morpheme to a transitive root.

[32] For a proposed analysis of Odawa "lexical" passives vs. "inflectional" passives as passives and middles, respectively, see Christianson (2002).

3.3 Methods

3.3.1 Experimental design

It should be obvious by now that a good number of issues that arise when considering how Odawa sentences are parsed have yet to be addressed in the human sentence processing literature. Based on linguistic fieldwork in Wikwemikong, Manitoulin Island, Ontario and discussions held primarily with Genevieve Peltier, Kenny Pheasant, Helen Roy, and Alex Peltier (all native speakers who live in or come originally from Wikwemikong), I suspected that several factors might affect Odawa processing. To begin with, if frequency statistics are kept by the HSPM and used to weight competing parses in parallel as predicted by "constraint-based" theories, an obvious question is: What frequencies are more/less salient to the parse? SVO is the most common order when two overt NPs are present in a direct, independent clause, but this fact does little to predict or rank the relative difficulty of processing the other five possible orders, which were used approximately equally by speakers in Experiment 1 (Chapter 2). And since in the language itself it is common for one or both NPs to be *pro*-dropped, the relative order of subject and verb or object and verb might be a salient frequency statistic, perhaps more so than the three-constituent orders (cf. Dryer, 1997). Furthermore, all of the frequency statistics based on the data from Experiment 1 and textual counts hold only for direct clauses, since the inverse is used so infrequently that robust frequency counts are not available for that verb form.

Aside from the obvious complications imposed by "free" word order, native Odawa speakers and Algonquian linguists alike have noted that many more factors beyond grammatical relations determine which sentences feel "right" or seem easier to understand in any given context. For example the obviation status of two overt NPs might be critical in determining word order, irrespective of the grammatical functions of the NPs. This possibility is suggested in the syntactic analysis of Passamaquoddy by Bruening (2001) for both direct and inverse clauses. It is also noted by Thomason (p.c.) in Fox (Mesquakie) based on text analyses. Thomason reports that SVO orders are most common in Fox, while OSV and OVS orders are exceedingly rare: "[A] situation in which obviative precedes proximate is generally tolerated only if the obviative occupies the relatively uninteresting space between the verb and the final element in the clause" (from Thomason, in preparation), i.e., only in VOS orders (which occur second-most frequently behind SVO). Thomason further comments that in situations where word order restrictions appear to apply in Fox (e.g., when two or more overt obviative NPs occur), the restrictions can best be characterized in terms of "higher-ranking" and "lower-ranking" NP, rather than grammatical functions or even obviation status (see Chapter 4 below for an investigation of how NP "rankings" appear to affect Odawa comprehension).

The problem is that in sentences with two overt third-person NPs, Odawa speakers must choose *which* of the NPs is "higher-ranking." The one that is more highly ranked will (usually) be the proximate NP when the NPs differ in obviation status (but not necessarily the first NP in the string), and (usually) the first NP if they do not differ in obviation status. The factors taken into account when determining which NP is "higher-ranking" were explored in the discussion of Experiment 1 (Chapter 2), as well as in Christianson (2001a, b, in press) for Odawa, and in Aissen (1997, 1999a, b, 2001) for a range of languages, including some Algonquian languages. These factors include:

animacy (cf. Minkoff,1994, 2000, 2001), definiteness (cf. Bruening & Rackowski, 2000; Tomlin & Rhodes, 1979), thematic role (cf. Aissen, 1997, 1999a, b), context (including relative topicality of each NP) (cf. Aissen, 1997, 1999a), and conceptual accessibility (cf. Tomlin, 1997). Thus all of these factors could potentially interact with frequency to make a given word order more or less difficult to parse and comprehend.

Including all of these factors in an experimental design would be unwieldy, to say the least. The minimum factorial design would have to be: 3 x 2 x 2 x 2 x 3 x 4 x 3 x 3 x 4 (10,368 total conditions), as listed in (3.22).

(3.22) Potential factors influencing Odawa parsing (independent variables in a factorial design) and number of levels within each factor

a. Verb position (3 levels: V1, V2, V3)

b. NP argument order (2 levels: S before O, O before S)

c. Obviation order (2 levels: Prox. before Obv., Obv. before Prox.)

d. Verb form (2 levels: direct and inverse)

e. Size of thematic assignment domain (3 levels: 0, 1, or 2 adverbs)[33]

f. Definiteness (4 levels: Def. subject / Indef. object vs. Indef. subject/Def. object vs. balanced Def. vs. balanced Indef.)

g. Animacy (3 levels: "more animate" agent – "less animate" patient vs. "less animate" agent – "more animate" patient vs. balanced animacy)[34]

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[33] See discussion of parsing models in §3.3.

[34] As discussed at some length in Chapter 1, a number of linguists and psycholinguists have sought to determine the degree of articulation in the so-called "Animacy Hierarchy" (cf. Clark & Begun, 1971; Creamer, 1974; Hale, 1973; Minkoff, 2001; Silverstein, 1976; Witherspoon, 1977), e.g., to determine if humans are in some linguistically salient or psychologically salient way "more animate" than animals. Minkoff (2001) cites several languages that allow the equivalent of *The woman bit the dog* but not *The dog bit the woman*. Analyses differ, however, whether this is a restriction on the grammar of these languages or, as proposed by Minkoff, reflective of a universal property of the HSPM interacting with certain syntactic properties of some languages. Clark & Begun (1971) did find, however, a preference to associate

h. Context (3 levels: no context, agent-topic, patient-topic)

i. Overt NP inclusion (4 levels: both overt, S overt, O overt, both elided)

The dilemma I faced in planning the present experiment, however, was that, as discussed above, the factors in (3.21a-d) are practically inextricable form one another. So little is known about processing in a language with these properties, and so little time and opportunity remains before the native-speaking population of Odawa shrinks to a size that would preclude empirical research, that I felt it was of paramount importance to include as many factors as possible, while still allowing for reliable statistical analysis. The factors in (3.21f-i) were excluded from the design of Experiment 2,[35] making for a 3 (verb position) x 2 (NP argument order) x 2 (verb form) x 3 (thematic assignment domain size, or "adjunct") design.[36] (3.21e), the size of the thematic processing domain (termed from now on as "number of adverbs") was included in the design in order to test the conflicting predictions of the various parsing theories discussed in §3.3. It was hoped that the performance of an omnibus ANOVA on these four factors would fail to yield a significant (and uninterpretable) four-way interaction. However, as discussed below in the Results section, this hope was not realized. Consequently, the verb position and argument order variables had to be collapsed in the analysis into one Word Order variable with six levels, making for a 6 (word order) x 2 (verb form) x 3 (number of adverbs) design. This alteration did not decrease the number of conditions (36) in the design, but it did yield interpretable, significant three-way interactions.

"humanness" with agentivity, and proposed that humans rank at the top of the Animacy Hierarchy, immediately above animals (*human nouns > animal nouns > concrete count nouns...*).

[35] The effects of Animacy, *pro*-drop, and verb form and their interaction during parsing are explored in Experiment 3 (Chapter 4).

[36] Since the obviation status of arguments vary depending on the verb form, obviation order was not explicitly included in the design, though it can and will be pulled from the data for analysis.

Yet even narrowing the design from 10,368 potentially interesting conditions down to 36 placed prohibitive demands on native-speaking participants in the experiment. In order to limit session time to a maximum of one hour, it was determined that subjects could hear (in a self-paced auditory moving window paradigm, described below) no more than 150 sentences. In order to include sufficient distracters, including sentences with one or both NPs elided, along with enough practice trials to ensure that participants would be comfortable with the procedure, it was decided that 72 actual experimental stimuli would suffice, pseudo-randomly interspersed among 68 distracters (including 32 sentences serving as stimuli for Experiment 3 [Chapter 4]). This meant the statistical analysis would depend on a maximum of only two data points for each condition; however, the statistical power in this sort of repeated measures design stems from the recursive, repeated nature of the design, as well as the ability to collapse across variables when performing certain comparisons. And, based on what I have learned of the language from native speakers over the past five years, I was fairly confident that systematic, significant patterns of results would emerge, even from a limited data set.

3.3.2 Auditory moving-window (AMW) paradigm

Developed by Ferreira et al. (1996), the auditory moving-window (AMW) paradigm was first employed to investigate garden-path effects in spoken-language processing. Prior to the Ferreira et al. study, the vast majority of research dealing with garden-path phenomena has been conducted using written stimuli presented visually. Ferreira et al. found that effects similar to those reported using written stimuli could be observed using auditory stimuli, and that the AMW paradigm provided accurate measures of on-line auditory processing.

Although the Roman alphabet has been adopted by Odawa language teachers and some native speakers who are trying to encourage Odawa literacy, the language is not historically a written one. As a result, the vast majority of native speakers do not read or write Odawa (although most of them are literate in English and/or French). Consequently, the only feasible way to present the stimuli in the present experiment was in an AMW paradigm.

The experiment was designed using Eprime (version 1.0, Psychology Software Tools, Inc., 2001). The program was designed to record button-press latencies as on-line measures. These latencies were measured by recording the time from the start of an audio file to the time when the participant pushed a button on a button-box to begin the next audio file. The actual length of the audio file was then subtracted from the total time between button presses, yielding a response time. It was possible for this response time to be negative, if the participant pressed the button before the end of the audio file. If no response was signaled within five seconds, the program moved automatically on to the next audio file or the end-of-sentence line drawing (see below). These on-line measures were kept for every segment of each stimuli and filler sentence, including the end of sentence "wrap-up" section (see §3.4.3 immediately below), as well as the time it took to determine whether the line drawing appearing after each sentence matched the thematic content of the sentence. Thus, for sentences consisting of a subject, adverb, verb, object, and wrap-up region, the on-line measures were: (1) Button-press latency during recognition of subject, (2) Button-press latency during recognition of adverb, (3) Button-press latency during recognition of verb, (4) Button-press latency during recognition of object, (5) Button-press latency during recognition of wrap-up region, (6) Button-press latency while determining whether or not the line drawing matched the preceding sentence.

The program also kept track of one off-line measure of interpretation: Participants' accuracy in the picture verification task. Participants were told that at the end of each sentence, their final button-press would bring up a line drawing on the screen of the laptop computer. They were then to determine whether the drawing that appeared matched the sentence they had just heard with respect to the "actors" in the picture. They were instructed that some pictures would match, and some would not. Specifically, some pictures would show the opposite situation from that described in the sentence. During the practice session, which typically lasted nine trials, participants were shown examples of both matching and mismatching drawings. (The actual instructions, as written and read in English, appear in Appendix A.) These instructions were given in English, and, if requested by the participant or deemed necessary by myself or the native-speaker who assisted me with administering the trials, were repeated in Odawa.

In this way, two sorts of measures were recorded: on-line (button-press latencies of reaction times) and off-line (accuracy on picture verification task).

3.3.3 Materials

3.3.3.1 Creating the experimental and filler sentences

One list of 72 experimental sentences was developed. The sentences were counterbalanced with respect to the experimental conditions, as described in §3.3.3 and as summarized in Table 3.1. (The full set of stimuli [sentences and drawings] for Experiment 2 is given in Appendix C.) The relative animacy of the NPs in the sentences was balanced, with either two human NPs or two animal NPs. Extreme care was used in choosing NPs that would be visually salient and easily distinguished from one another during the picture verification task. With respect to the verbs, it was critical to find verbs that were both reversible (but crucially not necessarily reciprocal) and easy to depict in a line drawing.

Table 3.1: Examples of experimental conditions

(One and two adverb conditions in parentheses)

All translations: 'A/The moose chased a/the bear (yesterday/yesterday by a/the tree)'

VSO

Direct

Gii-mnashkow-aa-n (jiinaago/jiinaago mtig-ong) mooz mkwa-n

3.PAST-chase-Dir.3>3'-Obv (yesterday/yesterday tree-Loc) moose bear-Obv

Inverse

Gii-mnashka'-igoo-n (jiinaago/jiinaago mtig-ong) moozw-an mkwa

3.PAST-chase-Inv.3'>3'-Obv (yesterday/yesterday tree-Loc) moose-Obv bear

VOS

Direct

Gii-mnashkow-aa-n (jiinaago/jiinaago mtig-ong) mkwa-n mooz

Inverse

Gii-mnashka'-igoo-n (jiinaago/jiinaago mtig-ong) mkwa mooz-wan

SVO

Direct

Mooz gii-mnashkow-aa-n (jiinaago/jiinaago mtig-ong) mkwa -n

Inverse

Moozw-an gii-mnashka'-igoo-n (jiinaago/jiinaago mtig-ong) mkwa

OVS

Direct

Mkwa -n gii-mnashkow-aa-n (jiinaago/jiinaago mtig-ong) mooz

Inverse

Mkwa gii-mnashka'-igoo-n (jiinaago/jiinaago mtig-ong) moozw-an

SOV

Direct

Mooz mkwa -n gii-mnashkow-aa-n (jiinaago/jiinaago mtig-ong)

Inverse

Moozw-an mkwa gii-mnashka'-igoo-n (jiinaago/jiinaago mtig-ong)

OSV

Direct

Mkwa -n mooz gii-mnashkow-aa-n (jiinaago/jiinaago mtig-ong)

Inverse

Mkwa moozw-an gii-mnashka'-igoo-n (jiinaago/jiinaago mtig-ong)

It was also important to choose both verbs and NPs that are relatively common in the language. Since no formal written corpus of Odawa exists, I consulted extensively with native speakers Genevieve Peltier and Alex Peltier to make sure that the lexical items used in the stimuli sentences would be recognizable to all potential participants. This procedure was apparently successful, since only one participant in the experiment reported in post-session interviews that one lexical item (*ga'ag* 'porcupine') was hard for her to recognize at first. The same criteria were used to choose adverbs to use in the one and two adverb conditions. The NPs used in the experimental stimuli are given in (3.22), the verbs in (3.23), and the adverbs in (3.24). In addition, the three sentence-final clauses used are given in (3.25). One of these was added to the end of every item (stimuli and fillers) in order to control for so-called "end-of-sentence" or "wrap-up" effects (Just & Carpenter, 1976). The content of these clauses, which I will term as "wrap-up regions" from now on, was judged by native speakers to be equivalent between each of the three with respect to difficulty and "fit" with the experimental items. The wrap-up region containing a proper name (e.g., *Maanii* 'Mary') was never used in a sentence with a female agent or patient to avoid any possible coreferential reading.

(3.22) List of NPs used in stimuli (Experiment 2 and 3)

Animals

mkwa	'bear'
gaazhag	'cat'
mooz	'moose'
bizhiki	'cow'
mgizi	'eagle'
ga'ag	'porcupine'
gookoosh	'pig'
gnebig	'snake'
bezhgoognzhii	'horse'
mik	'beaver'

gookookhoo	'owl'
nimoons	'puppy'
jidimooh	'squirrel'
bineshins	'bird'
baakaakwenh	'chicken'
makhkii	'frog'
maashtaanish	'goat'
waashkesh	'deer'
zhagaag	'skunk'
kaadi-gnebig	'alligator'

Humans

giisenini	'hunter'
mdaabiichigenini	'driver/chauffeur'
ktegenini	'farmer'
ktegeninikwe	'female farmer'
dwechigenini	'musician'
dwechigeninikwe	'female musician'
nini	'man'
kwe	'woman'
gwiizens	'boy'
kwezens	'girl'
mshkiikiinini	'doctor'
mshkiikiininikwe	'nurse, female doctor'

jiibaakwenini	'chef, cook'
dakonwenini	'police officer'
binoojiins	'baby'
zhmaaganish	'soldier'
shoskwadenini	'hockey player'
kokodakenini	'baseball player'
gigoonhkenini	'fisherman'
mzinbiigenini	'artist'
mzinbiigeninikwe	'female artist'
zhigenini	'construction worker'
mzinaazogenini	'photographer'
mooshwenini	'barber'

(3.23) List of verbs used in stimuli, direct (3>3') version only (Experiment 2 and 3)

jiismaabinaan	'pinch'
gozhe'aan	'cover'
tikomaan	'bite'
takobinaan	'bind'
webinaan	'swing'
wiikbinaan	'pull'
mzinbii'aan	'draw'
shamaan	'feed'
mna'aan	'give drink to'
nooskwanaan	'lick'

mznaazowaan	'photograph'
digishkowaaan	'kick'
nsaan	'destroy/kill'
bgnenaan	'strangle/choke'
ziigwepidowaan	'spray'
jiimaan	'kiss'
mbinaan	'lift up'
dbaabiiginaan	'measure'
miigaanaan	'fight, attack'
bakskiingwe'aan	'slap'
bashkezowaan	'shoot'
gzhiipinaan	'scratch'
nimkowaan	'wave to/at'
bwaanaan	'dream about'
bjibwaan	'stab'
midaabaanaan	'drag'
ganjwebinaan	'push'
mwe'aan	'make cry'
waabmaan	'see'
tankshkwaan	'kick hard'
mnashkowaan	'chase'
giikaamaan	'yell at'
boojaapinaan	'poke in the eye'

bangdebeyaan	'hit on the head'
zegaan	'frighten'
moomaan	'carry (on back)'
tokinaan	'carry (in both arms)'
aptojinaan	'hug'
zagojwebinaan	'throw out'
naadmowaan	'help'
tsakwe'aan	'comb'
gnowaamaan	'watch'
ptakshkowaan	'bump into'
ngamtowaan	'sing to'
gaasgnoozotwaan	'whisper to'
ngaabinaan	'stop'

(3.24) List of adverbs used in stimuli

Temporal

jinaago	'yesterday'
oosnaago	'the other day'
dibikong	'last night'
zhebaa	'this morning'
jiinaago enaakwek	'yesterday at noon'

Locative

ziibiiying	'near river'
ziibiinsing	'near stream'

mtigong	'near/in tree'
kchisining	'near big rock'
gdaake	'on hill'
daabaaning	'near car'
jiigibiik	'on beach'
megwegemeyang	'in rain'
jiibakwegamigong	'in kitchen'
jiigeskode(ng)	'by fire'

(3.25) "Wrap-up segments"

Gii-keda Maanii	'Mary said it'
Mii sa genii gaa-goowaanh	'that's what I was told'
N-dinendam	'I think'

Regarding the actual full stimuli sentences themselves, I consulted with native speakers Genevieve Peltier, Alex Peltier, and Kenny Pheasant to be certain that none of the sentences were in fact ungrammatical. All three speakers agreed independently that the sentences with two adjuncts (3.25a) sounded "awkward" or "clumsy." All three also agreed that Odawa sentences of this sort sounded to their ears equally (un)acceptable to the awkward English sentence in (3.25b), where adjuncts of various sorts come between the VP and the oblique object. The three native speaker consultants suggested that it would be more natural to place the adverbs at either the beginning or the end of the sentence; however, when placed in second position the adverb(s) is/are not ungrammatical, just odd. In verb-initial orders, the consultants agreed that the adverbs made them expect no overt NPs. In NP-initial orders with one or (especially) two adverbs, they reported that their first impression was that the NP to the left of the adverb(s) is "left hanging" somehow. These intuitions, it would turn out, proved extremely insightful in interpreting the data.

(3.26) a. mashkikiinini oosnaago daabaan-ing gii-bjibw-aa-n jiibaakweniniw-an
doctor other.day car-Loc 3.PAST-stab-Dir.3>3'-Obv chef-Obv
'A/The doctor stabbed a/the chef the other day near a/the car'

b. Sally sent the boy who she met last week while vacationing with her parents a letter.

A single list of experimental sentences was devised rather than multiple lists due to the complexity of the experimental design. Recall that there were 36 conditions, requiring 36 separate lists, and at least 36 subjects in order to have each list seen once by at least one participant. It was determined ahead of time, however, that a maximum of 25 participants could be guaranteed during the time available for testing in Wikwemikong (three days). It was also assumed that at least a few of these 25 participants would prove to be unsuitable for various reasons (discomfort with the apparatus, misunderstanding of directions, etc.). A single list of stimuli was therefore used, knowing that subsequent items analyses (Clark, 1973) would necessarily consist of between-items ANOVAs, with an associated loss of statistical power in the items analyses as compared to the within-subjects analyses.

3.3.3.2 Creating the line dawing stimuli

After the stimuli and filler sentences had been judged by native speakers as grammatical, a line drawing was matched to each sentence. A portion of the drawings were recycled from Experiment 1 (Chapter 2), some being adapted to the present sentences through the addition of trees, big rocks, etc., for sentences containing locative adverbs. The remainder of the required line drawings was created according to my instructions by two artists, who were paid $3 for each drawing. Recall that half of the drawings corresponding to the experimental items and fillers matched the thematic content of the sentences, while the other half depicted the opposite thematic content. For example, if the sentence described a moose kicking a horse, a matching picture would have depicted a moose kicking a horse. A non-matching picture would have depicted a horse kicking a moose. No other mismatches with the content of the sentences were depicted. (The complete set of stimuli line drawing used in Experiment 2 and 3 is provided in Appendix C.)

After the line drawings were created, each one was presented along with the corresponding stimulus/filler sentence to a native speaker, who determined whether or not the drawing actually either matched or did not match (in the relevant way) the sentence. Approximately a dozen drawings were deemed inappropriate during this session. I took notes on how the drawing should be changed in order to better match/mismatch the corresponding sentence. I then conveyed these notes to the artist, who revised the drawings as needed.

3.3.3.3 Recording the experimental and filler sentences

Once all stimuli and filler sentences had been judged to be grammatical by native speakers, and to match or mismatch (with respect to thematic content only) the corresponding line drawings, the sentences were recorded. Recording took place over two three-day sessions at the Wikwemikong residence of Genevieve Peltier. The sentences were recorded by Ms. Peltier onto a Dell Inspiron 4000 laptop computer using an

Optimus *Nova 79* headphone/microphone combination headset, at a sampling frequency of 22050 Hertz. Sentences were recorded digitally directly into the Praat software package, version 4.0.8 (Boersma & Weenink, Feb. 21, 2002). Since Ms. Peltier, like most native Odawa speakers, does not read the language, I provided her with the written English translation of each sentence, along with the oral Odawa version to be recorded. After rehearsing each sentence a few times, she recorded the sentence at a natural pace. Both she and I then listened to each sentence to check that each conformed to the basic requirement that it sound "natural." It should be noted, however, that this requirement of naturalness was both relative and subjective. Some of the sentences themselves, due to their content, failed in certain respects to sound natural. As discussed above, sentences with two sentence-medial adverbs and two overt NPs are extremely rare in actual usage. As such, they proved difficult for Ms. Peltier to produce in a "natural," conversational pace. The best attainable result was fluent, if somewhat halting enunciation of these longer sentences, all of which nevertheless contained the characteristic fall in pitch associated (perhaps universally) with the progression of a sentence from beginning to end (cf. Selkirk, 1984).

Once all the sentences had been recorded and saved into Praat, each sentence was first standardized with respect to amplitude, and then split up word by word into individual .wav files. The only exception to the word-by-word parse was the final wrap-up region, which comprised one sound file, irrespective of the number of words it contained. The result was a collection of sound files for each sentence, numbering at minimum two (for fillers consisting of just a verb and the wrap-up region) and at maximum six (for experimental items containing two overt NPs, a verb, two adverbs, and a wrap-up region). These files were then imported into the Eprime program detailed in §3.4.2.

3.3.4 Participants

A total of 26 participants agreed to take part in the experiment, exceeding expectations by one. Participants were paid for participating, receiving either US$20 or CAN$30, whichever they preferred. The demographics of these 26 participants are given in Table 3.2. The data from three participants were discarded. The mean age of the remaining participants was 45.35. The tests sessions, exclusive of instructions and practice trials, lasted on average 46 minutes. The instructions and practice trials required approximately 15 minutes to administer and complete.

Table 3.2: Participant Demographics[37]

(GP = Genevieve Peltier; CC = Community Center)

Part. #	Gender	Age	Residence	Location of Session	Length
1	M	49	Wikwemikong	GP's kitchen	60 min.
2	M	43	Wikwemikong	same as #1	45 min.
3	M	50	Wikwemikong	same as #1	55 min.
4	F	34	Wikwemikong	participant's kitchen	45 min.
5	M	60	Wikwemikong	same as #4	40 min.
6	F	45	Wikwemikong	same as #4	45 min.
7	F	54	Wikwemikong	same as #4	50 min.
8	F	51	Wikwemikong	same as #4	45 min.
9	F	46	Wikwemikong	participant's kitchen	55 min.

[37] I did not enquire as to the participants' educational background. To do so, according to my native-speaking consultants, would have been considered inappropriate.

Table 3.2 (con't).

10	M	56	Wikwemikong	same as #9	45 min.
11	M	38	Wikwemikong	participant's living room	50 min.
12	F	37	Wikwemikong	same as #11	40 min.
13	F	54	Wikwemikong	participant's kitchen	55 min.
14	M	49	Wikwemikong	same as #13	45 min.
15	F	50	Wikwemikong	CC hallway	40 min.
16	F	56	Wikwemikong	CC hallway	40 min.
17	F	43	Wikwemikong	CC hallway	40 min.
18	F	28	Wikwemikong	CC hallway	40 min.
19	M	43	Wikwemikong	CC hallway	45 min.
20	F	38	Wikwemikong	CC hallway	45 min.
21	F	48	Wikwemikong	CC hallway	40 min.
22	M	52	West Bay	CC hallway	40 min.
23	F	48	West Bay	CC hallway	45 min.
24	F	77	Wikwemikong	participant's kitchen	60 min.
25	M	44	Wikwemikong	participant's kitchen	45 min.
26	F	45	Wikwemikong	same as #25	45 min.

The data from three participants were discarded for the following reasons. Participant #16 was disqualified because she failed to respond 'NO' to the picture verification task through the first 62 items, despite the fact that nearly half of the drawings did not match the sentences. Although it emerged as a general pattern that participants were more reluctant to answer 'NO' than 'YES' (see discussion in §3.5-6 below), Participant #16 represented an extreme example of this behavior. Participant #18 was disqualified due to an equipment malfunction, which resulted in the loss of her data. In addition, Participant #18 was 28 years of age—younger than most native speakers of the language in the community—and she also described herself as having learned the language later in life than the other participants. Participant #24 was disqualified for two reasons. First, she was 17 years older than the next oldest participant, and her hands trembled noticeably. Second, at item #117, she asked to make sure that it was all right if she answered 'NO' when the drawing failed to match the sentence, thus indicating that she had not understood the directions.

The uncertain status of Participant #18 as a "native speaker" of Odawa highlights the importance of establishing criteria for "native-speaker-hood" when investigating endangered or minority languages. The criteria used in the present research are listed in (3.27). The criteria are obviously flexible; however, they seemed to serve as an effective filter for potential participants.

(3.27) Criteria for determining that participants were "native speakers"

a. The participant had learned the language as a child, preferably prior to any exposure to English or French.

b. Even if raised bilingually, Odawa had been the primary language spoken in the home when the participant was a child.

c. The participant prefers to use Odawa today when interacting with others who know the language.

d. The participant considers Odawa his/her "language of choice" both at home and at work.

e. The participant is known to the native-speaker consultant as "a fluent speaker."

The varying locations at which the experimental sessions took place introduced certain uncontrolled (or uncontrollable) environmental variables into the experiment. These variables and the issues they raise in the context of "field psycholinguistics" are discussed in §3.4.7.

3.3.5 Apparatus

The stimuli were presented aurally over the same Optimus *Nova 79* headphone/microphone combination headset on which they were originally recorded. The microphone was rotated out of the way of the participants. All trial sessions were run on a Dell Inspiron 4000 laptop computer with a 13-inch LCD screen. A five-button button box (Psychology Software Tools, Inc., model 200A) was connected to the laptop computer. Participants advanced from segment to segment of the stimuli sentences by pressing the middle button of the button box, which was marked with an arrow (⇨). To respond 'YES' or 'NO' to the picture verification task, participants pressed either the far left button for 'YES' (marked "Y") or the far right button for 'NO' (marked "N"). To proceed to the next sentence, participants pressed the SPACE BAR of the laptop computer, which was marked with the word "NEXT."

The button box was placed immediately between the participant and the laptop computer. Participants generally used only their right hand to press the button box buttons and the SPACE BAR. Since they were allowed to move on to each next sentence at their own pace, and a short pause between the press of the SPACE BAR and the start of the next sentence was built into the program, there was ample time for participants to reposition their right hand on the button box between trials. Some participants did use both hands during the sessions: their right to operate the button box and their left to press the SPACE BAR to proceed to the next sentence.

3.3.6 Procedure

Every experimental session was conducted by both the investigator (me) and my native-speaker assistant, Alex Peltier, who was paid US$25 per hour for his assistance. Mr. Peltier was also primarily responsible for contacting potential participants ahead of time and scheduling sessions. According to the agreement I had reached with Chief Gladys Wakegijig and the Wikwemikong Band Council, by which they had granted me permission to work in Wiwemikong, I agreed to consult with either Genevieve Peltier or Alex Peltier while conducting the experiment, deferring to their judgment when/if issues of cultural sensitivity arose. Mr. Peltier and I were both present during all experimental sessions to answer questions in either English or Odawa, depending on the preference of each participant.

Each experimental session proceeded roughly according to the same protocol. First, participants read a consent form in English and signed it. They were then seated in front of the laptop computer and button box so that they could comfortably reach all of the relevant buttons on both apparatuses. The instructions (see Appendix A) were then read in English to the participant. If the participant signaled any confusion at all, Mr. Peltier repeated the instructions in Odawa. The nine practice trials (which included a representative sample of sentence types of both the experimental and filler items) were then begun. During these, participants were encouraged to press the relevant buttons as quickly as their comprehension of the words and judgment of the pictures allowed. Between practice trials, participants were encouraged to pause to ask questions, if necessary. After each practice and experimental trial alike, the participants were in control of when the next sentence would begin, so they were able to laugh, cough, ask questions, etc., without time pressure. During these times between practice trials, participants were reminded to press the NO button if the picture and sentence did not match. Despite these reminders, however, participants appeared hesitant to answer 'NO,' as discussed in more detail in §3.5-3.6. Participants had the option of repeating the practice trials until they became comfortable with the procedures/apparatus, but only one of them (Participant #13) requested to do them again. A few participants were a bit uneasy with the computer buttons at first, but many more said that they were regular computer users, or at least had used a computer more than once in the past.

When sessions took place in locations where other participants were gathered, I made sure that the participants who had not yet run were seated such that they were unable to see the computer display screen. The participants waiting for their turns could not hear the stimuli, since these were presented over headphones. As much as possible, participants who were performing the task were separated from other people and shielded from outside noise and activity. Doing so, however, was not always easy, considering the nature of the surroundings at some of the testing locations.

3.3.7 Some notes on "field psycholinguistics"

While fieldwork is common in linguistics, it is practically non-existent in psycholinguistics. As far as I can determine, the present research may be the first to fall under the title of "field psycholinguistics" (though see some of the studies on spatial conceptualization and language, e.g., Pederson, Danziger, Wilkins, Levinson, Kita, & Senft [1998]; Sridhar [1989], and Bavin & Shopen's work in Walpiri [1985, 1989]). There is good reason for this, however: Variation in the physical surroundings from one session (even one trial) to the next introduces uncontrolled variability into the experimental design. So the variation implied by the term "field psycholinguistics" is anathema to the strict environmental controls generally imposed by those working in empirical fields. Nevertheless, the fact is that Odawa speakers could not be transported to a laboratory to participate in this research (nor would they have allowed themselves to be, even if such transport had been fiscally possible). So I had to go to them.

The first consideration was requesting and receiving permission from Chief Gladys Wakegijig and the Wikwemikong Band Council to conduct research in Wikwemikong. The second consideration was scheduling times and locations to conduct the testing sessions. Native speakers Genevieve Peltier and Alex Peltier assisted in this respect, by contacting likely participants ahead of time to ask if they would be interested. Time in most indigenous North American cultures is very fluid, and setting specific appointments in advance would not have proven effective. Instead, when I arrived in Wikwemikong with my laptop computer, Alex Peltier simply accompanied me from house to house, where most of the sessions took place. Some of these sessions were pre-arranged, and some were not.

Certain environmental factors were difficult to control for under such conditions. First and foremost was noise created by children, dogs, televisions, and other participants waiting for their turns. Although it was possible for me as an outsider to attempt to control some of this noise, if I had tried to exert too much control, it would have been considered offensive. Alex Peltier, as a native of Wikwemikong and friend or acquaintance of all of the participants, had more latitude to shush children, scold dogs, turn off televisions, and ask people to be quiet. Still, only so much could be done. For example, in the hallway of the Wikwemikong Community Center, where participants 15-23 were run, the usual quiet conditions were occasionally interrupted by people walking through the hallway, sometimes talking and laughing. I kept a close watch on participants during these times, and was impressed with their levels of concentration; none seemed distracted at all by the hall traffic. Nor did they report in post-session interviews that any of the sentences had been hard to hear due to the noise. Recall that participants controlled when each new trial began, so they could wait for conditions to quiet down before starting a new sentence.

Another culturally sensitive issue that had to be taken into account was the feeling on the part of native speakers that they are the last generation of people for whom Odawa is their first language. As such, they consider themselves experts on the language, and were sensitive to any indications that they were incorrect in their interpretations of any of the test sentences. Therefore, even if I noticed that during the practice trials a participant had incorrectly answered 'YES' to the picture verification task on one trial, I could not point out that the answer was wrong or explain why it was wrong, without fear of offending the participant. (I had done this sort of thing in previous field work in Wikwemikong, and had felt the entire mood of the people with whom I was working change.) Instead, all I could do was remind the participant several times that some drawings matched the sentences, and some were the exact opposite. This culturally imposed limitation on instruction would turn out to be critical, as I discovered during the data analysis that participants were, on the whole, reluctant to answer 'NO' during the picture verification task, even when 'NO' was the correct answer. In some ways, this performance on the picture verification task is similar to the experience of many field linguists who discover that native-speaker consultants are very accepting of ungrammatical constructions, judging them grammatical (or at least acceptable) so as not to offend the non-native speaking linguist who is trying so hard to learn the language.

Despite all of the potential sources of statistical "noise" inherent in the conditions under which the experiments reported here took place, results were obtained that are systematic and consistent. I turn now to these results.

3.4 Results

As discussed above, the experimental design elicited both on-line measures and an off-line measure. The on-line measures were the button-press latencies at various points in each stimulus sentence. The off-line measure was the 'YES'/'NO' response to the picture verification task. I report first the results of the off-line measure, since they ultimately provide the most consistent picture of performance. These off-line data illustrate one of the unforeseen complications encountered in the course of the data analysis.

3.4.1 Off-line Measure: Picture verification task

I collapsed the verb position and argument order conditions into one word order condition with six levels (VSO, VOS, SVO, OVS, SOV, and OSV). The picture verification task data were then analyzed as a 2 (verb form) x 6 (word order) x 3 (number of adverbs) factorial. The mean correct response in each condition is shown in Table 3.3.

Table 3.3: Mean CORRECT Responses to Picture Verification Task

	0 Adverbs		1 Adverb		2 Adverbs		*M*
	Mean (% Correct)	Std. Deviation (%)	Mean (% Correct)	Std. Deviation (%)	Mean (% Correct)	Std. Deviation (%)	
DIRECT							
VSO	84.8	23.5	54.4	29.8	69.6	36.1	**69.6**
VOS	80.4	29.2	56.5	27.4	58.7	32.5	**65.2**
SVO	95.7	14.4	58.7	28.8	76.1	25.5	**76.8**
OVS	76.1	33.3	47.8	28.1	63	31	**62.3**
SOV	78.3	25.3	78.3	25.3	65.2	35.2	**73.9**
OSV	54.4	42.4	67.4	32.4	54.4	25.7	**58.7**
M	*78.3*		*60.5*		*64.5*		***67.8***
INVERSE							
VSO	58.7	28.8	54.4	29.8	73.9	25.5	**62.3**
VOS	82.6	24.4	58.7	35.8	47.8	31.9	**63.0**
SVO	69.6	25	52.2	35.3	80.4	25	**67.4**
OVS	69.6	32.8	56.5	22.9	65.2	35.2	**63.8**
SOV	71.7	29.5	67.4	28.6	52.2	28.1	**63.8**
OSV	87	22.5	65.2	27.9	60.9	33.6	**71.0**
M	73.2		59.1		63.4		***65.2***
GM	**75.7**		**59.8**		**64.0**		

What is initially striking about the data in Table 3.3 is the overall low percentage of correct responses, with certain conditions hovering within the chance range of 50%. I will return to this issue shortly, but suffice it to say for now that these low "correct" rates can be attributed, at least in part, to the above-mentioned reluctance by the participants to answer 'NO' on the picture verification task. Therefore what is of central interest in the subsequent results will be *relative* percentages correct, rather than *absolute*. In other words, what is of interest is that Condition X had a significantly higher (or lower) percentage of correct responses than Condition Y, rather than the fact that both X and Y were lower than might be expected with a normal, native-speaking population.[38]

Ever since Clark (1973), it is *de rigueur* in psycholinguistic investigations to perform two analyses of variance (ANOVAs) on data obtained in factorial, within-subjects designs: one treating the subjects as a random factor (F_1) and one treating the stimuli sentences (or items) as a random factor (F_2). Both analyses are often (but not always) performed as within-factor, repeated measure ANOVAs; however, given that there was only one list of stimuli for the present experiment, the ANOVA treating items as a random factor had to be performed as a between-items ANOVA. The ANOVA treating subjects as a random factor was fully within-subjects. Recall that the reason there was only one list was that in order to maintain a fully factorial design with 36 conditions, 36 lists would have been required, and at least 72 participants. This would have been impossible, given the limited subject pool and financial resources available. The problem with doing a between-items ANOVA, however, is that given the low number of subjects (23) and observations in each cell (two), the repeated measures lend statistical power to the ANOVA. The between-items analysis suffered from a lack of power in the current

[38] Studies on syntactic processing by Broca's aphasics often employ a forced picture-matching paradigm (eg. Beretta, et al., 1996), in which normal controls are also tested. The normal controls generally perform at or near ceiling levels (Alan Beretta, p.c.). However, I know of no studies where non-brain damaged subjects were asked to determine whether a single picture shown to them after presentation of a sentence matches that sentence, as in the present experiment. So there is no existent baseline against which to judge the Odawa performance. Perhaps the "act out" paradigms (in which participants act out sentences after they have heard them, using toys) used in the experiments by MacWhinney & Bates and colleagues (cf. MacWhinney & Bates, 1989) would be the closest sort of procedure. The papers in that volume report a wide variability in performance by both children and adults on the act out task, depending on the various features of the given sentences. In addition, Clifton & De Vincenzi (1990) report systematic error rates of 15% and overall low accuracy rates (66%-72%) by Italian speakers when confronted with non-contextualized sentences with null pronominals and non-canonical subjects. They attributed these error rates to lack of context.

design, and thus yielded few significant results. I therefore do not report the between-item ANOVA results (F_2) unless they were significant.

The 6 (word order) x 2 (verb form) x 3 (number of adverbs) within subjects ANOVA using a Greenhouse-Geisser correction to correct for violations of sphericity revealed a number of significant effects, including a significant three-way interaction between verb form, word order, and number of adverbs, $F_1(10,22) = 2.677$, $MSE = .114$, $p = .012$, which I focus on here. The first point of interest is that the word orders defined as "basic" according to Bruening's (2001) account of Algonquian syntax—namely SVO in the direct form and OSV in the inverse form—were largely comprehended significantly better than other word orders, but only in the 0 Adverb condition. Although the data plotted in Figures 3.1a-b are a bit overwhelming, these plots offer the clearest picture of how the individual word orders stacked up against each other in each of the adverb conditions. Note that in the direct form, SVO order resulted in significantly better comprehension in the 0-adverb condition than any other word order, except for VSO. In the inverse, OSV order resulted in better comprehension than any order other than VOS. Both of these non-basic orders represent cases of simple verb-fronting, which appears to not strain the HSPM.

Figure 3.1a: Three-way Interaction (Plotted by Verb Form) Accuracy on Picture Verification Task (DIRECT)
(error bars represent 95% confidence intervals)

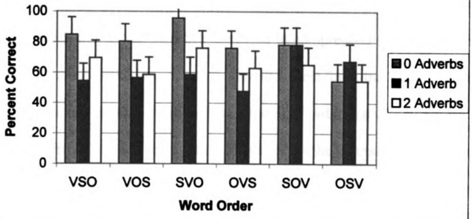
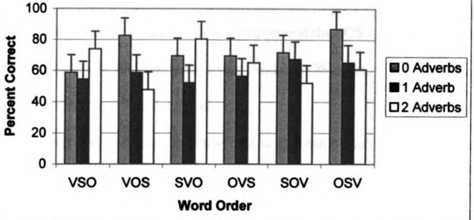


Figure 3.1b: Three-way Interaction (Plotted by Verb Form) Accuracy on Picture Verification Task (INVERSE)
(error bars represent 95% confidence intervals)



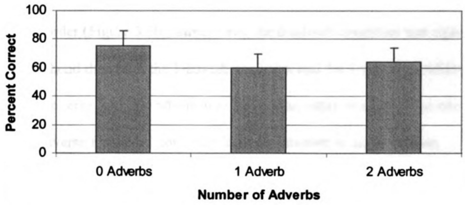
Limiting comparisons initially to within verb form and number of adverbs groups, let us consider the significant differences within the 0-adverbs condition in Figure 3.1a (direct), as illustrated with 95% confidence intervals (calculated according to Loftus & Masson, 1994). The main pattern to emerge within this group is that comprehension of SVO sentences (containing no adverbs) was significantly better than any other order, other than VSO. The comparison to VSO order was, however, just barely non-significant. Turning to the inverse verb, we find a similar pattern of results in the 0-adverb condition. Comprehension for OSV sentences was significantly better than on all other orders except VOS, which was in turn significantly easier to comprehend than all other orders.

In the 1-adverb condition, we see that, in the direct form, the SVO order lost its advantage completely. In this condition, it was the SOV order that was significantly easier to comprehend than any other order. Interestingly, the inverse, 1-adverb condition patterned in the same direction as the direct (i.e., verb-final orders tended to be a bit easier to comprehend), although none of the comparisons turned out to be significant.

Moving on to the 2-adverb condition in the direct form, SVO again was easier to comprehend, but only in comparison to OS orders: VOS, OVS, and OSV. The 2-adverb condition in the inverse form proved to yield the only unruly results. While it was generally true that SO orders were easier to comprehend than OS orders, this trend was not consistent throughout the comparison sets. And one OS order, OVS, was easier to comprehend than another OS order, VOS.

Further exploration of the three-way interaction can be accomplished through scrutiny of the data as presented in Figures 3.3a-f, which show the three-way interaction grouped by word order. As is discussed in more detail in the General Discussion for Experiment 2, the processing theories described in §3.3 all make some prediction with respect to the effect of separating thematic role assigners from assignees (or visa versa) by inserting adverbs between them. Testing the predictions of the various models was in fact the reason for including this condition in the design. The pattern of results immediately apparent upon eyeballing the data in Figures 3.1a-b and 3.3a-f is that not only did these adverbs affect processing, but they did so in a way that is *not* predicted (completely) by *any* of the theories presented above. In fact, the only significant main effect was of number of adverbs (0, 1, 2) by subjects, $F_1(2,22) = 24.771$, $MSE = .088$, $p < .001$, such that the 0-adverb condition resulted in better comprehension than the 1-adverb condition. The 2-adverb condition may have actually been easier (the difference was not significant) than the 1-adverb condition, but just barely harder than the 0-adverb condition. Although the 1- and 2-adverb conditions did not differ reliably, this overall trend repeats itself again and again throughout the data, and is central to the general discussion, which follows the data analysis. The main effect for number of adverbs is shown in Figure 3.2.

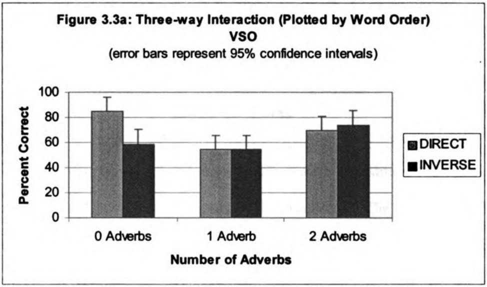
Figure 3.2: Main Effect of Number of Adverbs
(error bars represent 95% confidence intervals)



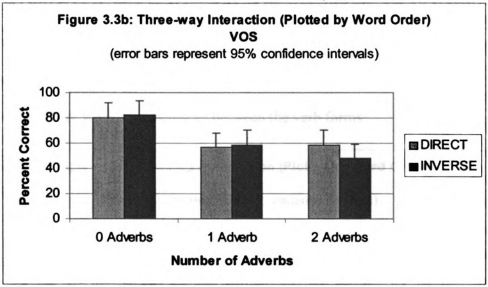
In VSO order[39] (Figure 3.3a), direct verb form, the 0-adverb condition differed significantly from the 1-adverb condition and from the 2-adverb condition. The 2-adverb condition also resulted in significantly better comprehension than the 1-adverb condition In the inverse form, the 2-adverb condition was more accurate than the 0- or 1-adverb

[39] I begin throughout Experiment 2 with verb-initial orders, followed by verb-medial, and verb-final. Within each verb position, I always list the SO order before the OS order.

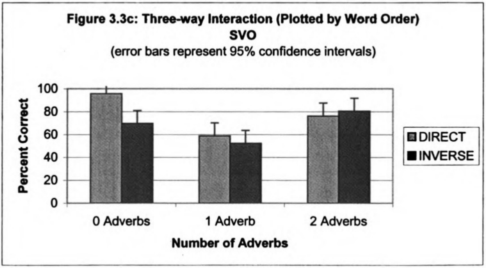
conditions. Thus the overall inverse pattern was quite similar to that in the direct form, but in reverse. We might also note that the difference between direct and inverse forms in the 0-adverb condition was wiped out completely with the addition of one or two adverbs.



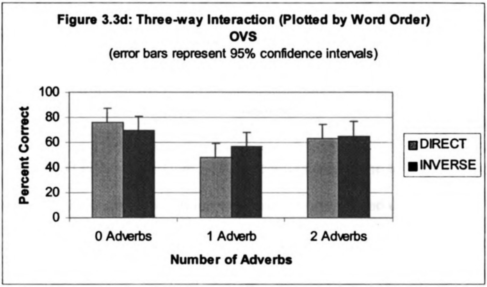
In VOS order (Figure 3.3b), direct form, the 0-adverb condition was significantly easier to comprehend than both the 1-adverb condition and the 2-adverb condition. Likewise in the inverse form, no adverb was easier than either one adverb or two adverbs. The direct and inverse forms did not differ from one another in any condition.



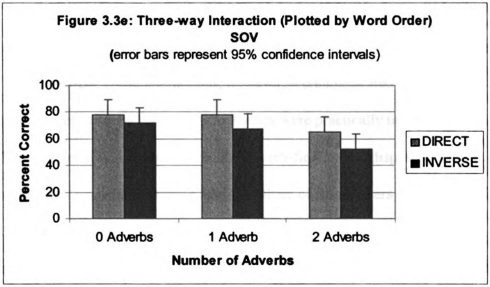
In SVO order (Figure 3.3c), direct form, the 0-adverb condition was significantly easier than both the 1-adverb condition and 2-adverb condition. The 2-adverb condition was also significantly easier than the 1-adverb condition. The pattern for inverse verbs was similar to the direct, but the 0- and 2-adverb conditions did not differ from one another; both were significantly easier than the 1-adverb condition, though. The direct and inverse forms differed only in the 0-adverb condition, with direct easier to comprehend than inverse.



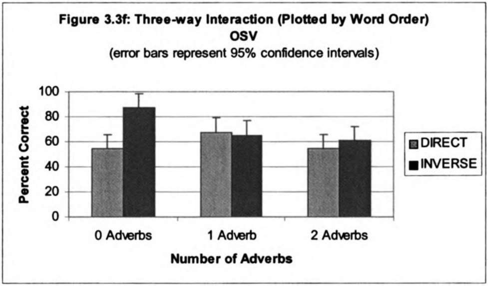
In OVS order (Figure 3.3d) in the direct form, the 0- and 2-adverb conditions were significantly easier than the 1-adverb condition. In the inverse, sentences with no adverbs resulted in better comprehension than those with one adverb, but not those with two adverbs. There were no differences between the verb forms.



In SOV order (Figure 3.3e), significant differences emerged in both direct and inverse forms, with a similar pattern of results in both. Here we finally observe a hint of a linear increase in difficulty in the inverse form, corresponding to the addition of adverbs. Although the 0-adverb condition did not differ from the 1-adverb condition, it was easier than the 2-adverb condition. The 1-adverb condition was also easier than the 2-adverb condition. There was a drop in accuracy in the direct 2-adverb condition compared to the other two direct conditions as well, mirroring the inverse form.



Finally, in OSV order (Figure 3.3f), differences emerged in both verb forms. In the inverse form, the 0-adverb condition was easier to comprehend than either the 1- or 2-adverb condition. In the direct form, the 1-adverb condition was actually easier than the 0- and 2-adverb conditions. This reversal in pattern from other word orders is curious. But is ti notable that the 0- and 2-adverb conditions again patterned together.



Although there were no main effects of verb form (direct, inverse) or word order (VSO, VOS, SVO, OVS, SOV, OSV), there was a reliable two-way interaction between word order and number of adverbs, $F_1(10,22) = 4.843$, $MSE = .104$, $p < .001$. There was also a reliable two-way interaction between word order and verb form, $F_1(5,22) = 4.843$, $MSE = .112$, $p = .026$. These interactions, however, were implicated to such an extent in the three-way interaction (see Figures 33a-f), they were practically uninterpretable by themselves. Suffice it to note that the four non-verb-final orders displayed a uniform drop in accuracy in the 1-adverb condition, and then three of these orders (VSO, SVO, OVS) rebounded to varying extents in the 2-adverb condition. The verb-final orders also performed uniformly: Their accuracy rates tended to drop rather steadily as adverbs were introduced.

3.4.1.1 A word about the low accuracy

As already mentioned, the overall accuracy of participants' responses on the picture verification task was surprisingly low. This performance, however, can be attributed in large part to participants' aversion to answering 'NO,' as can be seen in Table 3.4, which lists each participant's performance when the drawings matched the sentence ("match" condition) and when they did not ("mismatch" condition).

Table 3.4: Participants' Number of Correct Responses on the Picture Verification Task

(n = 36 in both match and mismatch conditions)

Part	match	%	mismatch	%
1	33	92	27	75
2	31	86	17	47
3	33	92	21	58
4	30	83	8	22
5	31	86	22	61
6	34	94	17	47
7	28	78	25	69
8	23	64	18	50
9	27	75	11	31
10	25	69	22	61
11	35	97	6	17
12	32	89	12	33
13	31	86	23	64
14	35	97	10	28
15	36	100	20	56
17	33	92	4	11
19	29	81	21	58
20	34	94	5	14
21	32	89	14	39
22	27	75	25	69
23	34	94	18	50
25	28	78	17	47
26	24	67	11	31
Mean		**75**		**40**

One explanation for participants' apparent aversion to responding 'NO' on trials when the line drawing depicted the opposite content of the sentence might be related to a similar phenomenon common in field linguistics. Field linguists often report that native-speaking consultants judge ungrammatical sentences as acceptable in an attempt to appear accommodating to the linguist. I should have suspected the same thing might occur in a field psycholinguistics situation. Since this potential factor was not considered ahead of time, no "match" vs. "mismatch" comparison was included in the experimental design; however, I did counterbalance the stimuli such that one of each pair of stimuli in each condition matched its drawing, and the other did not. This counterbalanced design allowed for some *post hoc* tests to determine how the low numbers of correct 'NO' responses may have affected the overall results, if at all.

First, to determine if performance on matching sentence/picture pairs really differed from mismatching pairs, a paired t-test using a Bonferroni correction to protect against familywise Type 1 error (Keppel, 1991) was computed by both subjects and items, comparing the mean number of correct responses in match and mismatch sentences. The differences were significant for both subjects ($t(22) = 8.097, p < .001$), and items ($t(35) = 9.605, p < .001$). But neither the within-subject ANOVA nor between-items ANOVA (both using a Greenhouse-Geisser correction and a Bonferroni correction) yielded any significant results when "match condition" was added into the model, other than a main effect in each case for match condition. The ANOVAs were initially run as three-factor analyses, within verb form groups (i.e., first for direct sentences only, and then for inverse). Then they were run as two-factor ANOVAs, comparing match condition to verb form, word order, and number of adverbs each separately. The between-items analyses were all non-significant. (For both within-subjects and between-items comparisons, the Bonferroni correction resulted in a significance level of .01, .05/5 comparisons.)

The within-subjects match condition x number of adverbs ANOVA yielded significant main effects of number of adverbs ($F(2,22) = 31.948$, $MSE = .011$, $p < .001$) and match condition ($F(1,22) = 67.315$, $MSE = .09$, $p < .001$). There was also a marginally significant two-way interaction, $F(2,22) = 5.018$, $MSE = .01$, $p = .012$. The interaction was such that the rate of correct responses in the mismatch condition decreased slightly more in 1- and 2-adverb conditions than it did in the 1- and 2-adverb conditions in the match condition. There were no other reliable interactions.

The relative lack of interaction between the *post hoc* match condition and the real experimental conditions suggests that any effect of participants' reluctance to answer 'NO' was marginal. In order to double-check the validity of this inference, I removed the data from participants whose ratio of correct 'YES' responses to correct 'NO' responses was less than .60, leaving data for just ten participants: #1, #3, #5, #7, #8, #10, #13, #19, #22, #25. A within-subjects ANOVA with a Greenhouse-Geisser correction performed on the data from the remaining ten participants yielded similar results to the ANOVA performed on the data of all 23 participants. Even with the reduced data set, there was a significant main effect for number of adverbs, $F_1(2,9) = 14.541$, $MSE = .115$, $p = .002$. There was also a significant two-way interaction between number of adverbs and word order, $F_1(10,9) = 3.862$, $MSE = .195$, $p = .008$. The weak two-way interaction between verb form and word order resulting from the ANOVA on all 23 participants' data was not significant with only ten participants. The between-items analysis yielded no significant results.

Somewhat more worrisome, though, was that the within-subjects, three-way interaction between verb form, word order, and number of adverbs was not significant with only ten participants. However, after graphing the results of the ANOVA with ten participants (Figures 3.4a-f) and comparing those plots to the results of the ANOVA with 23 participants (Figures 3.1a-f, without error bars, since the interaction was non-significant), it became obvious that the pattern of results were remarkably consistent between the two tests. In the ANOVA run on the data from the ten subjects, it seems clear that the three-way interaction, $F_1(10,9) = 1.603$, $MSE = .155$, $p = .175$, *n.s.*, was non-significant simply due to the loss of power associated with such a small data set. I therefore infer that despite the surprisingly low numbers of correct responses due to participants' aversion to responding 'NO' even when doing so constituted the correct response, the results of interest to this research were not greatly affected. This said, the low number of correct responses *does* have negative implications for analyzing and interpreting the on-line measure of button-press latencies, since only data from trials which were responded to correctly could be used in the analysis of these measures (see §3.5.2).

Figure 3.4a: Three-way Interaction (n.s.), 10 Subjects
VSO

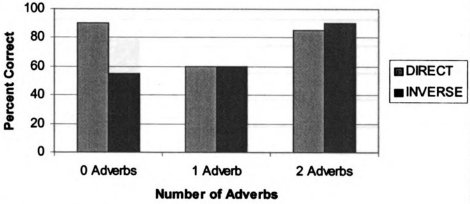
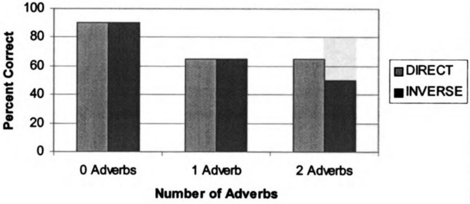


Figure 3.4b: Three-way Interaction (n.s.), 10 Subjects
VOS



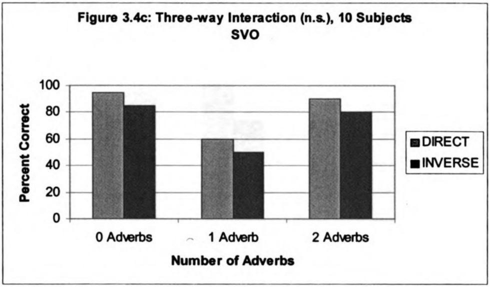


Figure 3.4c: Three-way Interaction (n.s.), 10 Subjects
SVO
100
80
60
40
20
0
Percent Correct
0 Adverbs
1 Adverb
2 Adverbs
Number of Adverbs
DIRECT
INVERSE

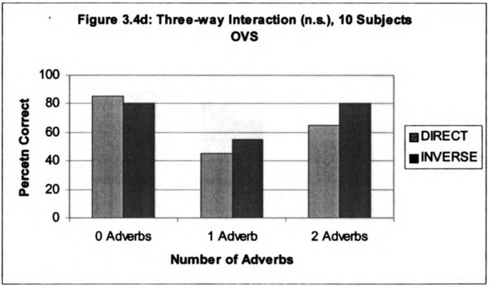
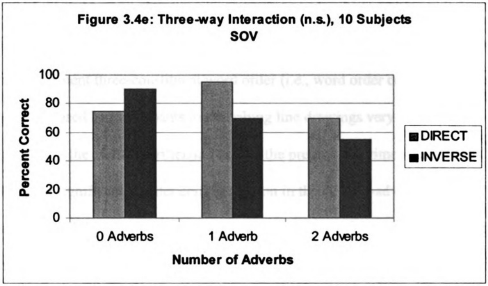
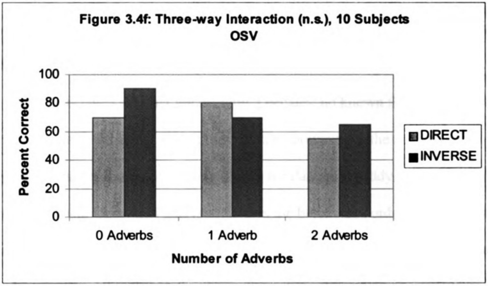


Figure 3.4d: Three-way Interaction (n.s.), 10 Subjects
OVS
100
80
60
40
20
0
Percetn Correct
0 Adverbs
1 Adverb
2 Adverbs
Number of Adverbs
DIRECT
INVERSE





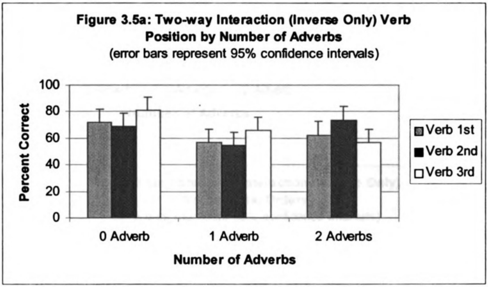
3.4.1.2 Discussion of off-line measure results

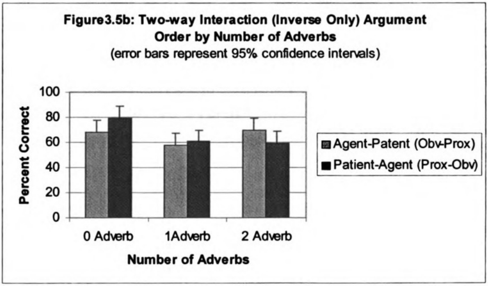
The off-line measures produced a number of intriguing and theoretically suggestive results. Recall that one of the broad goals of this research was to demonstrate that psyhcolinguistic data from "nonconfigurational" or "exotic" languages could inform theories of sentence processing. I believe that these off-line measures do just that. First, two facts of broad theoretical interest emerged. One is that, if the results of Experiment 1 (Chapter 2) and the text counts of word orders in the Algonquian literature are accurate, frequency of a given word order in the language is not a terribly reliable predictor of the ease with which a given word order can be comprehended. In Experiment 1, SVO was by far the most frequent three-constituent word order (i.e., word order containing a verb and two overt NPs) used by participants in describing line drawings very similar to the line drawings used in the picture verification task in the present experiment. But even though SVO produced significantly better comprehension in the direct 0-adverb condition, it lost its advantage in all the inverse conditions, and even the 1- and 2-adverb conditions within the direct form. Furthermore, despite a complete absence of frequency data to predict any preference in the inverse form, OSV proved easier to comprehend in the 0-adverb condition than any other order (except VOS, which was statistically no more difficult than OSV).

These facts taken together are intriguing because no known frequency data could have predicted them. What did predict these results, however, is the analysis of Algonquian syntax set forth by Bruening (2001) for Passamaquoddy and applied in Chapter 1 to Odawa. Under this analysis, SVO is the basic word order for direct clauses, OSV the basic word order for inverse clauses. This analysis was supported for Odawa in Chapter 1 by, among other things, the requirement that subordinate direct clauses with two overt obviative NPs be ordered SVO, and subordinate inverse clauses with two overt NPs be ordered OSV. The accuracy of performance on VOS sentences in the inverse (and for VSO in the direct) can be attributed to the common and syntactically straightforward operation of verb-fronting, observed to by quite common in Algonquian texts (cf. Tomlin & Rhodes, 1979), applied to the basic SVO and OSV orders, respectively.

An additional piece of evidence supporting a syntactic rather than frequency-based or somehow "intuitive" explanation of the preference for OSV order in the inverse form is connected to the low accuracy rate in the VSO order in the 0-adverb condition. Prior to the start of this investigation, I imagined that verb-initial orders would impose less processing burden than verb-final orders. At the very least, I suspected that this would be the case in the inverse form, where delaying input of the verb would allow a longer build-up of false expectation that the verb would be direct, which is far more common in all Algonquian languages. On the other hand, I was told by native speakers that verb-initial orders seemed intuitively more difficult than verb-final orders, especially in the inverse. But these intuitions became muddied when adverbs were added and/or the order of the overt NPs was shuffled. As it turned out, the native-speaker intuitions were accurate: According to the data in Figure 3.1b, inverse VSO was much more difficult than OSV. And although not statistically significant, VSO also appeared somewhat harder than SOV in the 0-adverb condition. Both verb-initial orders also appeared somewhat more difficult than either verb-final order in the inverse 1-adverb condition (just the opposite in the direct form, though), and VOS was reliably more difficult than OSV in the 2-adverb condition (and nearly so compared to SOV). This last fact is one that cannot be explained by any frequency-based account of the present data: Verb-final inverse orders were not automatically harder than verb-initial orders (or verb-medial orders for that matter), even though one would expect, based on the infrequency of the inverse in everyday language, that speakers would assume sentences to be in the direct form until the inverse verb was encountered.

The reversal of preference within the verb-initial inverse orders and the overall loss of preference for the basic syntactic orders of SVO in the direct and OSV in the inverse, however, raise the intriguing question of why word order preferences appeared to change—and change dramatically—with the addition of the adverbs. Notice in Figure 3.1a-b that while the direct form displayed a rather consistent preference for the subject (and proximate) NP to precede the object (and obviative) NP, no such consistency was observed in the inverse, with respect to either subject-object or proximate-obviative order. In order to better understand this mixed pattern of results in the inverse, where grammatical function and obviation marking do not align (as they do in the direct), I computed a separate within-subjects 3 (verb position) x 2 (argument order) x 3 (number of adverbs) ANOVA with a Greenhouse-Geisser correction for both direct and inverse forms. Since it is in the inverse where grammatical function and obviation marking do not align and possible parsing preferences based on the linear order of one or both of these factors can be teased apart, I report only the results for the inverse tests. And again, because of the decreased power in the between-items analysis, none of the results were significant by items, so I report only the F_1 values for the within-subjects analysis. First, there was a significant main effect of number of adverbs, $F_1(2,22) = 8.483$, $MSE = .088$, $p = .001$, such that comprehension for sentences with no adverbs was better than for either one or two adverbs. There was a significant two-way interaction of verb position and number of adverbs, $F_1(4,22) = 4.318$, $MSE = .078$, $p = .005$, such that verb-initial and verb-medial orders became harder to comprehend with one adverb as compared to none, and then somewhat easier again with two as compared to one. Verb-final orders became harder with the introduction of each additional adverb. This interaction is shown in figure 3.5a. There was also a significant two-way interaction of argument order and number of adverbs, $F_1(2,22) = 6.031$, $MSE = .071$, $p = .006$. This interaction suggested that although orders in which the proximate NP precedes the obviative NP were easier when no adverbs were present, orders in which the agent precedes the patient were easier when two adverbs were present. And the two NP orderings were about equal in difficulty with one adverb present. See Figure 3.5b.





Finally, there was a significant three-way interaction, $F_1(4,22) = 3.393$, $MSE = .087$, $p = .023$, which is shown in Figures 3.6a-c.

Figure 3.6a: Three-way Interaction (Inverse Only)
Verb-initial Orders
(error bars represent 95% confidence intervals)

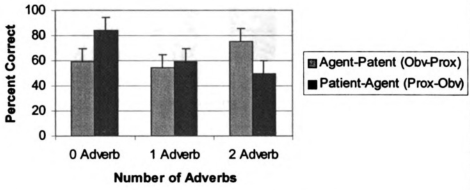


Figure 3.6b: Three-way Interaction (Inverse Only)
Verb-medial Orders
(error bars represent 95% confidence intervals)

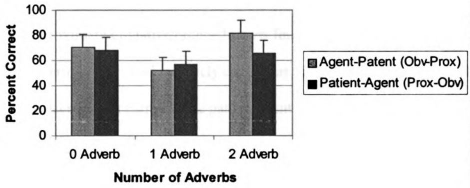
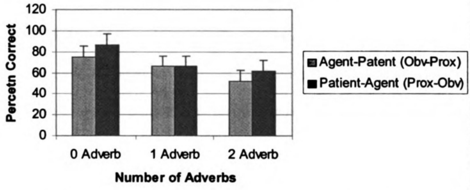


Figure 3.6c: Three-way Interaction (Inverse Only)
Verb-final Orders
(error bars represent 95% confidence intervals)



In the verb-initial orders, there was a significant preference for the proximate NP to precede the obviative in the 0-adverb condition. This preference was completely neutralized in the 1-adverb condition, and fully reversed in the 2-adverb condition. In verb-medial orders, there was no ordering preference in the 0-, or 1-adverb condition but there was a reliable increase in accuracy for agent-patient orders in the 2-adverb condition over proximate-obviative orders. In verb-final orders, accuracy associated with all argument orderings decreased relatively steadily as adverbs were introduced. The largest of these decreases occurred in the patient-agent order between the 0-adverb and 1-adverb conditions and the agent-patient order between the 1-adverb and 2-adverb conditions. In addition, both orders decreased from the 0-adverb to 2-adverb condition.

I postpone an extensive discussion of the implications of these data with respect to the processing theories cited in §3.2. For the moment, allow the following observations to suffice. First, while some frequency-based account of processing in Odawa could predict an overall preference for the proximate NP to precede the obviative, based on the fact that the proximate NP is more topical than the obviative (cf. Aissen, 2001;

Christianson, 2001a, b, in press; Chapter 1 above), and topics—or old information—tend to precede non-topics—or new information—cross-linguistically (cf. Choi, 1999; Lambrecht, 1994), none could predict that this preference should not hold as sentences get longer through the addition of adverbs. Even if the canonical information-structure ordering is reversed in Algonquian languages (cf. Tomlin & Rhodes, 1979 on Ojibwa; Wolfart, 1996, on Cree), it would still not predict the *reversal* of preferences observed in verb-initial and verb-medial orders. Also of critical importance here and in the general discussion in §3.6, is the fact that verb-final orders displayed no such ordering preference; instead, these orders showed an overall decline in comprehension as adverbs were introduced. This decrease was predicted for all orders by Gibson's (1998) SPLT and Hawkins's (1994) EIC. Once again, the overall lack of preference for either an obviation-based or thematic/syntactic-based canonical order preference is difficult to derive from a frequency-based account.

Finally, since another broad goal of this research is to investigate the extent to which processing data might inform syntactic accounts of "exotic" languages, let us take a minute to speculate on what if any predictions the Pronominal Argument Hypothesis (PAH) account of Odawa syntax would make for processing. Recall that the PAH says that all overt non-WH NPs in "nonconfigurational" languages are freely adjoined above IP, and related via co-indexation to *pro*s or agreement morphemes that absorb case and theta-roles from the verb. Case and theta-roles are then transferred via the co-index to any adjoined overt NPs. The most obvious prediction with respect to processing that this view of the syntax would make is that whatever the co-indexation mechanism is, it should become more computationally complex as adverbs are introduced (much the same prediction as that made by Hawkins's [1994] EIC, actually). Making the co-indexation links longer between overt NPs and *pro*s should impede processing. Furthermore, we might imagine that the order in which the NPs occur might facilitate the co-indexation in *all adverb conditions*, with, perhaps, agent-patient orders being easier irrespective of the number of adverbs, since this order maps from left to right onto the thematic grid of the verb, i.e., since the verb assigns the agent role to its left, and the patient role to its right, and since under the PAH, there would be no object movement (to Spc,HP) in the inverse. Clearly, these predictions, if they can be fairly attributed to the PAH, were not borne out by the data here. To the extent that empirical processing data might be used as evidence for or against a given formal account of a language's syntax, the data here add one more straw onto the increasingly burdened back of the PAH.

3.4.2 On-line measures: Button-press latencies

The auditory moving-window paradigm (Ferreira, et al., 1996) was employed in this experiment. Participants initiated each trial by pressing the space bar of a Dell Inspiron 4000 laptop computer. After a three-second pause, the first word of the stimuli or filler sentence was played over a pair of headphones worn by the participant. Participants had been instructed to press the middle button (marked with an arrow) on a button box as soon as they had understood the word. As soon as the button was pressed, the next word in the sentence was played, and so on throughout the remainder of each sentence. The final segment of each sentence was a clause that served to allow for "wrap-up" or "end of sentence" effects—processing slowdown induced by finalizing the structure and attaching meaning to it (Just & Carpenter, 1976). The computer measured the time between button presses, and then the actual response times were calculated by subtracting the length of each word/clause from the total time between button presses. The so-called button-press latency associated with each NP or V constituent and the wrap-up region were analyzed as the on-line measures of processing difficulty. The standard assumption is that longer button-press latencies (whether the stimuli are presented aurally or visually) signal increased processing difficulty.

The main complication in analyzing these on-line data was that due to participants' worse than expected performance on the picture verification task, a relatively small number of data points were available for analysis. It is generally agreed that only trials for which participants have answered comprehension questions correctly can be used in the analysis of on-line measures such as button-press latencies, since correct and incorrect trials are qualitatively different. The logic is that there is no way to know the reason why a participant has misunderstood a sentence; the reason for the error, may be totally unrelated to the independent variables. Whatever caused the misunderstanding may affect the on-line measures as well. The number of data points available for analysis was consequently small. In order to conduct the analysis, empty cells were replaced with the mean of the combined cells in that condition. This method of correcting for empty cells does not change the overall mean, but it does tend to reduce variance in the data. In a small number of comparisons (< 5), a total of 12 empty cells in a given condition were filled in this way. However, in the remaining comparisons, empty cells were generally limited to two to six per condition.

3.4.2.1 Latencies at Region 1

Before proceeding, I should make clear what the regions in each experimental sentence were. For the purposes of the planned analyses, the adverb(s) were not included in the region count. (3.27) provides an illustration of the regions within each experimental sentence.

(3.27) Regions relevant to button-press latency analyses (SVO order, as an example)

mkwa	(zhebaa)/(zhebaa mtigong)	gii-mnashkowaan	moozwan	ndinendam
bear	ADVERB(S)	chased	moose	I think
1		2	3	**wrap-up**

'A/The bear chased a/the moose (this morning)/(this morning by a/the tree), I think'

Of course, as word orders varied, the elements in each of the numbered regions changed as well. In verb-initial sentences, for example, the verb was in region 1, whereas in verb-final sentences, the verb was in region 3.

The only planned comparison at region 1 was performed to determine whether proximate NPs were comprehended more slowly than obviative NPs. Recall that Vasishth's (2002) AIM theory of sentence processing predicts inputs that have more possible minimally consistent completions associated with them should impose a greater processing cost than inputs with a smaller number of possible minimally consistent completions. A proximate NP in Odawa is minimally consistent with a passive, middle, detransitive, true transitive, or locative verb. An obviative NP minimally predicts either a direct or and inverse verb (3.3)-(3.14). As such, processing of the proximate NP is predicted to be slower on the NP itself because of the higher "abduction cost" imposed by entertaining several minimally consistent completions. Furthermore, processing cost should also be higher on a transitive verb (either direct or inverse) following a proximate NP. The reason is that none of the minimally consistent (intransitive) completions are correct, and what Vasishth calls "mismatch cost" is incurred. Since the obviative NP predicts a transitive completion, there should be no mismatch cost with an obviative NP in the sentence-initial position.

A single-factor within-subjects ANOVA was conducted, comparing the button-press latencies of proximate NPs in sentence-initial position to those of obviative NPs in sentence-initial position. No effect of obviation status was found by subjects or by items (*p*s >.3). Table 3.5 contains the means and standard deviations for both the within-subjects and between-items ANOVAs. These null findings lend no support to the occurrence of "abduction cost" in NP-initial Odawa sentences.

Table 3.5: Mean Button-press Latencies (msec.) for both Within-subjects and Between-items ANOVAs of Sentence-initial NPs

		Mean	***SD***
Subjects	*Proximate NP*	407.31	201.34
	Obviative NP	379.27	221.04
M		***393.29***	
Items	*Proximate NP*	424.12	162.79
	Obviative NP	393.82	152.23
M		***408.97***	

3.4.2.2 Latencies at Region 2

There were no planned analyses of button-press latencies at the adverbs in sentences that contained one or two adverbs (though see §3.6 for *post hoc* analyses and discussion). Therefore analyses of the second NP or verb region were performed next. A

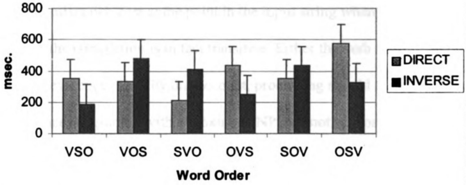
2 (verb form) x 3 (number of adverbs) x 6 (word order) within-subjects ANOVA with a Greenhouse-Geisser correction was performed, considering subjects as a random effect. The means and standard deviations for the 36 conditions are given in Table 3.6.

Table 3.6: Means and Standard Deviations for Button-press Latencies at second NP or Verb constituent (within-subjects ANOVA)

	0 Adverb		1 Adverb		2 Adverbs		
Order	Mean	SD	Mean	SD	Mean	SD	
DIRECT							***M***
VSO	404.37	249.38	266.68	302.29	380.18	402.93	*350.41*
VOS	503.52	335.96	202.02	342.29	290.76	439.63	*332.10*
SVO	285.78	189.10	135.40	272.28	212.37	242.21	*211.18*
OVS	507.43	349.57	411.71	287.51	386.53	480.54	*435.22*
SOV	461.33	328.06	281.35	259.43	318.08	517.74	*353.59*
OSV	718.44	478.88	419.93	277.81	591.07	577.98	*576.48*
M	*480.15*		*286.18*		*363.17*		
INVERSE							
VSO	221.24	239.87	20.30	422.27	322.41	309.64	*187.98*
VOS	719.30	402.46	164.17	412.34	556.97	413.31	*480.15*
SVO	352.41	355.60	433.33	416.23	448.48	455.79	*411.41*
OVS	215.14	228.23	356.34	351.65	177.00	368.18	*249.49*
SOV	477.30	358.99	484.75	454.46	342.20	411.46	*434.75*
OSV	449.91	356.99	234.52	289.73	288.50	308.05	*324.31*
M	*405.88*		*282.24*		*355.93*		
Grand M	**443.01**		**284.21**		**359.55**		

The ANOVA revealed a significant main effect of number of adverbs, $F_1(2,22) = 6.450$, $MSE = 349116.81$, $p = .007$, such that button-press latencies at region 2 were slowest when no adverbs were present, fastest when one adverb was present, and somewhere in between those two extremes when two adverbs were present, reminiscent of the effect that the number of adverbs had on the accuracy rates in the picture verification task. There was also a significant main effect of word order, $F_1(5,22) = 6.552$, $MSE = 116292.97$, $p < .001$. Both main effects interacted with other factors, however, so I will not comment on them further. There was a reliable two-way interaction between verb form and word order, $F_1(5,22) = 15.092$, $MSE = 120842.77$, $p < .001$, and also a reliable interaction between number of adverbs and word order, $F_1(10,22) = 5.583$, $MSE = 981657.72$, $p < .001$. These interactions are shown in Figures 3.7 and 3.8, respectively. There were no other reliable main effects or interactions.

Figure 3.7: Button-press Latencies at Region 2
Interaction of Verb Form and Word Order
(error bars represent 95% confidence intervals)



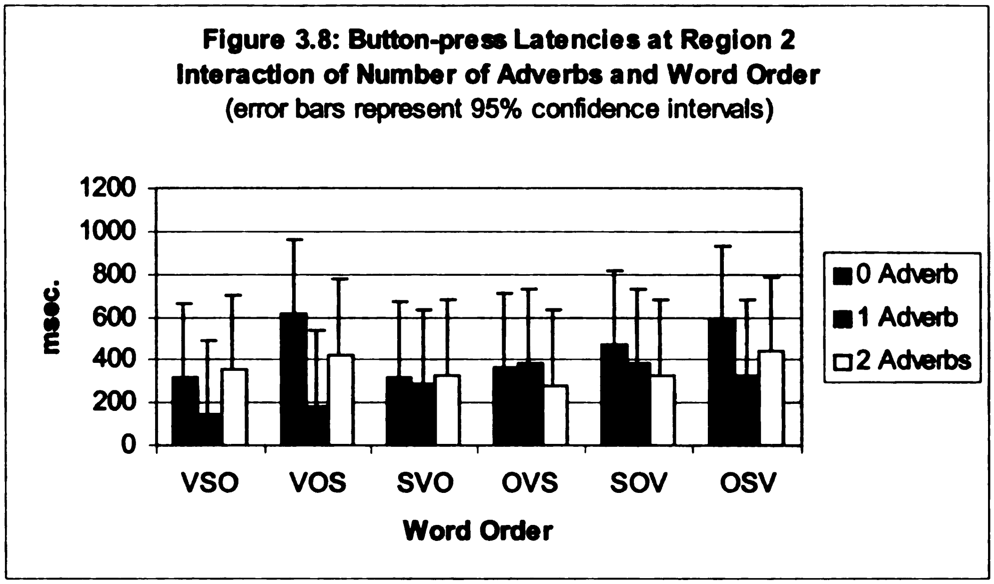


Figure 3.7 shows the opposite pattern of results from those predicted by Vasishth's (2002) AIM model of sentence processing. Recall that a sentence-initial proximate NP is minimally consistent with a number of intransitive completions, but not with any transitive completion. A sentence beginning with an obviative NP is minimally consistent with either a direct or inverse transitive completion, but not any intransitive completions. As such, AIM predicts that sentences starting with a proximate NP should lead to increased mismatch cost at the point in the input string where evidence is encountered that the completion is in fact transitive. Either the verb itself or an obviative NP provides this evidence. Thus by this account, processing should slow at the second element of sentences beginning with a proximate NP, but not in those beginning with an obviative NP. Figure 3.7 shows a pattern of data exactly opposite to this prediction. Button-press latencies on the second NP or verb element are faster in sentences beginning with a proximate NP, namely direct SVO and SOV sentences and inverse OVS and OSV sentences. Latencies are slower in sentences beginning with an obviative NP, namely direct OVS and OSV sentences and inverse SVO and SOV sentences. As shown in

Figure 3.7, region 2 of orders beginning with a proximate NP actually had shorter button-press latencies than those beginning with an obviative NP, opposite the prediction made by AIM. In SVO, the verb in direct sentences (where the initial NP was proximate) displayed shorter latencies than the verb in SVO inverse sentences (where the initial NP was obviative). In OVS orders, latencies at the verb were shorter in inverse sentences, which again began with a proximate NP. In SOV orders, latencies on the second NP in direct sentences were faster than in inverse sentences, though not significantly so. And in OSV sentences, latencies at the second NPs in inverse sentences (which began with a proximate NP) were again faster than in direct sentences (which began with an obviative NP).

The lone significant result in the between-items ANOVA was a significant main effect of number of adverbs, $F_2(2,71) = 8.186$, $MSE = 24578.14$, $p = .001$, which patterned in the same way as the within-subjects main effect for number of adverbs.

No other planned comparisons were performed on button-press latency data at the second position. Note in Figure 3.8, however, even at this early point in the sentences that certain word orders—specifically VSO, VOS, and OSV—displayed faster latencies in the 1-adverb condition compared to the 0-adverb condition, as well as slowed latencies in the 2-adverb condition as compared to the 1-adverb condition. Also, in Figure 3.7, aside from the verb-initial orders, we see shorter latencies for SO orders in direct sentences, and shorter latencies for OS orders in inverse sentences. This is true even in verb-medial sentences where the second NP has yet to be encountered. These patterns of results are repeated throughout the data set, and their connection to the off-line data will serve as a main focus of attention in the General Discussion (§3.6).

3.4.2.3 Button-press latencies at Region 3

The third position was critical in the stimuli. In verb-initial or verb-medial orders, the third position is filled by an NP. In verb-final orders, it is filled by the verb. An overt NP in this position signaled that no *pro*s occurred in the sentence; if one (or two) had been posited, it (they) would need to be replaced with overt NP(s). In verb-final orders, the appearance of a direct verb would, it was hypothesized, only confirm the frequency-based assumption that the sentence was direct. The appearance of an inverse verb, on the other hand, would require a revision of this assumption, revising predicted thematic roles such that the proximate NP would be the agent and the obviative NP the patient.

One 2 (verb form) x 3 (number of adverbs) x 6 (word order) within-subjects ANOVA with a Greenhouse-Geisser correction was performed, considering subjects as a random factor (F_1), and one 2 x 3 x 6 between items ANOVA was performed considering items as a random factor (F_2). The means and standard deviations for the 36 conditions are given in Table 3.7.

Table 3.7: Means and Standard Deviations for Button-press Latencies at Third NP or Verb constituent (within-subjects ANOVA)

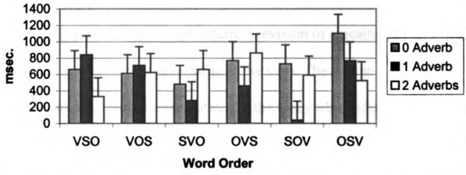
	0 Adverb		1 Adverb		2 Adverbs		
Order	Mean	SD	Mean	SD	Mean	SD	
DIRECT							***M***
VSO	660.76	496.27	841.13	797.79	329.08	652.74	*610.32*
VOS	611.39	653.59	709.00	766.19	624.45	572.37	*648.28*
SVO	479.65	289.19	279.50	435.31	661.04	478.54	*473.40*
OVS	769.33	381.73	461.39	789.66	862.83	862.18	*697.85*
SOV	729.87	551.76	41.41	435.04	592.83	553.87	*454.70*
OSV	1102.09	467.98	767.55	517.74	524.12	647.34	*797.92*
M	*725.52*		*516.66*		*599.06*		
INVERSE							
VSO	481.86	398.37	523.18	618.45	435.11	709.10	*480.05*
VOS	943.78	681.12	360.86	546.15	426.50	430.56	*577.05*
SVO	996.50	397.91	442.17	434.35	768.28	753.96	*735.65*
OVS	770.07	625.47	525.27	553.90	459.43	361.63	*584.92*
SOV	396.09	620.01	538.70	759.40	610.73	673.79	*515.17*
OSV	656.22	686.96	554.34	608.06	544.10	461.71	*584.89*
M	*707.42*		*490.75*		*540.69*		
Grand M	**716.47**		**503.71**		**569.87**		

The analysis revealed a significant main effect of number of adverbs by subjects, $F_1(2,22) = 9.819$, $MSE = 343236.57$, $p < .001$, and by items, $F_2(2,71) = 27.489$, $MSE = 32135.67$, $p < .001$, such that latencies in the 0-adverb condition were slower than the 1-

adverb condition, and those in the 2-adverb condition were somewhere between those in the 0- and 1-adverb condition—nearly identical to the pattern observed at region 2.

There were also reliable two-way interactions between number of adverbs and word order, $F_1(10,22) = 3.152$, $MSE = 489296.59$, $p = .007$, and between verb form and word order, $F_1(5,22) = 3.432$, $MSE = 406866.14$, $p = .015$. The interaction between verb form and word order was also reliable by items, $F_2(5,71) = 3.137$, $MSE = 32135.67$, $p = .019$. These two-way interactions will not be explored further, however, since there was a significant three-way interaction, in which they participated. This three-way interaction, $F_1(10,22) = 4.771$, $MSE = 426434.86$, $p < .001$, is shown in Figures 3.9a-b (grouped by verb form), and Figures 3.10a-f (grouped by word order).

Figure 3.9a: Button-press latencies at Region 3
Three-way Interaction (Direct)
(error bars represent 95% confidence intervals)



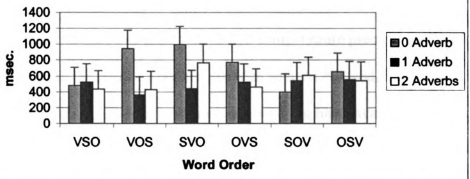


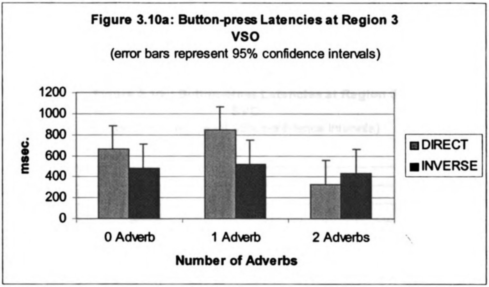
Figure 3.9b: Button-press latencies at Region 3
Three-way Interaction (Inverse)
(error bars represent 95% confidence intervals)

The only *a priori* expectations for the results were not theoretically determined, but rather were determined by intuition. First, recall that direct verbs far outnumber inverse in both Experiment 1 (Chapter 2) and in extant corpus data from several Algonquian languages. Thus, if frequency data biases the human sentence processing mechanism (HSPM) to posit certain frequent structures or verb forms, one would imagine that inverse verb-final sentences would require a revision of a posited direct form, along with an associated slow-down in processing at the verb. The data in Figures 3.9a-b fail, for the most part, to confirm this expectation. In the 0-adverb condition, latencies at the verb of inverse SOV sentences (396.09 msec.) were actually shorter than those in direct SOV sentences (729.87 msec.). The same was true in OSV order, where latencies on the inverse verb (656.02 msec.) were shorter than on the direct verb (1102.09 msec.). In the 1-adverb condition, one instance of the expected result was found in SOV order, where latencies at the inverse verb were significantly longer (538.70 msec.) than those at the direct verb (41.41 msec.).

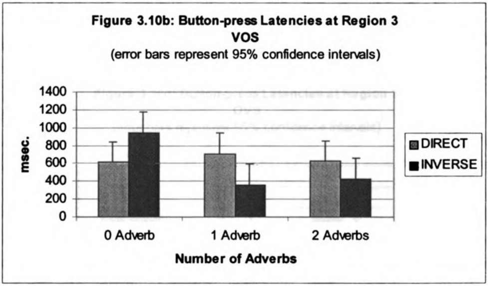
Second, recall that if the HSPM seeks to fill argument positions as soon as possible (cf. Hawkins, 1994), and if *pro* is an option in a language, the HSPM should posit one or more *pro*s in canonical position(s), if no overt NP has yet been encountered (De Vincenzi, 1991). This is particularly likely in Algonquian languages, in which sentences with two overt third person NPs are relatively rare (see the discussion in §3.1). As such, we might imagine that sentence-final NPs might cause processing slow-downs as the parser is forced to replace a posited *pro* with an overt NP, and, if necessary, revise the syntactic structure to reflect scrambling operations that have taken place to account for any non-canonicity in the word order. One clear instance where this sort of slow-down should occur is in direct OVS clauses, as compared to direct SVO clauses. In OVS clauses, at the point of the verb, the simplest possible, most complete parse has the object scrambled to some pre-verbal adjunction site, and a *pro* in the canonical subject position (see example [3.8b]). In contrast, the SVO order, being canonical, does not require that a *pro* be posited, nor does the eventual appearance of the overt object NP force any revision of the initial structure. Figure 3.9a shows that button-press latencies were significantly slower on the S in OVS sentences than on the O in SVO sentences. A parallel difference, however, was not observed in the 1- or 2-adverb condition. If the SVO/OVS difference in the 0-adverb condition is in fact representative of structural revision and replacement of a posited *pro* with the sentence-final overt NP, an analogous difference was not found in the inverse verb-initial orders. In the inverse, the overt subject in a VOS order should be relatively easy to incorporate into the final structure, since all that is required is to replace a (potential) posited *pro* with the overt NP (see examples [3.6b-c]). VSO order is more complex, since, if the simplest possible parse is initially posited (3.5bi), encountering the overt object NP requires not only that the initially posited *pro* be replaced, but also that the structure be revised to reflect scrambling of the subject NP (see examples [3.5b-c]). Nevertheless, a comparison of inverse VSO and VOS orders revealed a significant difference in the opposite direct from what would be predicted based on the above discussion. Namely, the mean button-press latencies on the subject of the inverse VOS order were significantly slower than on the object of the inverse VSO order.

By plotting the three-way interaction by word order, a pattern becomes more apparent, similar to that observed in the results of the picture verification task; namely, a simple, linear change in difficulty failed to emerge (in either direction), corresponding to the introduction of one then two adverbs generally. Instead, certain word orders exhibit slower button-press latencies at region 3 (and as we will see, at the wrap-up region as well) in the 1-adverb condition compared to the 0-adverb condition. Then however, in the 2-adverb condition, latencies shorten again dramatically, sometimes to lower levels than in the 0-adverb condition. In other word orders, this pattern is reversed. And only in verb-final orders is there any hint of a linear effect (in either direction) of adverb inclusion on processing, as would be predicted by all of the processing theories discussed above.

In VSO order (Figure 3.10a), the only significant differences in button-press latencies occurred in the direct form, where the 2-adverb condition was significantly faster than both the 0-adverb condition.



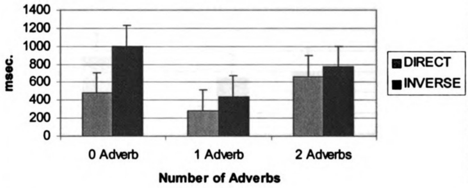
In VOS order (Figure 3.10b), nearly the opposite effects obtained: The only significant differences emerged in the inverse form, with the 0-adverb condition slower than both the 1-adverb condition.



In SVO order (Figure 3.10c), all three comparisons differed reliably in the direct form. The 0-adverb condition was slower than the 1-adverb condition, but faster than the 2-adverb condition. The 1-adverb condition was also faster than the 2-adverb condition.

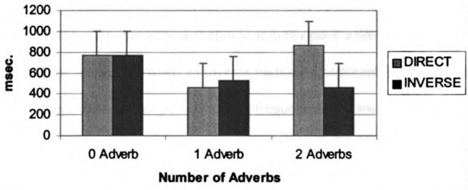
In the inverse form, the 0- and 2-adverb conditions were slower than the 1-adverb condition, and the 2-adverb condition was marginally faster than the 0-adverb condition.

Figure 3.10c: Button-press Latencies at Region 3
SVO
(error bars represent 95% confidence intervals)



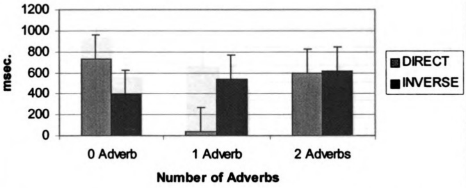
In OVS order (Figure 3.10d), direct form, the 1-adverb condition was faster than both the 0- and 2-adverb condition. In the inverse form, the 1- and 2-adverb conditions were faster than the 0-adverb condition.

Figure 3.10d: Button-press Latencies at Region 3
OVS
(error bars represent 95% confidence intervals)



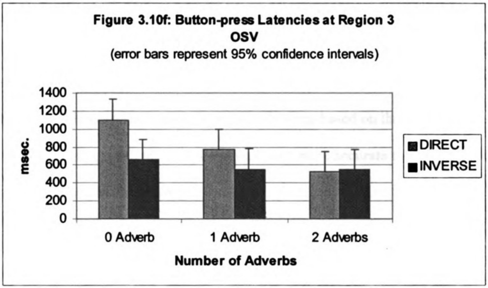
In SOV order (Figure 3.10e), the significant differences again emerged only in the direct form. The 1-adverb condition was significantly faster than both the 0-adverb condition and the 2-adverb condition. Although non-significant, a linear increase in difficulty seemed to emerge in the inverse form in this verb-final order.

Figure 3.10e: Button-press Latencies at Region 3
SOV
(error bars represent 95% confidence intervals)



Finally, in OSV order (Figure 3.10f), the only significant differences again emerged in the direct form. In the direct form, the 0-adverb condition was slower than both the 1-adverb condition and the 2-adverb condition. As such, this order constituted the only significant linear decrease in processing speed, corresponding to the introduction of adverbs. Interestingly, even though the relatively infrequent inverse verb occurred clause-finally, there was no apparent effect of adverb in the OSV order, contrary to the frequency-based prediction that a speaker should initially posit a direct verb and then be forced to change that prediction when an inverse verb is encountered. The data suggest that Odawa speakers either do not posit the most frequent verb form from the outset (perhaps delaying any assumption of thematic role assignment until the verb is encountered), or that recovering from an ultimately incorrect verb form prediction is relatively cost-free, at least at the point where the verb itself is encountered (for a discussion of these results with respect to head-driven parsing, see Chapter 5). In

§3.5.2.4, the button-press latencies at the sentence-final wrap-up region to look for evidence of processing difficulty down-stream from the final constituent.



To summarize, region 3 was predicted to be a key region for on-line measures. In verb-initial and verb-medial orders, the occurrence of an overt NP in this position meant that no *pro*s occurred in the sentences. In verb-final orders, the occurrence of an inverse verb was expected to slow processing. The reason for this is that the inverse is far less frequent than the direct, so one would expect participants to assume the verb would be direct. When an inverse verb was encountered, it should have forced a revision of thematic role assumptions. The predictions regarding the verb-final orders were on the whole not borne out by the button-press latencies at region 3. Participants apparently found verb-final inverse sentences no more difficult in general than direct. One interesting implication of this result is that strong predictions regarding thematic roles of NPs do not appear to be made before a lexical head is encountered, and the roles can be formally assigned (cf. Ferreira & Henderson, 1990, 1991; Christianson et al., 2001; but cf. Konieczny et al., 1997; Yamashita, 2000). So even though frequency-based expectations as to the alignment of proximate morphology with agent role and obviative morphology with patient role might exist, they seem to be relatively easy to revise. In verb-medial direct orders, button-press latencies conformed to syntactically based expectations, such that latencies on the O in SVO sentences were shorter than those on the S in OVS sentences. An analogous difference between inverse VSO and VOS orders was not observed, however. Overall, though, predictions based on the relative syntactic complexity of building a full structural analysis were more accurate than those based on frequency counts within the language.

3.4.2.4 Button-press latencies at the Wrap-up Region

The button-press latencies at the sentence-final wrap-up region might be the best on-line indicator of processing difficulty, given the nature of the stimuli in the present experiment. Stimuli were all mono-clausal (not counting the wrap-up region), and ranged from just three words long to five words long. In addition, the aural presentation of the stimuli in the auditory moving window paradigm may have worked to push the effects of processing difficulty or cognitive load farther downstream, toward the wrap-up region, more so than is normally the case with visually presented stimuli. The reasoning behind this speculation is that when participants read stimuli, they control the speed of presentation—at least to some degree—not only between segments, but also within segments. With aurally presented stimuli, participants can control the movement from one segment of the sentence to another through their button-presses, but cannot control presentation speed within each segment. As such, it is conceivable that if a segment that is particularly difficult to integrate into the on-going parse—perhaps because it is potentially ambiguous—is encountered, the item itself may be held in short-term memory while button-presses continue as the participant seeks to gain some clues from subsequent segments as to the proper parse of the segment in question. The automatic phonetic playback associated with verbal short-tem memory may assist in this process. For these reasons, I give added weight to the button-press latency data from the wrap-up segments in the general discussion of the data in §3.6.

One 2 (verb form) x 3 (number of adverbs) x 6 (word order) within-subjects ANOVA with a Greenhouse-Geisser correction was performed, considering subjects as a random factor (F_1), and one 2 x 3 x 6 between items ANOVA was performed considering items as a random factor (F_2). The means and standard deviations for the 36 conditions are given in Table 3.8.

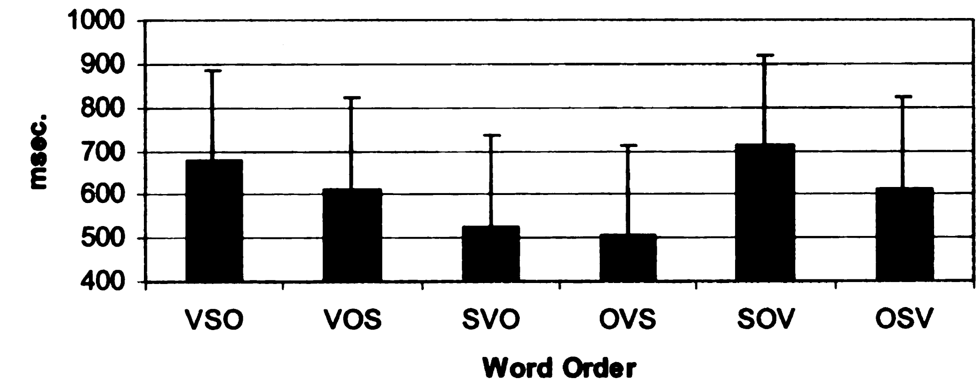
Table 3.8: Means and Standard Deviations for Button-press Latencies at the Wrap-up Region (within-subjects ANOVA)

	0 Adverb		1 Adverb		2 Adverbs		
Order	Mean	SD	Mean	SD	Mean	SD	
DIRECT							***M***
VSO	729.43	478.71	1463.00	991.49	262.78	595.85	*818.40*
VOS	634.45	493.02	1072.93	866.72	489.40	686.62	*732.26*
SVO	426.74	555.24	-2.69	992.94	607.78	893.96	*343.94*
OVS	850.48	649.64	370.95	611.88	272.00	617.93	*497.81*
SOV	589.15	628.46	737.98	696.82	456.43	705.47	*594.52*
OSV	1182.22	725.52	640.60	535.60	37.36	740.11	*620.06*
M	*735.41*		*713.80*		*354.29*		
INVERSE							
VSO	506.88	547.92	448.60	462.15	649.91	917.16	*535.13*
VOS	629.65	479.78	395.79	593.48	457.44	467.45	*494.30*
SVO	860.12	595.24	551.95	535.78	711.80	552.04	*707.94*
OVS	859.38	752.00	278.00	506.22	398.85	862.50	*512.08*
SOV	974.86	838.21	647.55	835.48	858.48	871.57	*826.96*
OSV	828.02	586.81	546.09	540.15	443.18	417.36	*605.76*
M	*776.48*		*477.99*		*586.61*		
Grand M	**755.95**		**595.89**		**470.45**		

The ANOVA revealed a significant main effect of number of adverbs, $F_1(2,22) = 15.448$, $MSE = 365978.83$, $p < .001$, such that button-press latencies at the wrap-up region decreased with each additional adverb, though significantly so only between the 0- and 2-adverb conditions.

There was also a main effect for word order, $F_1(5,22) = 2.80$, $MSE = 428933.99$, $p = .034$. Although only the difference between OVS and SOV orders was significant, I plot the main effect of word order nevertheless in Figure 3.11 because the trend is so consistent: The orders pattern broadly together according to verb position, as would be expected if the parse of an Odawa sentence hinges in some sense on the verb, as it does in other languages. This line of reasoning will be explored more fully in §3.6.

Figure 3.11: Button-press Latencies at Wrap-up Region: Weak Main Effect of Word Order
(error bars represent 95% confidence intervals)



All possible two-way interactions were highly significant: Number of adverbs by verb form ($F_1(2,22) = 11.308$, $MSE = 442317.67$, $p = .001$), number of adverbs by word order ($F_1(10,22) = 6.718$, $MSE = 564244.04$, $p < .001$), and verb form by word order ($F_1(5,22) = 7.913$, $MSE = 311409.24$, $p < .001$). These interactions are plotted in Figures 3.12a, 3.12b, and 3.12c, respectively. Because all of the factors involved in these two-way interactions were also involved in a significant three-way interaction, $F_1(10,22) = 4.112$, $MSE = 680404.36$, $p = .002$, I limit discussion of them to a few relevant comments. (The between-items (F_2) analysis yielded no significant effects, either main effects or interactions.)

First, in Figure 3.12a, notice that the direct and inverse were almost identical: The 2-adverb condition was the one that differed from the 0- and 1-adverb conditions in the direct, and in the inverse, the 2-adverb condition differed from the 0-adverb condition, but not the 1-adverb condition. In Figure 3.12b, notice the consistency within word orders: In verb-initial orders, latencies spiked in the 1-adverb condition. In verb-final orders, latencies declined as more adverbs were introduced. In verb-medial orders, latencies dipped in the 1-adverb condition. OVS differed from SVO in that this dip persevered into the 2-adverb condition. In Figure 3.12c, notice the similarity between the verb-initial orders. Also, it appears to be the case in general that SO orders were preferred when the verb was direct, but this preference disappeared when the order of arguments was OS (verb-medial and verb-final orders only).

Figure 3.12a: Button-press Latencies at Wrap-up Region: Interaction between Number of Adverbs and Verb Form
(error bars represent 95% confidence intervals)

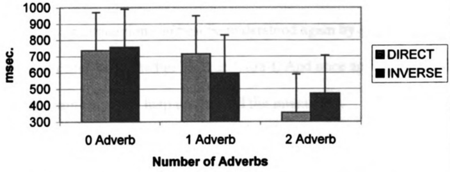


Figure 3.12b: Button-press Latencies at Wrap-up Region: Interaction between Number of Adverbs and Word Order
(error bars represent 95% confidence intervals)

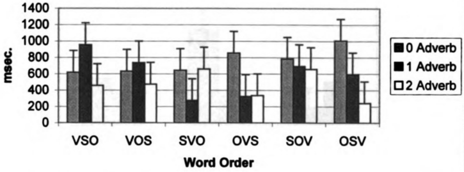
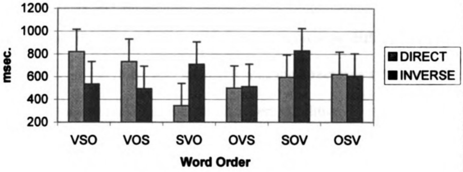
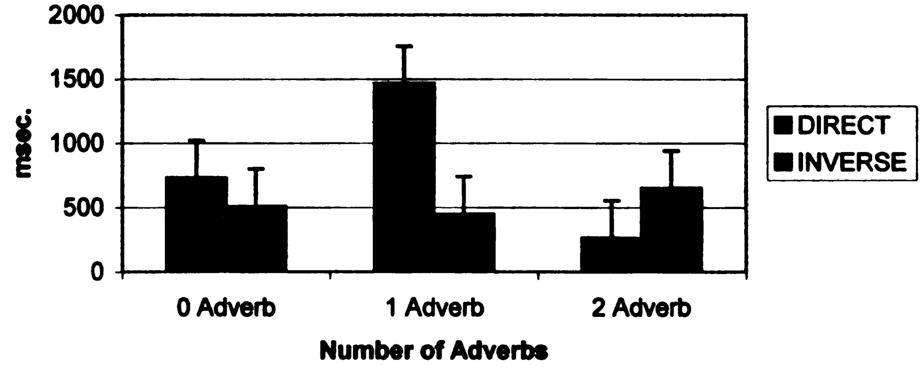


Figure 3.12c: Button-press Latencies at Wrap-up Region: Interaction between Verb Form and Word Order
(error bars represent 95% confidence intervals)



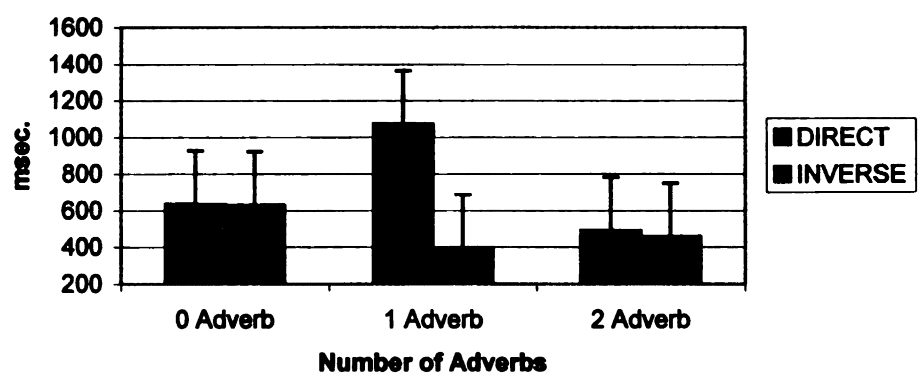
The three-way interaction can best be understood again by grouping the results according to word order, as plotted in Figures 3.13a-f. And once again, after each figure I summarize significant results to help understand the interaction.

Figure 3.13a: Button-press Latencies at Wrap-up Region VSO
(error bars represent 95% confidence intervals)

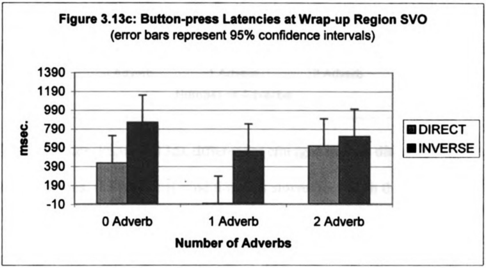


In VSO order (Figure 3.13a) three significant differences between adverb conditions within the direct form obtained. The 1-adverb condition was slower than both the 0-adverb condition, and the 2-adverb condition. The 0-adverb condition was also significantly slower than the 2-adverb condition. There were no differences within the inverse form. Between the direct and inverse forms, the direct was slower in the 1-adverb condition and the inverse was slower in the 2-adverb condition.

Figure 3.13b: Button-press Latencies at Wrap-up Region VOS
(error bars represent 95% confidence intervals)

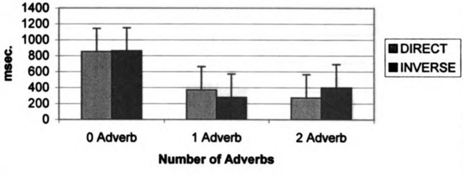


In VOS order (Figure 3.13b), all significant differences again occurred in the direct form, where the 1-adverb condition was slower than the 0-adverb condition and slower than the 2-adverb condition. Between verb forms, the inverse was again faster than the direct in the 1-adverb condition, but no other differences were significant.



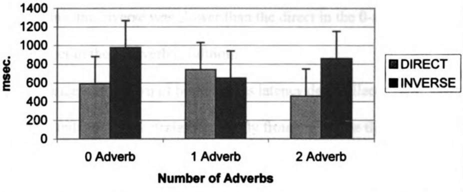
In SVO order (Figure 3.13c), significant differences again emerged within the direct form but not within the inverse form. In the direct, the 1-adverb condition was this time faster than the 0-adverb condition, and the 2-adverb condition. Between the two verb forms, the direct was faster than the inverse in the 0-adverb condition, and in the 1-adverb condition.

Figure 3.13d: Button-press Latencies at Wrap-up Region OVS
(error bars represent 95% confidence intervals)



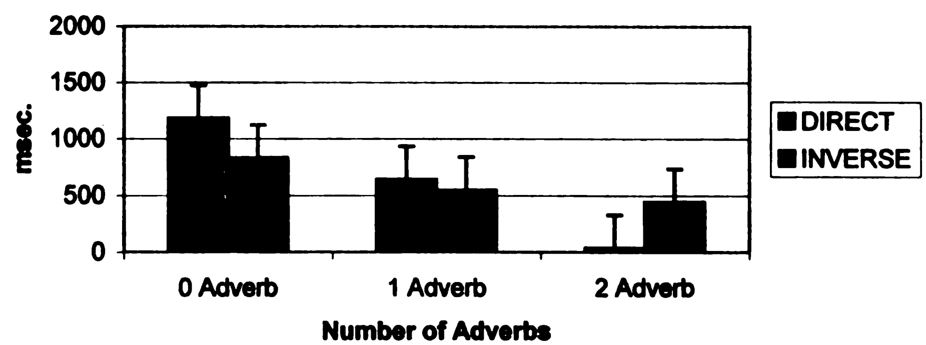
In OVS order (Figure 3.13d), differences emerged in both direct and dnverse forms. In both forms, the 0-adverb condition was slower than both the 1-adverb condition and the 2-adverb condition. There were no significant differences between verb forms.

Figure 3.13e: Button-press Latencies at Wrap-up Region SOV
(error bars represent 95% confidence intervals)



In SOV order (Figure 3.13e), only the difference between the 0-adverb condition and the 1-adverb condition in the inverse form was significant. Between verb forms, the inverse was significantly slower than the direct in the 0-adverb condition.

Figure 3.13f: Button-press Latencies at Wrap-up Region OSV (error bars represent 95% confidence intervals)



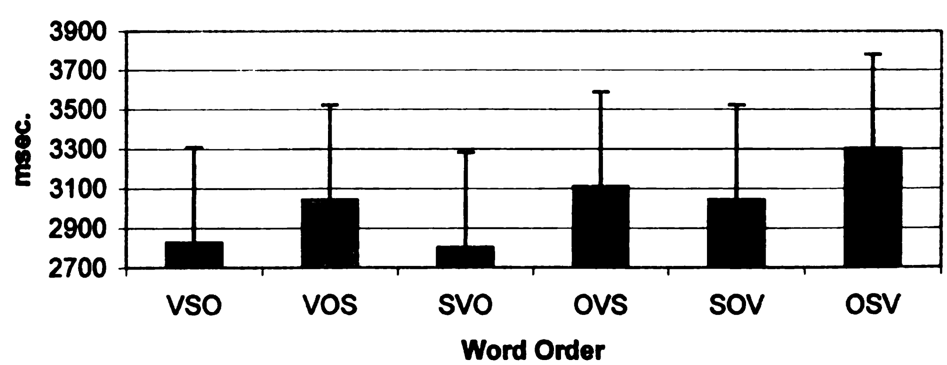
In OSV order (Figure 3.13f), direct form, the 0-adverb condition was significantly slower than both the 1-adverb condition and the 2-adverb condition, and the 1-adverb condition was slower than the 2-adverb condition. In the inverse form, the 0-adverb condition was also slower than both the 1-adverb condition (barely n.s.) and the 2-adverb condition, but the 1-adverb condition did not differ reliably from the 2-adverb condition. Between verb forms, the inverse was slower than the direct in the 0-adverb condition, but faster than the direct in the 2-adverb condition.

To summarize, the pattern of button-press latency data collected at the wrap-up region once again fails to follow straightforwardly from any of the theories of sentence processing summarized in §3.2. As with the off-line data and earlier button-press latencies, the 0- and 2-adverb conditions tended to pattern together, and the 1-adverb condition was either slower or faster. In §3.6, I detail where the theories surveyed here both succeed and fail in predicting the Odawa data, and then propose an account of the data which, in combination with certain aspects of some of these theories, seems to allow for a reasonable understanding of how speakers of Odawa parse and interpret single-clause sentences of the type investigated here.

3.4.2.5 Button-press latencies at Picture Verification Decision

One last set of on-line measures remains to be examined: button-press latencies at the point when participants had to decide if the line drawing matched the sentence they had just heard. A *post-hoc* paired t-test was first computed to determine if latencies at this point in the trial were significantly longer when participants responded incorrectly than when they responded correctly. There was no significant difference in this regard, $t(35) = .253$, *n.s.*. Accordingly, both correct and incorrect trials were included in the 2 (verb form) x 6 (word order) x 3 (number of adverbs) ANOVA with a Greenhouse-Geisser correction, treating subject as a random factor. The only reliable effect was a main effect for word order, $F_1(5,22) = 3.34$, $MSE = 1950705.22$, $p = .017$. Despite a large amount of variability in the means, I plot the main effect in Figure 3.14 because it illustrates the broad overall preference (significant within each verb position) at the picture verification decision point for the agent to precede the patient. The between-items analysis yielded no significant effects.

Figure 3.14: Button-press Latencies at Picture Verification Decision Main Effect of Word Order
(error bars represent 95% confidence intervals)



3.5 Summary and Discussion

Before proceeding to examine how various theory-specific predictions faired for Odawa, I wish to make a few general observations. First, it is noteworthy that despite the relative rarity of the inverse verb form in Odawa (as evidenced by the results of Experiment 1 [Chapter 2]) and in Algonquian languages in general, participants were not significantly less accurate in the picture verification task on inverse sentences (65.2%) than on direct sentences (67.8%), collapsing across all word order and adverb conditions. Nor were button-press latencies significantly slower for inverse than direct forms at regions two or three, or at the wrap-up region, again collapsing across all conditions (see Table 3.9). Paired t-tests computed over grand means were all *n.s.*

Table 3.9: Grand Means and Standard Deviations for Relevant Comparisons between Direct and Inverse Verb forms

		M	*SD*
Pos. 2			
Msec.	*Inverse*	348.02	165.57
Pos. 3	*Direct*	613.75	242.20
Msec.	*Inverse*	579.62	182.08
Wrap-up	*Direct*	601.17	377.71
Msec.	*Inverse*	613.70	199.50
Pict. Ver.	*Direct*	67.80	12.90
%correct	*Inverse*	65.20	11.10

This result is inconsistent with the prediction that constraint-based models of sentence processing would presumably make for Odawa, especially those models emphasizing the role of lexical and structural frequencies as predictors of parsing difficulty (e.g., MacDonald et al., 1994; Spivey & Tanenhaus, 1998; and Trueswell; 1996). That frequency would fail to affect such measures in Odawa, where the bias toward direct is so great, is quite remarkable.

Frequency-based accounts of sentence processing also both over- and underestimate differences between word orders with respect to total processing time, as measured by summing all button-press latencies (excluding adverbs). For example, based on frequency alone, SVO direct sentences (0-adverb condition) should have elicited shorter response times overall, as compared to every other direct word order. This was not the case. While *post hoc* paired t-tests comparing overall response times showed that SVO was significantly faster than OVS, SOV, and OSV orders, it was not faster than

VSO or VOS, two orders that were used far less frequently in Experiment 1 (Chapter 2). Furthermore, frequency alone did not predict that, e.g., OSV would be slower than OVS or VSO, which paired t-tests again showed to be the case. And given the low frequency of inverse verb use in the language, we were able to make no clear frequency-based predictions about preferences for inverse verb orders.

Second, there does not appear to be any clear relation between button-press latencies at either position 3 or the wrap-up region and accuracy on the picture verification task. For example, in SVO order, 0-adverb condition, the button-press latencies for the inverse were significantly longer than the direct, and accuracy was higher in the direct. In OSV order, 0-adverb condition, there was a similar but reversed pattern: inverse latencies were faster and accuracy was higher. On the other hand, in VSO order with no adverbs, the button-press latencies for direct and inverse did not differ reliably, but responses in the direct condition were still significantly more accurate. When adverbs were introduced, the relations between latencies and accuracy were even more opaque.

Third, consistent with the picture of Odawa syntax sketched above (based on Bruening's work on Passamaquoddy syntax [2001]), SVO order displayed the highest level of picture verification accuracy in the direct form, and OSV in the inverse. These preferences held only in the 0-adverb condition, however. I return to this point below in relation to Townsend & Bever's (2001) theory of sentence processing.

3.5.1 Predictions of current parsing theories

Recall that two of the parsing theories summarized in §3.2 predicted that adding adverbs between theta-role assigners and assignees should make processing harder as a function of the distance between theta-assigner and theta-assignee—Gibson's SPLT (1998) and Hawkins's EIC (1994). Two other theories presented in that section predicted that the additions of adverbs should make processing easier—Lewis's RIT-02 (as presented in Vasishth, 2002) and Vasishth's AIM (2002). I address each of these two opposing predictions in turn.

Although formulated differently, both Gibson's SPLT (1998) and Hawkins's EIC (1994) predicted that adding adverbs between theta-role assigners and assignees should make processing harder as a function of the distance between theta-assigner and theta-assignee. Hawkins's EIC makes, perhaps, the stronger claim, since it counts all intermediate and terminal nodes in computing processing cost. Although Gibson's SPLT attributes part of the processing difficulty to increased memory load that accrues as elements are encountered in the input, his 1998 version of the theory and, to a greater extent, his more recent versions (see below) seem to restrict the set of items that increase memory load to elements that introduce discourse referents (i.e., NPs). The Odawa data presented above clearly do not support the stronger prediction. Specifically, although the 1-adverb sentences were usually harder to comprehend than the 0-adverb sentences, in many cases, the 2-adverb sentences were easier again than the 1-adverb sentences. With respect to the on-line measures, it was often the case that button-press latencies on the post-adverb constituent actually decreased as compared to the latencies on those same constituents in 0-adverb sentences. This pattern is also contrary to the predictions of the SPLT and EIC. In the verb-final inverse word orders, the pattern of picture verification accuracy does conform to the prediction of increasing difficulty with each adverb introduced. However, the results could also be explained by frequency facts: In these verb-final orders, the frequency-based expectation is that the verb will eventually end up being direct. When this expectation turns out to be incorrect, predictions as to the eventual thematic roles need to be revised, and accuracy goes down. However, given the lack of predictive strength of frequency overall, the effect in verb-final orders is more easily attributable to the reasons proposed in the SPLT/EIC.

The successor to the SPLT, the Discourse Locality Theory (DLT) (Gibson, 2000; Grodner, Gibson, & Tunstall, 2002; Warren, 2001) explicitly considers the integration/memory cost of discourse referents only, though Gibson (2000, p. 107) leaves open the possibility that adverbs might also increase processing difficulty when they intervene between thematic assigners and assignees (as discussed immediately above). The version of the DLT proposed in Warren (2001, and p.c.), however, predicts that Odawa temporal adverbs should not increase memory burden or computational load, but locative adverbs should, because they introduce discourse referents (e.g., TREE in *mtig-ong* 'near a/the tree').

The materials for the present experiment were created based upon the predictions regarding adverbs derived from Gibson (1998) and Gibson (2000). Moreover, native Odawa speakers reported no intuitive differences with respect to comprehension between sentences with temporal adverbs and locative adverbs. As such, stimuli in the 1-adverb condition—the only place where a difference in adverb type would matter—were not carefully counterbalanced for adverb type. Of the 24 items in the 1-adverb condition, 10 contained temporal adverbs (five of which occurred in sentences matching the line drawing presented at the end of each sentence, and five of which did not). 14 items in the 1-adverb condition contained locative adverbs (seven of which matched the drawing).

Complicating things even further, the adverb types were not counterbalanced at all between word orders. Table 3.10 gives the total number of data points available for a *post hoc* analysis of picture verification accuracy grouped by verb form and word order. Only three word orders in the direct form—VOS, SVO, SOV—and one in the inverse form—SVO—contained sufficiently balanced numbers of data points to allow for comparisons.

Table 3.10: Total data points available for comparisons between sentences containing Temporal and Locative adverbs

	DIRECT		INVERSE	
	Temp.	Loc.	Temp.	Loc.
VSO	44	1	0	43
VOS	22	23	0	45
SVO	21	22	22	21
OVS	0	43	0	45
SOV	23	23	0	45
OSV	45	0	44	0

A *post hoc* repeated measures 2 (adverb type: temporal vs. locative) x 3 (word order: VOS, SVO, SOV) ANOVA using a Greenhouse-Geisser correction was run on the direct verb data, treating subjects as a random effect.[40] The ANOVA revealed a significant main effect for word order, $F(2,22) = 8.128$, $MSE = .110$, $p = .002$, such that SOV order was significantly more accurate than VOS or SVO order (Figure 3.15). There

[40] Between-item *post hoc* analyses of adverb type effects failed to yield any significant results due to the small number of data points. For the sake of brevity, I will refrain from repeating the null between subjects effects in the report of the *post hoc* results.

was also a reliable two-way interaction, $F(2,22) = 40.515$, $MSE = .147$, $p < .001$, (Figure 3.16).

Figure 3.15: Temporal vs. Locative Adverb Comparison: Main Effect of Word Order
(error bars represent 95% confidence intervals)

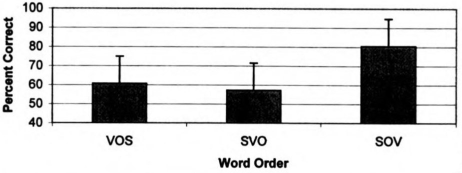
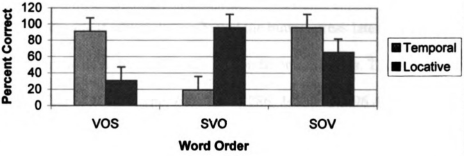


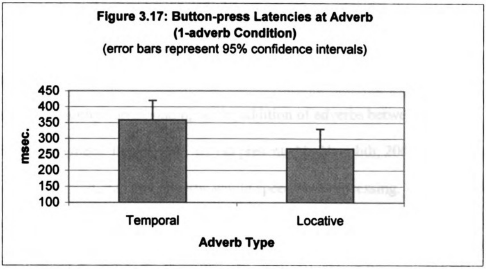
Figure 3.16: Two-way Interaction of Word Order and Adverb Type
(error bars represent 95% confidence intervals)



As can be seen in Figure 3.16, accuracy in the VOS temporal condition was significantly higher than in the VOS locative condition, as was also the case in the SOV condition. In SVO order, the situation was reversed, with a significantly higher accuracy rate in the locative adverb condition. In the inverse form, a single-factor repeated measures ANOVA yielded no effect of adverb type in the one order that was amenable to analysis (SVO).

There was no main effect of adverb type in the off-line measure of verification task accuracy. But the reliable interaction suggests that adverb type may be implicated in some way, though not as straightforwardly as the DLT would predict. Nevertheless, a further paired t-test of mean accuracy on the picture verification task, collapsing across all word orders and verb forms revealed a significant difference between sentences containing temporal and locative adverbs, $t(22) = 3.769$, $p = .001$, mean difference 14.1%, such that sentences with temporal adverbs produced a higher accuracy rate than those with locative adverbs, consistent with the DLT.

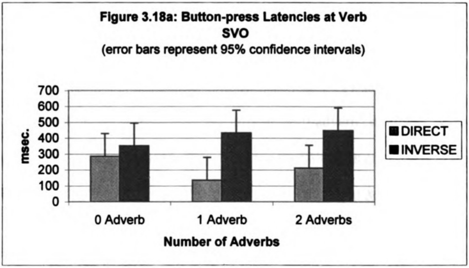
The DLT also predicts that button-press latencies should be slower on locative rather than temporal adverbs (and/or on the words immediately following the adverbs). A repeated measures, single-factor (adverb type: temporal vs. locative) ANOVA was performed to determine if adverb type affected the button-press latencies on the element immediately after the adverbs in all 1-adverb condition sentences. The ANOVA revealed no significant effect of adverb type, $F_1(1,22) = .286$, $MSE = 12996.42$, *n.s.* A between-items univariate ANOVA also revealed no significant effect of adverb type, $F_2(1,23) = .110$, $MSE = 14576.71$, *n.s.* A repeated measures, single-factor (adverb type: temporal vs. locative) ANOVA was also performed to determine if adverb type affected the button-press latencies on adverb itself in all 1-adverb condition sentences. The ANOVA revealed a significant effect of adverb type, $F_1(1,22) = 9.128$, $MSE = 10208.77$, $p = .006$, such that temporal adverbs had reliably longer latencies than locative adverbs (Figure 3.22). This effect was also reliable by items, $F_2(1,25) = 5.66$, $MSE = 14206.80$, $p = .026$.

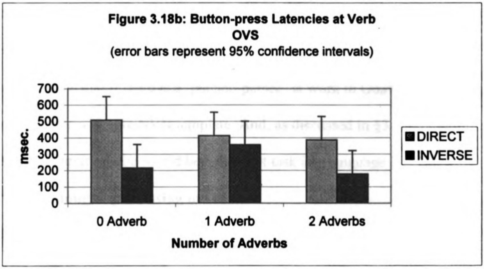


Interestingly, the only effect to surface in the on-line button-press latency measures—that temporal adverbs were responded to more slowly than locative adverbs—runs counter to the prediction of the DLT. Since the locative adverbs introduced discourse referents (NPs), they should have been the ones to produce slower response times. In addition, the locatives, due to the fact that they are rather underspecified with respect to actual locations in space (e.g., *mtig-ong* means broadly 'near a/the tree'), might be expected to impose some sort of heavier inferential burden than the temporal. Taken together, although there does seem to be some effect of adverb type that was not completely controlled for in the experimental design of Experiment 2, the actual results were not straightforwardly predicted by the DLT. Some results followed DLT predictions, some ran counter to predictions, and some predicted effects failed to materialize. As such, I draw no firm conclusions about the DLT based on the Odawa data. On the other hand, the results of Experiment 2 yielded no across the board increase in processing difficulty corresponding to the introduction of one or two adverbs between thematic assigners and assignees, as would be expected under either the SPLT or EIC theories.

Now let us turn to processing theories that predicted an across the board *decrease* in processing difficulty corresponding to the addition of adverbs between thematic assigners and assignees. Lewis's RIT-02 (as presented in Vasishth, 2002) and Vasishth's AIM (2002) both predicted that adverbs would speed/ease processing. The prediction stems from the predictive component of each theory: Since a verb is predicted at the beginning of every sentence, the occurrence of an adverb before that verb is encountered should only serve to strengthen that prediction. When the verb is then encountered, it is processed more rapidly than without a preceding adverb because the "pump is primed," as it were. Thus Vasishth's (2002) study of the processing of multiply center-embedded sentences in Hindi included results that showed that Hindi speakers processed such sentences with adverbs faster than ones without. RIT-02 and AIM thus predict the opposite results from SPLT and EIC.

Like SPLT and EIC, however, RIT-02's and AIM's predictions were not broadly supported in the Odawa data. In OSV order, actually, button-press latencies *did* decrease at the verb (Figure 3.10f) and wrap-up region (Figure 3.13f) linearly, corresponding to the introduction of one and two adverbs. This pattern was not observed in the SOV order, however. Another place to look for effects of processing facilitation by adverbs would be at the verb in verb-medial orders. The button-press latencies at this position should be especially sensitive to priming by the immediately preceding adverbs, according to RIT-02 and AIM. Figures 3.18a-b, however, show that the expected facilitative effect did not materialize. Although the 1-adverb condition was faster than the 0-adverb condition in the direct form, the 2-adverb condition was not shorter yet, as would be expected if the second adverb served to strengthen the prediction that a verb was soon to be encountered. And in the inverse form, no overall trend emerged in the OVS.





Finally, we turn to Townsend & Bever's (2001) LAST theory of sentence processing. Recall that this theory proposes that a fully-specified syntactic structure is actually the final step of the parse of any given sentence. The first step is instead simply a "rough and ready" parse whereby frequency-based knowledge of English directs the "pseudo-parser" to locate NVN strings and assign the preverbal N a thematic role higher on the thematic hierarchy (cf. Jackendoff, 1972) than the postverbal N. Obviously, this parsing strategy relies heavily on the dominance of SVO order in English. According to the results of Experiment 1 (Chapter 2), Odawa also displays a heavy bias toward SVO order, and thus might also display evidence of an NVN-biased "pseudo-parse." Indeed, in the direct form, SVO order did result in better accuracy in the picture verification task, and also shorter button-press latencies—but only in the 0-adverb condition. As soon as one or two adverbs were introduced, the preference for SVO was effectively erased.

Given that the "pseudo-parser" as described in Townsend & Bever should be able to skip over non-theta assigners/assignees if it is to yield a reliable and speedy "pseudo-parse," it seems that the addition of just one adverb should not disrupt the pseudo-parser's work to such a great extent. The fact that the performance on direct SVO sentences in the 0-adverb condition was so different from that in 1- and 2-adverb conditions suggests that if there is a "pseudo-parser" at work in Odawa, it uses some heuristic other than a simple NVN template. And, as discussed in §3.3.4, determining what that algorithm might be would be a difficult task in a language like Odawa.

3.5.2 "Good enough" processing in Odawa

In this section I propose that the pattern of Odawa comprehension results—especially the off-line measure of sentence interpretation—suggests that, when presented with certain non-canonical structures, Odawa speakers compute a "good enough," alternative parse of the input (Ferreira & Henderson, 1999; Ferreira et al., 2001, 2002). Such a parse, while syntactically licit, draws on non-syntactic resources and heuristics in order to arrive at a plausible interpretation of a sentence. I argue that "good enough" processing (also termed "shallow processing" in the following) can exploit any number of language-specific information sources (which may vary from language to language), but that it is triggered by a reticence on the part of the HSPM to initiate full-blown structural revision until it is absolutely necessary to do so.

3.5.2.1 Fundamental observations

The argument for "good enough" processing in Odawa is based on four fundamental observations: two regarding sentence processing, and two regarding facts of the language itself. The first of these is the finding by Christianson, et al. (2001) and Ferreira (in press) that people very often derive interpretations that are inconsistent with the content of garden-path, passive, and object-cleft sentences. For example, in experiments probing the interpretations derived from sentences such as *While Anna dressed the baby spit up on the bed*, Christianson et al. found that participants in a series of independent experiments maintained interpretations that "Anna dressed the baby" and that "The baby spit up on the bed." This interpretation is both syntactically illicit and also inconsistent with the actual content of the sentence (see also Chapter 1 above). Ferreira found that even in non-garden-path, reversible passive sentences (such as *The man was visited by the woman*), and object-cleft sentences (such as *It was the woman who the man visited*), people are more likely to misidentify the thematic agent and patient than they are in analogous active sentences. The authors of both of these studies connected their results to literature both in and outside of language processing, including text processing, visual cognition, and sequential decision-making (see also Ferreira et al. [2001, 2002] and the references cited therein, as well as the discussion in Chapter 1 above). The main point to be taken away from this growing body of research on the misinterpretation of certain difficult or in some way non-canonical sentence structures is that the HSPM may employ some means other than complete structural (re)analysis to arrive at an interpretation of certain input. Whatever the trigger for this alternative parsing strategy—be it time constraints, computational complexity, memory load, some other factor, or the combinations of several factors—evidence has begun to emerge that the information provided by the syntactic parser (even if it is automatic) might be ignored in favor of non-syntactic heuristic information sources in order to arrive at a timely, plausible interpretation of an input string.

These findings are fully consistent with an influential body of sentence processing research suggesting that structural reanalysis is undertaken by the HSPM only as a last resort. The "Reanalysis as Last Resort" (RALR) principle was first proposed by Fodor & Frazier (1980), in which the authors claimed that "the partial phrase marker...is not to be *changed* in response to subsequent words unless there is no other way of proceeding" (Fodor & Frazier, 1980, p. 427). Subsequent work by Fodor & Inoue (1998, 2000), Frazier (1990), Frazier & Clifton (1998), Schneider & Phillips (2001), and Sturt, Pickering, Scheepers, & Crocker (2001) have all presented evidence for the HSPM's preference not to revise structure that has already been built based on earlier input. For example, Sturt et al. (2001) even found that strong (non-syntactic) recency preferences and verb biases did not prompt the parser to initiate reanalysis of sentences such as *The cleaning lady who noticed the fireman had badly burned herself on the arm...*until the mismatching gender agreement of the reflexive pronoun was encountered. Some versions of RALR propose that not only structural incongruity but also semantic or pragmatic anomaly might push the parser into reanalysis (cf. De Vincenzi & Job, 1995; Kamide &

Mitchell, 1997). Christianson et al. (2001) also speculated on a semantic/pragmatic trigger for reanalysis, based on the finding that people were much better at arriving at a correct interpretation for implausible sentences such as *While Bill hunted the deer paced in the zoo* than they were for plausible sentences such as *While Bill hunted the deer ran through the woods* (Christianson et al.'s Experiment 1). In sum, then, there exists a growing body of evidence that the HSPM is loath to revise structure if not absolutely necessary.

The HSPM's inertia, in fact, might be the reason that "good enough" processing might intervene to construct an interpretation of certain problematic input: While the parser holds out for decisive evidence that reanalysis is necessary, real-time pressure, possibly along with frequency information of various grain sizes, sets in motion a quick process of heuristic evaluation of the input, from which an interpretation is derived. If the "good enough" interpretation is plausible, the interpretation derived from complete syntactic reanalysis (even if it is carried out) might not be accessed. If the "good enough" interpretation is not plausible, the one derived from the structural reanalysis is checked, *á la* Experiment 1 of Christianson, et al. (2001), where a deer pacing in the zoo was seen as a less plausible quarry for a hunter than a deer running into the woods. Although the details would need to be worked out, this picture of sentence parsing and interpretation appears to be compatible with evidence not only from two-stage parsing models (cf. Ferreira & Clifton, 1986; Frazier, 1978; Frazier & Rayner, 1982), but also one-stage "constraint-based" models of sentence parsing that maintain there is immediate access to non-syntactic information such as lexical and structural frequencies and context (cf. MacDonald, et al., 1994; McRae, Spivey-Knowlton, & Tanenhaus, 1998; Trueswell, et al., 1994), as well as Townsend & Bever's (2001) theory LAST, whereby an initial "pseudo-parse" results in a semantic interpretation that is subsequently checked against the syntactic parse (if environmental factors, such as time, allow).

The final two observations are specific to Odawa. First, native speakers agree that temporal and locative adverbs of the sort contained in the stimuli used in Experiment 2 most frequently occur clause-peripherally, either at the beginning or end of a clause. All of the permutations of (3.28) are thus judged to be equally natural. The order in (3.29), however, which was the one used in the present experiment, is called "awkward" by native speakers, but not ungrammatical.

(3.28) a. oosnaago daabaan-ing mashkikiinini gii-bjibw-aa-n jiibaakweniniw-an

other.day car-Loc doctor 3.PAST-stab-Dir.3>3'-Obv chef-Obv

'A/The doctor stabbed a/the chef the other day near a/the car'

b. mashkikiinini gii-bjibw-aa-n jiibaakweniniw-an oosnaago daabaan-ing

c. oosnaago mashkikiinini gii-bjibw-aa-n jiibaakweniniw-an daabaan-ing

d. daabaan-ing mashkikiinini gii-bjibw-aa-n jiibaakweniniw-an oosnaago

e. daabaan-ing oosnaago mashkikiinini gii-bjibw-aa-n jiibaakweniniw-an

f. mashkikiinini gii-bjibw-aa-n jiibaakweniniw-an daabaan-ing oosnaago

(3.29) mashkikiinini oosnaago daabaan-ing gii-bjibw-aa-n jiibaakweniniw-an

doctor other.day car-Loc 3.PAST-stab-Dir.3>3'-Obv chef-Obv

'A/The doctor stabbed a/the chef the other day near a/the car'

As discussed in connection with the similar examples given in (3.26) above, speakers report that sentences such as (3.29) present difficulties for interpretation because it seems like the NP to the left of the adverbs is "left hanging" somehow. Similarly, in

(3.30), both NPs to the right of the adverbs seem to be disconnected to some extent from the sentence, which would be complete with just the VP, since Odawa is a *pro*-drop language (3.30) that allows elision of both argument NPs.

(3.30) gii-bjibw-aa-n oosnaago daabaan-ing mashkikiinini jiibaakweniniw-an

3.PAST-stab-Dir.3>3'-Obv other.day car-Loc doctor chef-Obv

'A/The doctor stabbed a/the chef the other day near a/the car'

(3.31) *pro* gii-bjibw-aa-n *pro* oosnaago daabaan-ing

'[Some animate 3rd person] stabbed [some other animate 3rd person] the other day near a/the car'

The second observation specific to Odawa is that certain mono-clausal sentences can be globally ambiguous in the absence of contextual or prosodic cues. Thus, as discussed previously in this chapter, (3.32a) is normally interpreted as a simple declarative, which, for reasons presumably connected to the discourse (of which there is none in the example), has undergone verb scrambling and A'-movement of the object NP (cf. the papers collected in Kiss, 1995). However, imagine the following context: The speaker believes at the onset of uttering the sentence in (3.32b) that the hearer knows who the agent of the verb is, and thus *pro*-drops the syntactic subject. But by the end of the utterance, the speaker doubts (for whatever reason) that the hearer does in fact know whom the *pro* refers to. Consequently, as somewhat of an afterthought, the speaker tacks an overt NP onto the end of (3.32b), just to be sure the hearer is clear about who is doing what to whom. The resulting interpretation is akin to that of the English appositive or epithetical construction in (3.32c).

(3.32) a. gii-bjibw-aa-n jiibaakweniniw-an mashkikiinini

'A/the doctor stabbed a/the chef' (lit. 'Stabbed the chef the doctor')

b. *pro*$_i$ gii-bjibw-aa-n jiibaakweniniw-an, mashkikiinini$_i$

'[Some animate third person]$_i$ stabbed a/the chef, the doctor$_i$'

c. He$_i$ stabbed the chef, the doctor$_i$ (did)

The secondary interpretation is quite difficult for native speakers to get in simple, three-constituent sentences without an elaborate context and strong prosodic cues (including a prosodic phrase boundary between the two NPs). However, when one, or even better, two adverbs are present clause-medially, separating one or both NPs from the rest of the sentence, this interpretation is, according to Odawa speakers, far more easily attained, even without such obvious contextual or prosodic cues.

To sum up, the case I make in the next section for "good enough" processing in Odawa assumes (a) that people derive syntactically unlicensed interpretations of sentences when thematic roles are easy to confuse; (b) that the HSPM initiates structural reanalysis only as a last resort; (c) that temporal and locative adverbs in Odawa most often occur on the left or right periphery of a clause, and when they do occur clause-medially, they have the effect of separating overt NP arguments from the verb in some noticeable way; and (d) that certain word orders in Odawa are globally ambiguous between a normal, indicative interpretation and a contextually-determined interpretation resembling appositive, epithetical, or left-dislocated constructions.

3.5.2.2 Deriving a "good enough" interpretation for the Odawa data

In this section, I rely mainly on the off-line Odawa data to build a case for "good enough" processing. The reason for the focus on the accuracy in the picture verification task is two-fold. First, since the on-line measures included only the trials in which participants were correct in the off-line task, and participants did not perform as well as expected on that task, the on-line data is unstable in certain conditions. Although analyses of the on-line measures yielded significant results, the standard deviations of the various means were on the whole large, signaling a degree of instability in those means. Second, and more importantly, since the concept of "good enough" sentence processing is a relatively new idea, it is difficult to say how these processes affect on-line response times. Heuristic, shallow processing might be completed more quickly than a conventional, structural parse (as Townsend & Bever suggest [2001]). On the other hand, the heuristic parse might be triggered only after difficulties in the structural parse have been recognized. So although the heuristic parse might be a quick-fix employed to derive an interpretation without having to perform a lengthy structural reanalysis, the degree and/or type of trouble with the initial parse might add to button-press latencies at any given point in a sentence, and might do so to varying degrees, depending on the specific sentence and/or lexical items. In short, we cannot at this point say with certainty how "good enough" processes might manifest themselves in on-line measures. In addition, the off-line data provide a measure of the quality of participants' interpretations, which the on-line measures do not.

Aside from the four fundamental observations detailed in the immediately preceding section, I make one further assumption with respect to the way in which *pro*-drop languages are parsed. Both Vasishth's (2002) AIM and Hawkins's (1994) EIC predict that *pro*s should be posited in canonical subject and object positions if those positions are not filled by overt NPs or overt NPs have not already been encountered previously in the string. Vasishth's and Hawkins's theories base their predictions on slightly different grounds, however. AIM makes the prediction regarding *pro* based on the principle of Minimal Consistency, which states that at any given point in an input string, the parser considers only analyses that are minimally consistent with the input. In other words, the only structure posited at any given point is that which is minimally necessary to complete the input as a grammatical sentence. Minimal Consistency is in essence not very different from Frazier's (1978) proposal that as little structure as possible is built at any single point in the parse. Hawkins's EIC simply requires that thematic roles be assigned (or argument positions be filled) as soon as possible, again preferring structures with as few intervening nodes as possible between theta assigner and assignee. De Vincenzi's "Minimal Chain Principle" (1991) also predicts that the parser posits *pro* as soon as possible, rather than delaying theta-role and case assignment on the assumption that a canonical NP position is filled by a *trace* and co-indexed, scrambled overt NP.

Now consider the case of a verb-initial direct sentence in Odawa such as (3.4), repeated below as (3.33): Upon encountering the verb, the parser has three options (3.33ai-iii) (of course, there are several more options, but all of these would deviate even further from whatever versions of minimal consistency and minimal structure one would wish to impose on the parser). Option (3.33ai) satisfies the requirement that thematic roles be assigned as soon as possible; with just a verb in the input, both agent and patient role can be assigned to posited *pro*s. However, (3.32ai) also would seem to violate the requirement that no structure be built that is not immediately warranted by the input, which option (3.33aii) does not. As such, the two choices seem to conflict.[41] Imagine that both options are entertained, however. When the overt subject is introduced (3.33b), both of the options must be ditched in favor of (3.33aiii) (or some other even more cumbersome structure, involving one or more posited *pro*s). The cost of doing so would constitute something like Vasishth's (2002) "Mismatch Cost." If the realization of this mismatch cost is delayed by adding one adverb, comprehension suffers (see Figure 3.3a). The same situation arises in VOS direct sentences (see Figure 3.3b): Comprehension is affected by having to hold at least two conflicting "minimal" parses while non-thematic material is processed.

(3.33) **VSO (Direct)**

a. *gii-tikomaan...*

i. $[_{HP}$ *pro*$_i^{[+PROX]}$ $[_{vP}$ t_i $[_v$ v $[_{VP}$ gii-tikomaan *pro*$^{[-PROX]}$]]]]]

ii. $[_{HP}$ *pro*$_i^{[+PROX]}$ $[_{vP}$ t_i $[_v$ v $[_{VP}$ gii-tikomaan...

iii. $[_{XP}$ gii-tikomaan ... $[_v$ v $[_{VP}$ t_v ...

b. *gii-tikomaan nimosh...*

i. $[_{XP}$ gii-tikomaan $[_{HP}$ nimosh$_i^{[+PROX]}$ $[_{vP}$ t_i $[_v$ v $[_{VP}$ t_v *pro*$^{[-PROX]}$]]]]]

ii. $[_{XP}$ gii-tikomaan $[_{HP}$ nimosh$_i^{[+PROX]}$ $[_{vP}$ t_i $[_v$ v $[_{VP}$ t_v ...

c. *gii-tikomaan nimosh gaazhagan*

i. $[_{XP}$ gii-tikomaan $[_{HP}$ nimosh$_i^{[+PROX]}$ $[_{vP}$ t_i $[_v$ v $[_{VP}$ t_v gaazhagan$^{[-PROX]}$]]]]]

[41] Perhaps an inference can be made about which option might be preferred based on some recent experiments conducted in Spanish. Garcia-Albea & Meltzer (1996) investigated the differences between processing the empty categories of *PRO* and *pro* in Spanish sentences. Their results suggested that the two categories were processed differently. Whereas *PRO* triggered no immediate search for an antecedent in the discourse (because, the authors argue, it requires a syntactically local controller), *pro* did trigger an immediate search for an antecedent (because it is a locally unbound element). We might infer from this result, then, that if the HSPM prefers to identify a referent for *pro* as soon as possible, it might also prefer to posit *pro*s as soon as possible, so that the search for an antecedent can begin immediately. However, it might also be the case that the HSPM would want to avoid performing such a search, so would wait to make sure no overt NP were in the input before positing a *pro*.

Interestingly, in verb-initial inverse orders, there is a significant difference between the VSO order and the VOS order in the 0-adverb condition (see Figure 3.1b). If Bruening (2001) is correct about the basics of Algonquian syntax—as the various evidence from Odawa presented in Chapter 1 and the data from Experiments 1 and 2 suggest he is—the basic word order of an inverse clause is OSV. Hence the VOS order, which results in significantly better comprehension than the VSO order in inverse sentences, represents a structurally simple instance of verb-fronting. The VSO order, on the other hand, requires a structure reflecting both verb-fronting and subject-scrambling. Likewise, in the direct form, although the difference between VSO and VOS orders did not reach significance (see Figure 3.1a), it is in the direction predicted by a structural account of this sort. We can speculate that it is in cases such as this where frequency biases affect the impact of complex structural reanalyses on comprehension: Given the high frequency of direct clauses in the language, deriving an interpretation from multiply scrambled direct orders might not be as difficult in comparison to less scrambled orders, at least not as difficult as it is in the much more infrequent inverse form. However, frequency biases appear to have little impact on the effect of mismatch cost. In both VSO and VOS orders, comprehension in the 1-adverb condition dropped precipitously in the direct order, just as it did in the inverse VOS order. The infrequency of clause-medial adverbs may have acted to neutralize any verb-related frequency effects.

Now consider the differences between the comprehension in the 1-adverb and 2-adverb conditions in the verb-initial orders (again, Figures 3.2a-b). The *improved* comprehension for both direct and inverse sentences in VSO order (but not in VOS order) is critical to the overall interpretation of the results of Experiment 2. If adding one adverb exacerbates the effects of mismatch cost in the 1-adverb condition, it is reasonable to suppose that adding two adverbs does so to a much greater degree. Based on the reactions to such 2-adverb sentences by native Odawa speakers, and the alternative "appositional" interpretation allowed by the syntax of Odawa described above, I take the improvement in comprehension between VSO 1-adverb and 2-adverb conditions as evidence for an alternative parse, with a "good enough" flavor.

The final structure of the parses I suspect participants in this experiment often came away with in direct and inverse VSO sentences are shown in (3.34a-b). Co-indexation on the overt NPs signal simple coreference between them and the *pro*s in canonical argument and/or A-moved positions.

(3.34) a. **Direct**

$[_{CP}\ [_{IP}\ [_{HP}\ pro_i^{[+PROX]}\ [_{vP}\ t_i\ [_{v}\ v\ [_{VP}$ gii-tikomaan $pro_k^{[-PROX]}$]]]]] [jiinaago mtigong]] nimosh$_i$ gaazhagan$_k$]

'(Third-person, animate, proximate) bit (third-person, animate, obviative) yesterday by the tree, dog, cat'

b. **Inverse**

$[_{CP}\ [_{IP}\ [_{HP}\ pro_k^{[+PROX]}\ [_{vP}\ t_k\ [_{vP}\ pro^{[-PROX]}\ [_{v}\ v\ [_{VP}$ gii-tikomaan t_k]]]]]] [jiinaago mtigong]] nimosh$_i$ gaazhagan$_k$]

'(Third-person, animate, obviative) bit (third-person, animate, proximate) yesterday by the tree, dog, cat'

We need to take a few moments at this point to clarify some of the supporting evidence for this interpretation of the results. Some of this evidence has already been mentioned, some has not. First, recall that adverbs occur most frequently—and most naturally, according to native-speaker intuitions—at the edges of clauses. So when not one but two adverbs occur after the verb, they serve to strengthen the minimally consistent, simplest structure for the sentence, namely the one where two *pro*s fill the canonical argument positions and are thus able to immediately receive thematic roles from the verb. The introduction of a second adverb pushes the sentence (at least for most participants) past some threshold. Perhaps two adverbs are harder than one simply due to the added distance between thematic assigner and assignee (cf. Gibson, 1998; Hawkins, 1994). Perhaps the increased difficulty is due to the fact that all second adverbs in the 2-adverb condition were locatives, and these may introduce another discourse referent, as discussed above in connection to Gibson's DLT (cf. Gibson, 2000; Warren, 2001). Whatever the reason, participants had trouble giving up the assumption that the two adverbs signaled the right edge of the clause. When the NPs were then encountered, rather than initiate a complete reanalysis of the perfectly good clause preceding the adverbs, the parser took the NPs as appositional elements, matching them up with the *pro*s in argument positions via some sort of referential co-indexation.

This view of the Odawa data is consistent with a good bit of previous psycholinguistic research. Two-stage parsing models that assume reanalysis-as-last-resort (RALR) (e.g., Fodor & Inoue, 1998, 2000; Sturt, Pickering, Scheepers, & Crocker, 2001) predict that the parser should pursue any available parsing option that involves leaving a licit, complete, interpretable phrase marker that is consistent with the input alone. And evidence for two sorts of processing activities–tree-parsing (structure-building) and coreference processing—has been presented by Nicol (1988). Nicol proposes that coreference processing involves determining coreference between elements in anaphoric relationships (in an atheoretic sense of "anaphora"). Nicol suggests that this sort of processing might be influenced by pragmatic or other non-syntactic information (as long at it is not constrained in any given instance by syntactic requirements). It is this coreference processing that is initiated upon encountering first one, and then two, overt NPs in (3.34a-b).

To summarize, several factors help push the parser toward the alternative analysis proposed in (3.34a-b). First, if the HSPM does indeed build the minimally required structure and at the same time seeks to assign thematic roles to thematic assignees as quickly as possible, positing *pro*s immediately allows the parser to accomplish both tasks. Second, the adverbs lead people to believe the sentence is coming to an end, strengthening the assumption that *pro*s fill the argument positions. Third, the parser would rather not mess with the perfectly fine phrase marker it has built prior to encountering the overt NPs. Fourth, coreference processing is available to make sense out of the overt appositional NPs. Fifth, the syntax of Odawa allows for this sort of global ambiguity (between a scrambled and an appositional parse). Sixth, the relative lack of prosodic cues in the recorded stimuli (see discussion in §3.4.3.1) combined with the infrequent clause-medial position of the adverbs resulted in a situation where the appositional parse was less disfavored than it was in shorter sentences (especially those lacking adverbs), even without supporting context. Finally, according to native speakers, the appositional interpretation of the sentences in (3.34a-b) is even more accessible of one or both of the NPs occur with demonstrative determiners, just as the same sort of element improves similar English epithetical constructions (e.g.: *They trampled my flowers again, (those) creepy neighbor kids*). Taken together, I believe these factors conspired to create a situation where the parser, put under duress by the experimental procedure and stimuli, resorted to a simpler, "good enough" structural analysis (and resultant interpretation) of verb-initial sentences containing two adverbs.

Moving on to VOS order (Figure 3.3b), we are faced with a bit of a puzzle: Comprehension rates failed to go back up in the 2-adverb condition. And in the inverse form, comprehension even went down below the level of the 1-adverb condition. The explanation for this pattern of results hinges on the fact that verbs in direct and inverse form assign their thematic roles according to the same argument structure: verb{Ag, Pat}. So despite the fact that the basic word order in inverse clauses is assumed here to be OSV, the order in which thematic roles are assigned in both direct and inverse clauses is agent-patient. I assume that when the appositional NPs are in this order—subject-object—it is easier for the coreference processor (Nicol, 1988) to co-index them with the appropriate *pro/t* in the argument position of the verb. This assumption is supported in part by the overall pattern observed in the data plotted in Figure 3.15, where SO orders were observed to facilitate processing compared to OS orders at precisely the point where one would expect the coreference processor to be active: at the decision point in the picture verification task.

I base the above assumption on the basic tenet of Lewis's RIT: retrieval interference. All the various versions of Lewis's RIT (Lewis, 1998, 1999, 2002; Lewis & Nakayama, 2002; Vasishth, 2002) begin with the assumption that reactivating elements in short-term memory produces computational cost, and that this cost slows processing (and impedes comprehension) of structures where the cost approaches or exceeds some threshold level. Furthermore, the retrieval cost can be, and often is, elevated by interference stemming from similarities between elements to be retrieved. If we assume that this sort of interference arises when the coindexation processor is matching up overt NPs with *pro/t* in argument positions, the preference for NPs in the order mirroring that of the argument positions is explained.

Interestingly, the obviation morphology on the NPs does not appear to help differentiate between the NPs and match them to the corresponding empty categories in the pre-adverbial phrase marker as much as one might expect. This failure of the obviation morphology is especially curious, since the empty categories also have formal features of obviation (they must, according to the picture of Odawa syntax adopted from Bruening [2001], since these features drive A-movement). In addition, according to Lewis (p.c.) overt case marking, and presumably obviation marking as well, should result in significantly less interference between even two positionally similar elements. Note, however, since the coreference processor's job is to retrieve *pro*s from memory, not the overt NPs. The *pro*s, unlike the overt NPs, are *not* marked morphologically for obviation. Thus, it is reasonable to assume that the most salient feature of these empty categories by which the coreference processor can identify them is their positional dissimilarity. It is natural, therefore, to assume that if this positional dissimilarity mirrors that of the overt NPs, the matching process should be easier.

It is this linear mapping, rather than a structure-building process, that makes the alternative parse "good enough" with respect to the actual content of the input string. To interpret this parse, information about frequencies within the language and/or the argument structure of the verb must be taken into account, rather than strictly syntactic information. And the resulting interpretation is susceptible to errors deriving from overgeneralization or misapplication of these heuristics.

Let us turn now to verb-medial orders. In SVO and OVS order, the pattern observed in the VSO order repeats itself: Accuracy in both the 0-adverb condition and 2-adverb condition was generally better than in the 1-adverb condition (see Figures 3.2c-d). Although these differences were statistically significant only in the direct SVO order, and in the difference between direct OVS 0- and 1-adverb conditions, and the inverse SVO 1- and 2-adverb conditions, the direction of all the differences are predicted by an alternative parse such as the one outlined above. Two points are of particular interest.

First, the addition of just one adverb to a direct SVO sentence significantly lowered response accuracy (Figure 3.2c), despite the fact that revising the structure by simply scrambling the subject to a pre-adverbial position should not have been particularly difficult (see 3.35) if some sort of NVN=SVO heuristic of the sort proposed by Townsend & Bever (2001) were at work. Notice however a crucial difference between direct SVO and OVS in the 1-adverb condition: When the adverb is encountered in the OVS order, the structure does not need to be revised such that the preceding NP is scrambled to some A' position because the obviative NP in OVS order is already assumed to be in an A' position (see 3.36). This somewhat simpler aspect of the OVS compared to the SVO in the 1-adverb condition—where I assume that speakers still attempt full structural revision (often unsuccessfully, apparently)—may account for the lack of a difference between the very frequent SVO order and the very infrequent OVS order.

(3.35) **SVO (Direct)**

a. *nimosh...*

i. $[_{HP}$ nimosh$_i^{[+PROX]}$ $[_{vP}$ t_i $[_v$ v $[_{VP}$ (DIRECT) ...

ii. $[_{HP}$ nimosh$_k^{[+PROX]}$ $[_{vP}$ t_k $[_{vP}$... $[_v$ v $[_{VP}$ (INVERSE) t_k ...

b. *nimosh gii-tikomaan...*

i. $[_{HP}$ nimosh$_i^{[+PROX]}$ $[_{vP}$ t_i $[_v$ v $[_{VP}$ gii-tikomaan ...

ii. $[_{HP}$ nimosh$_i^{[+PROX]}$ $[_{vP}$ t_i $[_v$ v $[_{VP}$ gii-tikomaan *pro*$^{[-PROX]}$]]]]

c. *nimosh gii-tikomaan gaazhagan*

i. $[_{HP}$ nimosh$_i^{[+PROX]}$ $[_{vP}$ t_i $[_v$ v $[_{VP}$ gii-tikomaan gaazhagan$^{[-PROX]}$]]]]

(3.36) **OVS (Direct)**

a. *gaazhagan...*

i. $[_{XP}$ gaazhagan$_k^{[-PROX]}$ $[_{HP}$ *pro*$_i^{[+PROX]}$ $[_{vP}$ t_i $[_v$ v $[_{VP}$ (DIRECT) t_k...

ii. $[_{XP}$ gaazhagan$_k^{[-PROX]}$ ... $[_v$ v $[_{VP}$ (DIRECT) t_k...

iii. $[_{XP}$ gaazhagan$_i^{[-PROX]}$ $[_{HP}$ *pro*$^{[+PROX]}{}_k$ $[_{vP}$ t_k $[_{vP}$ t_i $[_v$ v $[_{VP}$ (INVERSE) t_k...

iv. $[_{XP}$ gaazhagan$_i^{[-PROX]}$. $[_{vP}$ ... $[_{vP}$ t_i $[_v$ v $[_{VP}$ (INVERSE)...

b. *gaazhagan gii-tikomaan...*

i. $[_{XP}$ gaazhagan$_k^{[-PROX]}$ $[_{HP}$ *pro*$_i^{[+PROX]}$ $[_{vP}$ t_i $[_v$ v $[_{VP}$ gii-tikomaan t_k]]]]]

ii. $[_{XP}$ gaazhagan$_k^{[-PROX]}$ ... $[_v$ v $[_{VP}$ gii-tikomaan t_k]]...

iii. $[_{XP}$ gaazhagan$_k^{[-PROX]}$ $[_{XP}$ gii-tikomaan $[_{HP}$ *pro*$_i^{[+PROX]}$ $[_{vP}$ t_i $[_v$ v $[_{VP}$ t_v t_k]]]]]]

iv. $[_{XP}$ gaazhagan$_k^{[-PROX]}$ $[_{XP}$ gii-tikomaan ... $[_v$ v $[_{VP}$ t_v t_k...

c. *gaazhagan gii-tikomaan nimosh*

i. $[_{XP}$ gaazhagan$_k^{[-PROX]}$ $[_{XP}$ gii-tikomaan $[_{HP}$ nimosh$_i^{[+PROX]}$ $[_{vP}\ t_i\ [_{v}\ v\ [_{VP}\ t_v$ t_k]]]]]]

The second point of interest is that although frequency would predict that direct SVO should be easier in the 0-adverb condition than OVS (which it was), this difference is also predicted by the parsing steps above. Notice that whereas the SVO order requires no revision to raise elements to adjoined XP projections, the OVS order does. A parallel set of circumstances obtains in the inverse form (3.37-3.38), where SVO is easier in the 0-adverb condition than OVS. This fact is intriguing since, on the whole, OS orders seem to be easier to comprehend in inverse forms than SO orders. The observation strengthens the claim that difficulty in comprehending certain Odawa sentences stems from structural complexity rather than frequency.

(3.37) **SVO (Inverse)**

a. *nimoshan...*

i. $[_{XP}$ nimoshan$_k^{[-PROX]}$ ... $[_{v}\ v\ [_{VP}$ (DIRECT) t_k...

ii. $[_{XP}$ nimoshan$_k^{[-PROX]}$ $[_{HP}$ *pro*$_i^{[+PROX]}$ $[_{vP}\ t_i\ [_{v}\ v\ [_{VP}$ (DIRECT) t_k...

iii. $[_{XP}$ nimoshan$_i^{[-PROX]}$ ... $[_{vP}$ .t_i. $[_{v}\ v\ [_{VP}$ (INVERSE) ...

iv. $[_{XP}$ nimoshan$_i^{[-PROX]}$ $[_{HP}$ *pro*$_k^{[+PROX]}$ $[_{vP}\ t_k\ [_{vP}\ t_i\ [_{v}\ v\ [_{VP}$ (INVERSE) t_k...

b. *nimoshan gii-tikomigoon...*

i. $[_{XP}$ nimoshan$_i^{[-PROX]}$ $[_{HP}$ *pro*$_k^{[+PROX]}$ $[_{vP}\ t_k\ [_{vP}\ t_i\ [_{v}\ v\ [_{VP}$ gii-tikomigoon t_k]]]]]]

ii. $[_{XP}$ nimoshan$_i^{[-PROX]}$. $[_{HP}$... $[_{vP}$...$[_{vP}\ t_i\ [_{v}\ v\ [_{VP}$ gii-tikomigoon...

iii. [$_{XP}$ nimoshan$_i^{[-PROX]}$ [$_{XP}$ gii-tikomigoon [$_{HP}$ *pro*$_k^{[+PROX]}$ [$_{vP}$ t_k [$_{vP}$ t_i [$_v$ v [$_{VP}$ t_v t_k]]]]]]]

iv. [$_{XP}$ nimoshan$_i^{[-PROX]}$ [$_{XP}$ gii-tikomigoon ...[$_{vP}$ t_i . [$_v$ v [$_{VP}$ t_v ...

c. *nimoshan gii-tikomigoon gaazhag*

i. [$_{XP}$ nimoshan$_i^{[-PROX]}$ [$_{XP}$ gii-tikomigoon [$_{HP}$ gaazhag$_k^{[+PROX]}$ [$_{vP}$ t_k [$_{vP}$ t_i [$_v$ v [$_{VP}$ t_v t_k]]]]]]]

(3.38) **OVS (Inverse)**

a. *gaazhag...*

i. [$_{HP}$ gaazhag$_i^{[+PROX]}$ [$_{vP}$ t_i [$_v$ v [$_{VP}$ (DIRECT) ...

ii. [$_{HP}$ gaazhag$_k^{[+PROX]}$ [$_{vP}$ t_k [$_{vP}$ ... [$_v$ v [$_{VP}$ (INVERSE) t_k ...

b. *gaazhag gii-tikomigoon...*

i. [$_{HP}$ gaazhag$_k^{[+PROX]}$ [$_{vP}$ t_k [$_{vP}$ *pro*$^{[-PROX]}$ [$_v$ v [$_{VP}$ gii-tikomigoon t_k]]]]]]

ii. [$_{HP}$ gaazhag$_k^{[+PROX]}$ [$_{vP}$ t_k ... [$_v$ v [$_{VP}$ gii-tikomigoon t_k...

iii. [$_{XP}$ gaazhag$_k^{[+PROX]}$ [$_{XP}$ gii-tikomigoon [$_{HP}$ t_k [$_{vP}$ t_k [$_{vP}$ *pro*$^{[-PROX]}$ [$_v$ v [$_{VP}$ t_v t_k]]]]]]]

iv. [$_{XP}$ gaazhag$_k^{[+PROX]}$ [$_{XP}$ gii-tikomigoon [$_{HP}$ t_k [$_{vP}$ t_k ... [$_v$ v [$_{VP}$ t_v t_k...

c. *gaazhag gii-tikomigoon nimoshan*

i. [$_{XP}$ gaazhag$_k^{[+PROX]}$ [$_{XP}$ gii-tikomigoon [$_{HP}$ t_k [$_{vP}$ t_k [$_{vP}$ nimoshan$^{[-PROX]}$ [$_v$ v [$_{VP}$ t_v t_k]]]]]]]

The third point of interest has to do with the relative improvements between the 1- and 2-adverb conditions in both the direct and inverse forms. In the direct SVO, the improvement in comprehension in the 2-adverb condition was significant, but not in the OVS condition. In the inverse form, the situation was identical, despite the fact that the overt NPs in the inverse sentences appeared in the canonical order relative to one another (i.e., OS) (see again Figures 3.2c-d and the results reported in connection with them). An explanation for this pattern of results follows naturally from the proposed alternative analysis of these sentences. In the object-initial order, the overt NP, if it is interpreted as appositional, and thus referentially co-indexed with a *pro* or *t* in the corresponding thematic assignment position, must be linked to a position at the end of the sentence. Presumably, holding the NP in memory until the appropriate time to make this connection would incur some processing cost. In the subject-initial orders, irrespective of whether the verb form is SVO or OVS, the thematic position corresponding to the appositional NP occurs earlier in the sentence, i.e., in subject position (see 3.39-3.40). So although the alternative parse in the 2-adverb condition appears to have less drastic consequences on comprehension than the syntactic reanalysis in the 1-adverb condition, the improvement in comprehension that it yields in the 2-adverb condition is greater when the co-indexation process it involves is less complex.

(3.39) **SVO**: 2-adverb condition alternative parses

a. Direct (***nimosh mtigong gii-tikomaan gaazhagan*** 'A/the dog bit a/the cat near a/the tree')

$[_{XP}$ nimosh$_i$ $[_{IP}$ jiinaago $[_{IP}$ mtigong $[_{HP}$ $pro_i^{[+PROX]}$ $[_{vP}$ t_i $[_{v}$ v $[_{VP}$ gii-tikomaan gaazhagan$^{[-PROX]}$]]]]]

b. Inverse (***nimoshan mtigong gii-tikomaan gaazhag*** 'A/the dog bit a/the cat near a/the tree')

$[_{XP}$ nimoshan$_i$ $[_{IP}$ jiinaago $[_{IP}$ mtigong $[_{XP}$ gii-tikomigoon $[_{HP}$ gaazhag$_k^{[+PROX]}$ $[_{vP}$ t_k $[_{vP}$ $pro_i^{[-PROX]}$ $[_{v}$ v $[_{VP}$ t_v t_k]]]]]]]

(3.40) **OVS**: 2-adverb condition alternative parses

a. Direct (*gaazhagan mtigong gii-tikomaan nimosh* 'A/the dog bit a/the cat near a/the tree')

[$_{XP}$ gaazhagan$_k$ [$_{IP}$ jiinaago [$_{IP}$ mtigong [$_{XP}$ gii-tikomaan [$_{HP}$ nimosh$_i^{[+PROX]}$ [$_{vP}$ t_i [$_v$ v [$_{VP}$ t_v $pro_k^{[-PROX]}$]]]]]]

b. Inverse (*gaazhag mtigong gii-tikomaan nimoshan* 'A/the dog bit a/the cat near a/the tree')

[$_{XP}$ gaazhag$_k$ [$_{IP}$ jiinaago [$_{IP}$ mtigong [$_{XP}$ gii-tikomigoon [$_{HP}$ $pro_k^{[+PROX]}$ [$_{vP}$ t_k [$_{vP}$ nimoshan$^{[-PROX]}$ [$_v$ v [$_{VP}$ t_v t_k]]]]]]]

Turning at last to verb-final orders (Figures 3.4e-f), we observed patterns of results nearly the opposite of the verb-initial and verb-final orders. In general, the 2-adverb condition failed in both direct and inverse forms, to prompt better comprehension than the 1-adverb condition. In SOV order, accuracy dropped in the 2-adverb condition compared to the 0- and 1-adverb conditions. In SOV inverse sentences, performance in the 2-adverb condition was significantly worse than in either the 0- or 1-adverb conditions. In OSV order, comprehension in the 1-adverb condition was better than in either the 0- or 2-adverb condition, which is consistent with the observation from other word orders that 0- and 2-adverb conditions very often pattern together. In the inverse OSV form, comprehension in both the 1- and 2-adverb conditions was significantly worse than in the 0-adverb condition. (Recall that OSV is taken here as the basic word order for inverse clauses.)

I believe that the patterns of comprehension accuracy in verb-final orders stems from the fact that the alternative, appositional parse proposed above to account for the data in verb initial and verb-medial orders is not available in verb-final orders. Before the parser can posit one or more *pros* in argument position(s), it must encounter a verb in the input string. Since the verb is delayed until the end of SOV and OSV sentences, no *pros* are posited. As a result, the parser is forced to hold both overt NPs in memory until the verb is encountered and the final, full structural parse can be built, at which point the obviation marking on the NPs becomes critical in determining their thematic roles (in combination with the direction morphology on the verb).

This picture of verb-final orders makes two predictions. First, consistent with Gibson's SPLT (1998) and Hawkins's EIC (1994), the longer the two NPs are held in memory, the harder it should be to compute the structure and, in turn, derive an accurate interpretation. This prediction is largely confirmed, with the exception of the extremely low comprehension accuracy in the OSV direct, 0-adverb condition. I am not sure what drove the comprehension of OSV direct orders down, but it may have been due in part to interference from the inverse, in which the OSV (or *patient-agent-verb*) order is canonical. Perhaps participants tended to map this order onto an inverse verb template. Second, considering the infrequency of the inverse form, it would be reasonable to expect that the parser might posit that the verb will eventually turn out to be direct. Consequently, the parser should posit that the proximate NP should be the agent and the obviative NP should be the patient. The longer these false hypotheses are held onto, the harder it should be for them to be revised (analogous to the "head-position effect" first reported in Ferreira & Henderson, 1990 and replicated in, e.g., Christianson, et al., 2001; Bailey & Ferreira, in press). These predictions for the inverse form appear to be correct, despite the failure of certain adverb conditions to significantly differ from others; the direction of change is always in the predicted direction.

Lastly, it is worth speculating for a moment on what predictions the pronominal argument account of Odawa grammar (PAH, Jelinek, 1984; Baker, 1996) would have made with respect to sentence processing. Recall that under the PAH all overt NPs are considered to be freely adjoined to the clause and coreferentially co-indexed with *pro*s in argument positions. As such, I believe that the "good enough" account of processing sentences with two adverbs would actually be consistent with the PAH. However, the PAH would also predict this same parse for sentences with one and no adverbs. The logical prediction would consequently be that sentences with two adverbs would be harder than sentences with one, which in turn would be harder than sentences with none—the longer the co-indexation links, the heavier the processing load. However, even if one assumed that the longer links would not actually increase processing load, then the PAH would predict no differences between the adverb conditions. Neither of these predictions was supported by the data, however. In addition, if NPs are adjoined to the clause, it would be natural to assume that the closer they appear to their co-indexed *pro*s, the easier processing would be. This would predict that SVO should be easier for both direct and inverse sentences (since thematic roles are assigned in the same way for both verb forms [McGinnis, 1995]), irrespective of the number of adverbs. Again, this prediction is not supported by the data, which show not only that OSV is preferred for the inverse, but also that the SVO preference in the direct form disappears with the addition of adverbs.

3.6 Summary of Experiment 2 Results and Discussion

Experiment 2, which represents the first known experimental psycholinguistic investigation of comprehension in an indigenous North American language, yielded a number of significant results in both off-line and on-line measures. The results bear directly on the three over-arching goals of this research. First, it has been shown in both Experiments 1 and 2 that "field psycholinguistic" research can feasibly be conducted. Second, the results from the two experiments are relevant and informative to current theories of sentence production (Experiment 1) and comprehension (Experiment 2). Third, the production frequencies and comprehension data both add to our current knowledge of Odawa, and support a configurational account of the syntax.

The basic pattern observed in both on-line and off-line measures was that sentences in which thematic assigners and assignees were separated by two adverbs were actually easier to comprehend than sentences in which only one adverb was present. The comprehension accuracy and processing speed of the sentences with two adverbs approached that of sentences containing no adverbs. These results were incompatible with specific predictions made by several current theories of sentence parsing.

Aspects of some of these theories, however, did account for certain patterns within the data, when combined with a shallow-processing or "good enough" mechanism of the HSPM. I proposed that the grammar of Odawa allows the parser to avoid cumbersome structural revisions in (most) sentences containing two adverbs. In these situations, in which the parser is pushed past some threshold of computational complexity, the parser opts for an alternative interpretation, whereby overt NPs in non-canonical positions at the periphery of a clause are interpreted as appositional elements (or part of VP-elliptical structures). This interpretation requires that the overt NPs be coreferentially co-indexed with empty categories appearing in canonical theta-assignment positions in the main clause, but it avoids necessitating a full-blown structural reanalysis in order to derive an interpretation. This alternative process is a type of "good enough" sentence processing strategy, defined as such because it relies on non-syntactic heuristics (such as frequency and the argument structure of verbs) to derive an interpretation, despite the fact that a completely syntactic revision *could* have been carried out instead.

In Experiment 3 (Chapter 4), the contribution of arguably non-syntactic, heuristic information sources is investigated with respect to their role in deriving interpretations for sentences containing one null pronominal (*pro*). It is argued in that chapter that once heuristic-based predictions are made, they—like syntactic analyses—are difficult to revise, and can lead to misinterpretations of even simple sentences.

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CHAPTER 4

Odawa Comprehension II

4.0 Experiment 3

This chapter contains a report of the results of Experiment 3, in which Odawa speakers heard transitive sentences containing one overt and one null (*pro*) NP. The hypothesis motivating the experiment was as follows: When no prior context exists, Odawa speakers should be forced to depend on sentence-internal context in order to deduce as much as possible about the referent of a *pro*. Sentence-internal context can be derived, at least in part, from the combinations of features of both the overt NP and those deduced for the null NP. The features represent rankings on various hierarchies including the animacy hierarchy, discourse hierarchy, obviation hierarchy, and thematic hierarchy. The working hypothesis was that Odawa speakers' comprehension would be better for sentences whose null NPs have expected or canonical combinations of features than for those that have null NPs with unexpected or non-canonical combinations of features. Experiment 3 was performed in order to investigate heuristic processes in comprehension in genral, and the effects of animacy and discourse on Odawa comprehension in particular.

4.1 Background and underlying assumptions

In Christianson (2001a, b, in press), I attempted to account for the production patterns obtained in Experiment 1 within the framework of Optimality Theory (Prince & Smolensky, 1993). In those papers, I described how the various hierarchies appeared to interact within Algonquian languages. These hierarchies included the "thematic hierarchy" (Fillmore, 1968; Jackendoff, 1972), the "relational hierarchy" (Aissen, 1997), the "discourse hierarchy" (Aissen, 1997, 1999b, 2001; Givón, 1994; Grimshaw & Samek-Lodovici, 1998; Levelt, 1989), and the "obviation hierarchy" (Aissen, 1997). To summarize the findings of the Christianson (2001) papers, it appeared that speakers preferred to align these various hierarchies as shown in (4.1).

(4.1) Preferred alignment of the various hierarchies observed in Odawa

Proximate	>	Obviative	(obviation hierarchy)
Subject	>	Object	(relational hierarchy)
Agent	>	Patient	(thematic hierarchy)
Topic	>	non-Topic	(discourse hierarchy)
Human	>	less Human	(animacy hierarchy)

As discussed in Chapter 1, syntactic subjects in Odawa are always thematic agents. As illustrated in (4.1), thematic agents are usually proximate (being marked obviative only in the infrequent inverse form). Proximate NPs are in some way "central" to the discourse (cf. Richards, 2000), and in Christianson, (2001a, b, in press) and Chapter 2 above, I proposed that this centrality is equivalent to topicality. The connection comes full circle, then, since active, volitional, causers of actions (e.g., typical properties of Dowty's [1991] "Proto-Agents") tend to be both human (or at least more animate along a graded animacy hierarchy) and tend to be subjects (are always subjects in transitive Odawa clauses), which tend to be discourse topics (Bock & Warren, 1985; Ferreira, 1994; Levelt, 1989).

The features of any given NP that serve to place it on these hierarchies are quite varied in nature, ranging from syntactic (relational hierarchy) to non-syntactic (animacy hierarchy). In Experiment 1 (Chapter 2), Odawa speakers preferred to describe the line drawings with sentences that encoded hierarchical alignment: Discourse topics were usually syntactic subjects (and thematic agents), for example. However, when further hierarchy rankings were considered, the connection between grammatical function and discourse status was affected. Also included in Experiment 1 (Chapter 2), was a subset of line drawings with NPs of mixed animacy (human agents with animal patients, and *visa versa*) on the suspicion that certain combinations of agent and patient might elicit descriptions using the inverse verb form. This suspicion conflicted with the intuitions of native speakers, who felt that the relative animacy of the NPs—as long as they were both grammatically animate—would make no difference. The results from Experiment 1 suggested that even fine-grained differences in animacy did make a difference after all: Speakers used more inverse forms to describe drawings with animal agents and human patients than drawings with human agents and animal patients or drawings that were balanced with respect to animacy.

Experiment 3 was conducted in an attempt to see if comprehension is also affected by interactions between these various hierarchies.

4.2 Establishing a referent for a null pronominal

The stimuli used in the present experiment were transitive sentences, consisting of just two words: an NP (either subject/agent or object/patient [inverted object/patient in the inverse form]) and a verb (either direct or inverse) (4.2).

(4.2) a. kwezens-an *pro* gii-gnowaabm-aa-n

girl-Obv *pro* 3.PAST-watch-Dir.3>3'-Obv

'[3rd person, singular] watched a/the girl'

b. mkwa gii-bgnen-aa-n *pro*

bear 3.PAST-strangle-Dir.3>3'-Obv *pro*

'A/The bear strangled [3rd person, singular]'

c. gookhookhoo *pro* gii-ziigwepidaa'-igoo-n

owl *pro* 3.PAST-spray-Inv.3'>3-Obv

'[3rd person, singular] sprayed a/the owl'

d. *pro* dwechigeniniw-an gii-nimkaa'-igoo-n

pro male.musician-Obv 3.PAST-wave.at-Inv.3'>3-Obv

'A/The male musician waved at [3rd person, singular]

Participants were asked to determine whether a line drawing shown to them after they heard sentences such as those in (4.2) matched the sentence that they had just heard. In order to perform this task, participants had to adjust any representation they had built for the referent of the *pro* to fit the referent depicted in the drawing. It was assumed that sentences in which the initial representation's features matched those of the referent would be easier to comprehend than sentences in which the representation's features turned out not to match those of the referent. The basic idea is that it should be easier to establish a referent for a *pro* in sentences in which features of the overt and *pro* NPs are aligned in the expected or canonical way than in sentences in which these features are aligned in an unexpected or non-canonical way. In order to make this prediction clear, however, we need to understand how the discourse status of the overt and null NPs interact with these other features.

4.2.1 Discourse status of NPs

Two of the main research questions of Experiment 3 have to do with the relative discourse status of the two NPs in a transitive Odawa clause. The first, and simplest, issue to address is the claim in Christianson (2001a, b, in press)—based on the results of Experiment 1—that in Odawa the proximate NP tends to be the discourse topic. By co-varying the overt NP with grammatical function, we can indirectly test the interaction of *pro*-drop with obviation morphology in the following way. Recall that in the direct, the subject is morphologically unmarked, and thus proximate. In the inverse, the subject is morphologically marked as obviative. If *pro*-drop is motivated by topicality, as is generally believed (cf. Artstein, 1999; Choi, 1999; Grimshaw & Lodovici, 1998; Lambrecht, 1994), and topicality is (at least) one major factor in determining an NP's "centrality," which determines the obviation status of Odawa NPs, we would expect to see processing preference for sentences where the more central proximate NP is *pro*-dropped, irrespective of its grammatical function. If, however, grammatical function is more tightly bound to the "centrality" of an NP than discourse status is, processing preferences should reflect this by better comprehension of sentences with *pro*-dropped subjects, irrespective of their obviation status.

The second issue having to do with the discourse status of the NPs is how the referent for a null NP (*pro*) is established when there is no prior context and, thus, no antecedent in the discourse. A great deal of psycholinguistic work in *pro*-drop languages has dealt with the mechanisms by which readers go about linking *pro*s with antecedents, thereby establishing referents for them. Nicol (1988) provided evidence for two types of processing—tree-processing and coreference-processing. Nicol suggested that the latter type of processing might be able to utilize pragmatic/semantic information. García-Albea & Meltzer (1996) found that Spanish speakers began searching for antecedents for a *pro* as soon as its position in the input was encountered, but that this search did not obtain immediately for *PRO*. García-Albea & Meltzer interpreted this result as support for Nicol's hypothesis regarding the two processors: Since *pro* must according to Chomsky's Principle B be locally free (Chomsky, 1986), the syntactic processor should have nothing to do with locating its antecedent, which will not only be non-local within a sentence, it might be in an entirely different sentence. De Vincenzi (1991) and Clifton & De Vincenzi (1990) report Italian speakers experienced less difficulty reading sentences with *pro*s in canonical pre-verbal position than they did reading sentences with overt post-verbal NPs, as reported in Chapter 3 above. More importantly for Experiment 3, however, is that Clifton & De Vincenzi (1990) note that 15% of their subjects systematically interpreted perfectly grammatical Italian sentences containing *pro* subjects incorrectly. Moreover, although reading times for sentences with *pro* subjects were faster than for sentences with post-verbal overt subjects, participants appeared to have more trouble interpreting such sentences (66% correct for *pro* sentences vs. 72% correct for post-verbal overt subject sentences). Clifton & De Vincenzi speculated that the 15% of participants who systematically derived incorrect interpretations of such sentences did so because of the lack of context. Specifically, the acceptance of *pro* seemed to depend on having prior context with an established topic, required to license the *pro*-drop (or topic-drop, cf. Grimshaw & Samek-Lodovici [1998]). When no prior context was present, a measurable minority of speakers was unable to interpret such sentences correctly.

The Italian findings are interesting in that they suggest that establishing a referent for a null pronominal is dependent on context. The Odawa sentences used in Experiment 3 present the same sort of difficulty to Odawa speakers. If subjects do immediately begin to hunt for a referent for a *pro* when a *pro* is encountered, the lack of context severely limits the search space.

One possibility is that the coreference processor will nevertheless attempt to deduce some information about the referent of the *pro* from whatever information there is available. In the case where the only "given" (Chafe, 1976) information about the referent of the *pro* is contained in the sentence itself, it may be that features of the overt NP are accessed (along with possibly the verb, although the selectional restrictions of the verbs used were not controlled for in the present experiment). If "given" NPs tend to be topics (cf. Choi, 1999; Lambrecht, 1994), and topics tend to be *pro*-dropped (cf. Grimshaw & Samek-Lodovici, 1998), participants should assume that the null NPs are in some way more topical or "given" than the overt NPs. One potential information source available to decide exactly how the null NP was more "given" is the fact that various hierarchies of features tend to correspond with certain other hierarchies of features, e.g., thematic agents tend also to be syntactic subjects (Aissen, 1997; Christianson, 2001a, b, in press; Ferreira, 1994). When these hierarchies are misaligned such that typically corresponding features no longer correspond, this state of affairs, if not included overtly by a speaker, might be difficult for a hearer to derive from the input. In this way, the sentence can be thought of as containing a sentence-internal context, derived at least in part from the features of the overt NP, from which predictions might be made as to the features of the null NP. If participants are actively predicting the features of the referent of the *pro* NP by considering the features of the overt NP, we should see evidence of processing difficulty when the features of the *pro* are incorrectly predicted. Such a result would be similar to those obtained by Ferreira (in press), who showed that English speakers tend to misinterpret passive and object-cleft sentences if the thematic roles of the NPs do not match expectations driven by schemata of the way the world generally works.

4.2.2 Animacy

One of the features that might be used by Odawa speakers to help establish the reference of a null pronominal is the relative animacy of each of two third person arguments of a transitive verb. With respect to Odawa—and a good number of the world's languages, actually—the term animacy does not simply refer to the notionally "animate" and "inanimate" distinction found in English. The notional animacy difference between, say, *rock* and *boy* has often been exploited in psycholinguistic experiments of both comprehension (Bever; 1970; Clark, 1965; Cupples, 2002; Hirose, 2002; Johnson, 1967; McDonald, Bock, & Kelly, 1993; Trueswell, et al., 1994; McRae, et al., 1998) and production (Ferreira, 1994). But the potential differences in animacy between, say, *dog* and *boy* or *flower* and *rock* largely have not. In Odawa, "animacy" refers not only to a notional categorization of entities in the world, but also to the grammatical gender of nouns—akin to the well-known gender systems of Germanic and Romance languages (see Corbett, 1991)—which determines whether the verb used with a given noun appears in animate form (VA) or inanimate form (VI) (see §1.1.1). The grammatical gender of a given Odawa noun generally adheres to the noun's notional animacy, so *gwiizens* 'boy' and *nimosh* 'dog' are both animate nouns. However, certain notionally inanimate nouns are grammatically animate, such as *mtig* 'tree' and *mskomin* 'raspberry'.

Linguists have long proposed that there exists a so-called "animacy hierarchy," within which any given noun in any given language fits. A version of this hierarchy from Minkoff (2001) is provided in (4.3).

(4.3) Animacy Hierarchy (Minkoff, 2001)

human > animal > plant > mineral

Traditionally, a number of linguists have maintained that the animacy hierarchy is grammaticalized to varying degrees in any given grammar. This explains why the grain size of the hierarchy's articulation varies from language to language (cf. Creamer, 1974; Hale, 1973; Silverstein, 1976; Witherspoon, 1977). For example, while the sentence (4.4b) is not acceptable in Maya-Mam, its English translation are, and (4.5a-d) are acceptable in Odawa, but (4.5e) is not.

(4.4) Maya-Mam (from Minkoff, 2000)[42]

a. Ø-Ø-t-il qya tx'yan

DC-ABS.3.sing-ERG.3.sing-see woman dog

'The woman saw the dog'

b. #Ø-Ø-t-il tx'yan qya

DC-ABS.3.sing-ERG.3.sing-see dog woman

'The dog saw the woman'

[42] DC = distant completive, ABS = absolutive case, ERG = ergative case

(4.5) Odawa

a. nini gii-ns-aa-n moozw-an

man 3.sing-PAST-destroy(kill)-Dir.3>3'-Obv moose-Obv

'A/The man killed a/the moose

b. mooz gii-ns-aa-n niniw-an

moose 3.sing-PAST-destroy(kill)-Dir.3>3'-Obv man-Obv

'A/The moose killed a/the man'

c. nini gii-nsaan mtigw-an

tree-Obv

'A/The man destroyed/killed a/the tree'

d. ?mtig gii-nsaan niniw-an

'A/The tree killed a/the man' (Pragmatically odd, but judged as acceptable of the tree fell on the man)

e. */#asin gii-nsaan niniwan

rock

'A/The rock killed a/the man'[43]

Psycholinguists have also noted an effect of animacy on how people tend to interpret sentences and rate sentences with respect to "acceptability" (where # means "unacceptable"), as opposed to grammaticality (where * means "ungrammatical"). Animate NPs have been found to be preferred as agents and subjects, at least in English (cf. Bever, 1970; Clark, 1965; Ferreira, 1994; Johnson, 1967; McDonald, et al., 1993;

[43] In a situation where the rock fell on the man, a circumlocution of some sort would need to be used, as in (i).

(i) gii-njibide asin miidash nini gii-nbot
3.sing-PAST-fall(VII) rock then man 3.sing-PAST-die(VAI)

Trueswell, et al., 1994; McRae, et al., 1998). Clark & Begun (1971) found that the acceptability of subjects of transitive sentences in English follows a pattern that closely resembles the animacy hierarchy proposed by linguists (4.2).

(4.6) *human nouns > animal nouns > concrete count nouns > concrete mass nouns > abstract count nouns > abstract mass nouns*

Minkoff (1994, 2000, 2001) has argued at length that the animacy hierarchy be considered not as part of any language's grammar, but instead as an innate property of the human sentence processing mechanism (HSPM). According to Minkoff, the HSPM prefers interpretations that assign the thematic role of agent in any given sentence to more animate NPs. This preference interacts with the syntax of certain languages, resulting in the unacceptability (nee ungrammaticality) of (4.4b).

Minkoff's explanation of asymmetries between animate and inanimate subjects/agents may in fact work for Odawa as well (research along these lines is in progress), but whether or not it does is beyond the scope of this dissertation. What is of immediate interest, however, is the contrast between acceptability in the sentences in (4.7), where the difference in animacy between humans and animals is at issue.

(4.7) a. nini gii-ns-aa-n moozw-an

man 3.sing-PAST-destroy(kill)-Dir.3>3'-Obv moose-Obv

'A/The man killed a/the moose

b. mooz gii-ns-aa-n niniw-an

moose 3.sing-PAST-destroy(kill)-Dir.3>3'-Obv man-Obv

'A/The moose killed a/the man'

c. nini moozw-an gii-ns-igoo-n

man moose-Obv 3.sing-PAST-kill-Inv.3'>3-Obv

'A/The moose killed a/the man'

d. #mooz niniw-an gii-ns-igoo-n

mooz man-Obv 3.sing-PAST-kill-Inv.3'>3.Obv

'A/The man killed a/the moose'

The decrement in acceptability in (4.7d) is not great; with sufficient context, native speakers judge it as perfectly acceptable. Only in a minimal pair with (4.6c) is the difference noticeable for most speakers consulted. And upon discovering the difference, speakers tend to be rather surprised by it, never having noticed it before. Thus Odawa speakers seem to be sensitive—but not consciously so—to a difference in animacy that is not encoded in the morphology of the language. This fact suggests that where ever the information contained in the animacy hierarchy is located—in the grammar, the HSPM, or somewhere else (see Asudeh, 2001, fn. 35)—it cannot be understood via introspection, is not consciously learned, is "inaccessible to cultural manipulation" (Minkoff, 2001, fn. 18, p. 212), and thus might be innate. The experiment reported in this chapter was conducted in part to try to determine if and how animacy interacts with certain other factors in the comprehension of Odawa sentences.

4.3 Syntactic complexity

One final word is required as to why hierarchies and non-syntactic features are at issue here rather than syntactic complexity and/or reanalysis, as was the case in Experiment 2. None of the sentences in (4.2) should be particularly difficult to parse word by word if (a) the syntactic analysis of Odawa adopted in Chapter 1 is correct, and (b) if the assumption from Chapter 3 that *pro*s are posited as soon as possible is correct.

In (4.2a), the sentence-initial obviative NP clues the listener in to the fact that the sentence will be transitive. And frequency considerations should bias the listener to expect a direct verb. When that verb is encountered, a *pro* in canonical position is posited, which is correct. In (4.2b), the sentence-initial proximate NP does not immediately lead to a Direct prediction, but the verb is immediately encountered, and when no overt NP follows, a *pro* is correctly posited. In (4.2c), the sentence-initial proximate NP is posited to be in [Spec,HP] (cf. Bruening, 2001, and Chapter 1 above), which is correct. Although the same NP is also biased toward an agent role due to the frequency of direct verbs, the inverse verb is quickly encountered, and the role should be relatively easily switched and a *pro* correctly posited in the canonical pre-verbal subject position. (4.2d) is the most complex of the four examples. In it, the listener likely interprets the sentence-initial NP as an A'-scrambled object of a direct verb. When the verb is encountered, however, it becomes clear that the overt NP must be lowered into canonical subject position, and that a *pro* proximate object occupies [Spec,HP] above the overt NP. If the complexity of syntactic reanalysis affects the efficacy of deriving an interpretation from even short sentences like these, sentences such as (4.2d) should be most difficult. However, it was expected that such short, immediate repairs would not cause any noticeable difficulty in interpreting the stimuli in the present experiment. I therefore focus on heuristic factors both in the research questions and in the analysis and discussion of the results.

4.4 Research questions

The broad goal of Experiment 3 was to examine heuristic or "good enough" processes at work in one aspect of Odawa comprehension: deriving an interpretation for null NPs in the absence of context. If, as suggested in Chapter 3, *pro*s are posited as soon as positions become available for them in an input string, the way in which these *pro*s are assigned an interpretation will be key in eventually understanding how speakers of Odawa and other *pro*-drop languages comprehend and interpret sentences. The specific research question motivating the present experiment was how discourse status and animacy might affect the comprehension of short Odawa sentences. The assumption was that these two arguably non-syntactic factors might interact with a number of other factors, syntactic and non-syntactic. Nicol's coreference processor provides motivation for this assumption: When faced with ambiguous anaphora, the HSPM seems to begin immediately to search for appropriate antecedents in the context. Absent any prior context, features of an overt NP will likely be accessed in an attempt to establish the features of the referent of a null pronominal, as a sort of sentence-internal context. The key features investigated here are the relative discourse status and animacy of both overt and null NPs, along with their thematic roles and obviation status, as assigned by the verb form in each sentence (either direct or inverse). At issue is the effect of hierarchical alignment on comprehension, the assumption being that when people can more easily predict the features of the referent of a *pro*, comprehension of sentences such as these will be better.

Further motivation for this experiment was taken from Ferreira (in press), who found that people have trouble linking thematic roles to syntactic positions in English passive and object-cleft sentences. Ferreira found also that certain implausible but strictly reversible active sentences produced the same effect as the passives. In Ferreira's stimuli, 11 out of 24 stimuli in the implausible, reversible, active condition were implausible by virtue of the animacy difference between the two NPs, e.g., *The dog bit the man*. If the difficulty Ferreira's participants had in linking thematic roles to NPs in such sentences arose in large part due to these 11 stimuli, the finding would be similar to that of Clark & Begun (1971), cited above, and it would be further evidence that the animacy hierarchy does indeed operate in English processing, despite the extreme paucity of evidence that it affects grammaticality judgments (but cf. Minkoff, 2000, examples [21-24] for some plausible examples of sentences in which it seems to). The Odawa inverse appears to be functionally similar to the English passive: Both demote the agent and promote the patient with respect to discourse topicality. The two constructions also appear to achieve this discourse effect via syntactic means: The patient NP undergoes A-movement to [Spec,IP] in English, to [Spec,HP] in Odawa (see Chapter 1 and Bruening [2001]). So we would expect inverse sentences to cause more processing difficulty than direct sentences. Unfortunately, I did not have the opportunity to include passive stimuli into the design of Experiment 3; doing so would have increased the number of experimental items and fillers such that experimental sessions would have taken too long. Obviously, it would be interesting to see how Odawa passive data compares to the English passive data presented in Ferreira (in press).

Finally, I wanted to test another somewhat curious and unexpected pattern of data obtained in Experiment 1. Of all 22 possible direct and inverse descriptions of the line drawings in Experiment 1 (V, SV, VS, VO, OV, VSO, VOS, SVO, OVS, SOV, OSV x 2 verb forms), only three were not used by the participants: inverse V, VO, and OV. The absence of these constructions in the data could well have been coincidental. But the fact that they are all inverse constructions lacking an overt subject (obviative) makes their collective absence suspicious. Therefore, the materials developed for the present experiment, consisting of sentences with *pro*-dropped arguments, are also suited to test whether there is a bias against inverse clauses with null subjects in comprehension, as there appeared to be in production.

4.5 Methods

4.5.1 Experimental design

One list of 32 Odawa sentences was developed (see Chapter 3 for discussion of why multiple lists were not used). These sentences took the general form of: *pro*-NP-verb-wrap-up region. Verb form (direct vs. inverse) was varied by the animacy of the agent as depicted in the line drawing that appeared at the end of each sentence (human agent [and animal patient] vs. animal agent [and human patient]), and the grammatical function of the overt NP (subject vs. object). This combination of conditions yielded a fully factorial 2 (verb form) x 2 (animacy of thematic agent) x 2 (overt NP) design. The stimuli for this experiment were presented in the experimental sessions of Experiment 2, and served as some of the fillers for that experiment.

4.5.2 Auditory moving window paradigm

The auditory moving window paradigm was identical to that used in Experiment 2.

4.5.3 Materials

All stimuli (n=32) and fillers (n=108) were created in the same way as those in Experiment 2. The line drawings for the picture verification task were also created in the same way as in the previous experiment. The nouns, verbs, and wrap-up segments for this experiment were taken from the lists in (3.21), (3.22), and (3.24), respectively. An example of a sentence from each condition is provided in Table 4.1. The full list of stimuli is found in Appendix C; as are the line drawings. Whether or not the line drawing matched the sentence was not counted as a variable (because, as was the case in Experiment 2, there was no *a priori* reason to believe that this would make a difference), but the drawings were counter-balanced such that of the four sentences in each condition, two matched the subsequent drawing, and two did not. Likewise, the decision was made to make the grammatical function/thematic role of the overt NP the variable, rather than the relative animacy of the overt NP, which was simply counter-balanced across conditions. Thus two overt NPs in each condition denoted humans, and two denoted animals. The reason for counting thematic role rather than animacy of the overt NP as a variable is that participants had no way of knowing that the animacy of the *pro* referent would differ from that of the overt NP; however, once the verb was encountered, they did know what the thematic role of the *pro* would be. The thematic role of the NPs might thus be expected to affect button-press latencies at the point of the noun and/or verb, whereas the animacy difference between the NPs would likely not. Accordingly, question marks appear along with check marks in these conditions. The check marks are also warranted, however, because the hypothesis was that participants would assume the animacy of the *pro* referent would be equal to or higher than the overt patient NP, or equal to or lower than the overt agent NP. The motivation for this hypothesis is explained in detail below.

Table 4.1: Example stimuli from Experiment 3

	Depicted in Drawing	
	human Ag.	*animal Ag.*
Direct		
overt subject: mkwa gii-mdaabaan-aa-n		√
'A/The bear dragged [3rd person animate]'		
jiibaakwenini gii-ns-aa-n	√	
'A/The chef killed [3rd person animate]'		
overt object: mkwa-n gii-mbin-aa-n	√/?	
'[3rd person animate] lifted up a/the bear'		
kwezens-an gii-gnowaabm-aa-n		√/?
'[3rd person animate] watched a/the girl'		
Inverse		
overt subject: mik-wan gii-jiim-igoo-n		√
'A/The beaver kissed [3rd person animate]'		
giigoonhkeniniw-an gii-kaam-igoo-n	√	
'A/The fisherman yelled at [3rd person animate]'		
overt object: bineshins gii-ngamta-igoo-n	√/?	
'[3rd person animate] sang to a/the bird		
kwezens gii-gozhe-igoo-n		√/?
'[3rd person animate] covered (with a blanket) a/the girl'		

One factor that was *not* controlled for was the plausibility of each verb given the animacy of the agent. Ferreira (in press) performed norming studies on large numbers of university students to determine that, for example, *bite* was more plausible with an animal agent and human patient than with a human agent and animal patient. Norming on an equivalent scale would have been impractical in Odawa. Through informal discussions with two native speakers, it was determined that 21of the 32 sentences contained verbs that were not heavily biased toward human or animal agenthood (translated as: *pull, push, chase, lift up, kill, kick, frighten, watch, drag, bump into, carry in arms, dream about, make cry, tickle, spray, whisper to, wave to, yell at*), nine sentences contained verbs that were somewhat biased toward human agenthood (translated as: *kiss, strangle, draw, tie up, swing, cover, photograph*), and two sentences contained verbs that were somewhat biased toward animal agenthood (translated as: *bite, carry on back*). Of the 21 sentences containing unbiased verbs, 11 described events with human agents, ten with animal agents. Of the nine sentences containing verbs biased toward human agenthood, four described events with human agents, five with animal agents. And the two sentences containing verbs biased toward animal agentivity were split between human and animal agents. So although the stimuli were not controlled with respect to verb bias, they were fairly evenly counterbalanced across conditions.

4.5.4 Participants

The participants and locations of the experimental sessions were the same as in Experiment 2.

4.5.5 Apparatus

The apparatus was the same as that used in Experiment 2.

4.5.6 Procedure

The procedure was the same as that used in Experiment 2.

4.6 Results

4.6.1 Off-line measure: Accuracy in picture verification task

As was the case in Experiment 2, overall accuracy was lower than expected. Although it is possible that participants perceived a mismatch between drawing and sentence due to the fact that the drawing had two overt participants and the sentences had only one, I feel that this is unlikely to be the source of the low results, since all sentences differed from the drawings in this way and there were significant differences between the conditions. Also, participants were more likely to err by deciding a drawing incorrectly matched a sentence, than *visa versa*, opposite what would be expected if they rejected drawings on the basis of the added information of the second actor. So once again, the low accuracy rates can be attributed at least in part to participants' curious aversion to answering 'NO,' even when that was the correct response. Note, though, that Clifton & De Vincenzi (1990) also reported relatively low accuracy rates with Italian sentences containing *pro*s and presented out of context. For the sake of brevity, I do not report an analysis of the data grouped by picture ("match" or "mismatch") conditions.

A 2 (verb form) x 2 (animacy of agent) x 2 (grammatical function of overt NP) ANOVA with a Greenhouse-Geisser correction was performed, treating subjects as a random effect (F_1). A separate between-items analysis was also conducted (see §3.5, Chapter 3), treating items as a random effect (F_2). The mean response accuracy and standard deviation for each condition are provided in Table 4.2.

Table 4.2: Mean Correct Response (%) and Standard Deviation (%): Picture Verification Task

	human Agent		*animal Agent*		*M*
	M	*SD*	*M*	*SD*	
DIRECT					
overt subject	57.6	23.2	68.5	20.3	63.1
overt object	79.4	23.4	48.6	20.2	64.0
M	*68.5*		*56.8*		
INVERSE					
overt subject	79.4	22.1	94.6	13.0	87.0
overt object	9.8	19.6	32.6	21.9	21.2
M	*44.6*		*63.6*		
M	***56.6***		***61.1***		

The within-subjects ANOVA yielded a significant three-way interaction between verb form, the animacy of the agent, and the overt NP, $F_1(1,22) = 19.298$, $MSE = .036$, $p < .001$, which was only marginal in the between-items analysis, $F_2(1,31) = 3.180$, $MSE = .042$, $p = .086$. The three-way interaction is plotted by the animacy of the agent in Figures 4.1a-b. 95% confidence intervals (Loftus & Masson, 1994) allow us to see better comprehension across the board when the overt NP was obviative, irrespective of verb form or the animacy of the thematic agent. In Figure 4.1a, the direct form was harder than the inverse when the agent was overt, but the direct was easier when the patient was overt. In Figure 4.1b, the situation was the same: Direct was harder when the agent was overt, but easier when the patient was overt. One significant difference was also evident between the two animacy conditions. Comprehension of direct sentences with an overt patient was reliably better when the agent *pro* turned out to be human (acting on an animal patient) than when the agent *pro* turned out to be animal (acting upon a human patient), $t(22) = 2.77$, $p = .011$. The patterns observed in this interaction are completely consistent with the view of the relations between animacy, obviation, discourse status, and thematic roles discussed in §4.1, Aissen (1997, 2000), and Christianson (2001a, b, in press). I postpone a discussion of the off-line measurement data, however, until after I present the on-line data, since the on-line data was minimal.

Figure 4.1a: Three-way Interaction: Accuracy in Picture Verification Task (Human Agent)
(error bars represent 95% confidence intervals)

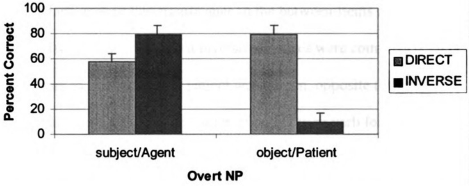
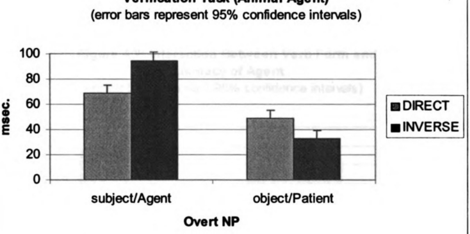
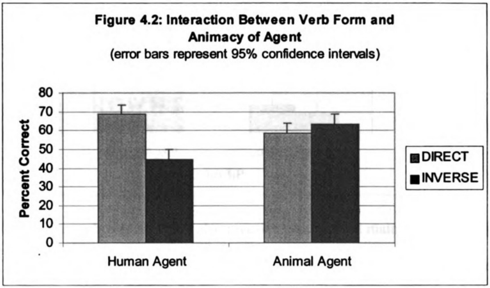


Figure 4.1b: Three-way Interaction: Accuracy in Picture Verification Task (Animal Agent)
(error bars represent 95% confidence intervals)



The within-subjects ANOVA also revealed reliable two-way interactions, which help to get a feel for some wider trends in the data. The first two-way interaction was between verb form and the animacy of the agent (Figure 4.2), $F_1(1,22) = 45.710$, $MSE = .021$, $p < .001$, which approached significance in the between-items comparison, $F_2(1,31) = 4.029$, $MSE = .042$ $p = .056$, such that inverse sentences were comprehended better when the agent was an animal and the patient was human, opposite the case of the direct form. There was also a reliable two-way interaction between verb form and the grammatical function/thematic role of the overt NP by subjects (Figure 4.3), $F_1(1,22) = 56.924$, $MSE = .090$, $p < .001$, as well as by items, $F_2(1,31) = 21.501$, $MSE = .042$, $p < .001$, such that in the inverse form, overt (obviative) subjects were comprehended better than overt (proximate) objects. There was no difference in this respect in the direct form. Comparing across verb forms, it is clear that overt obviative NPs, irrespective of grammatical function or thematic role, were easier to comprehend. Finally, the interaction between the animacy of the agent and the grammatical function of the overt NP was also reliable by subjects (Figure 4.4), $F_1(1,22) = 13.707$, $MSE = .024$, $p = .001$, but not by items.



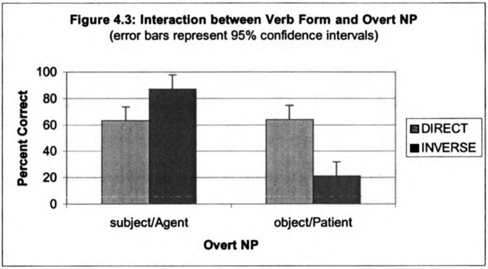
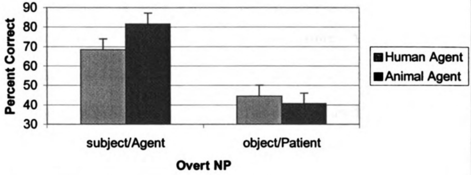


Figure 4.4: Interaction between Animacy of Agent and Overt NP
(error bars represent 95% confidence intervals)



The within-subjects ANOVA also revealed a significant main effect by subjects only of verb form, $F_1(1,22) = 14.10$, $MSE = .029$, $p = .001$, and a main effect of overt NP by subjects, $F_1(1,22) = 68.115$, $MSE = .071$, $p < .001$, and items, $F_2(1,31) = 18.674$, $MSE = .042$, $p < .001$; however, these main effects participated in the interactions to such a degree that they do not merit further discussion by themselves.

To summarize, the off-line measure of interpretation revealed that verb form, animacy, discourse, obviation, and thematic role all appear to interact during the interpretation of transitive Odawa sentences containing one *pro*. Evidence emerged that obviation morphology and discourse status are tightly linked: Participants had much more trouble deriving an accurate interpretation for sentences in which the obviative NP was *pro*-dropped, as opposed to sentences in which the proximate NP was *pro*-dropped. Comprehension was reliably better for direct sentences in which the agent *pro* turned out to be a human (acting upon an animal), than when it turned out to be an animal (acting upon a human). In the inverse, comprehension was better overall when the agent was animal and the patient was human, in accordance with (very subtle) native-speaker intuitions.

4.6.2 On-line measures: Button-press latencies

4.6.2.1 Button-press latencies at verb

Only trials in which participants correctly answered 'YES' or 'NO' to the picture verification task were used in the analysis of on-line measures. As was the case in Experiment 2, the unexpectedly low accuracy rates on the picture verification task in the present experiment limited the amount of data that could be used. Empty cells were replaced with the mean from the non-empty cells in the condition. One condition contained two empty cells, one contained four, and one condition—inverse with *pro* human agents—contained 16. This last condition, therefore, represented by far the most difficult condition. A 2 (verb form) x 2 (animacy of agent depicted in drawing) x 2 (grammatical function of overt NP) ANOVA with a Greenhouse-Geisser correction was performed, treating subjects as a random effect (F_1). A separate between-items analysis was also conducted (see §3.5, Chapter 3), treating items as a random effect (F_2). The mean button-press latency at the verb in each condition along with the standard deviations are provided in Table 4.3.

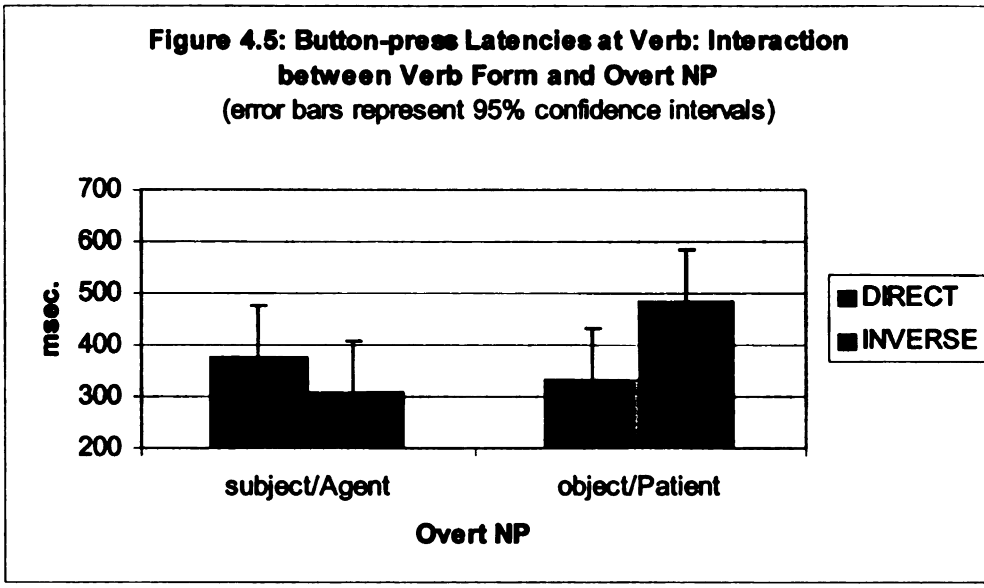
Table 4.3: Mean Button-Press Latency (msec.)

and Standard Deviation (in parentheses):

at Verb

	human Agent	*animal Agent*	*M*
DIRECT			
overt subject	415.34 (297.78)	337.43 (306.74)	376.39
overt object	409.77 (321.36)	256.91 (283.59)	333.34
M	*412.56*	*297.17*	
INVERSE			
overt subject	316.60 (280.43)	296.05 (239.01)	306.33
overt object	525.41 (284.60)	440.43 (486.13)	362.15
M	*421.01*	*368.24*	
Grand M:	**416.78**	**332.71**	

The within-subjects ANOVA revealed only one significant result: a two-way interaction between verb form and the grammatical function of the overt NP, $F_1(1,22) = 6.878$, $MSE = 80663.7$, $p = .016$. The interaction in Figure 4.5, where we can see a significant difference only in the inverse form. The between-subjects ANOVA yielded no significant effects.



Collapsing across animacy, the two-way interaction in Figure 4.5 can be directly compared to the two-way interaction between the same factors that was observed in the picture verification data in Figure 4.3. In both, the only significant difference appears in the inverse form, such that when the patient (and proximate) NP was overt and the agent (obviative) null, comprehension was worse and button-press latencies on the verb were longer.

4.6.2.2 Button-press latencies at Wrap-up Region

Neither the within-subjects nor between-items ANOVA revealed any significant effects at the wrap-up region. Since the sentences for this experiment consisted of only two words each (not counting the wrap-up region), so-called "end of sentence" effects may have been absent all together. It is more likely, however, that since the sentences contained a *pro* argument, that the effects associated with building a final representation for the sentence were delayed until the point when a referent for the null pronominal could be identified, i.e., until the line drawing was displayed.

4.6.2.3 Button-press latencies at picture verification decision

A *post hoc* paired t-test was first computed to determine if latencies at this point in the trial were significantly longer when participants responded to the picture verification task incorrectly than when they answered correctly. There was no significant difference in this regard, $t(22) = .404$, *n.s.*, mean difference 45.542 msec. Then a 2 (verb form) x 2 (animacy of agent) x 2 (grammatical function of overt NP) ANOVA with a Greenhouse-Geisser correction was performed on data collected in all trials, both correctly and incorrectly responded to, treating subjects as a random effect (F_1). A separate between-items analysis was also conducted (see §3.5, Chapter 3), treating items as a random effect (F_2). The mean button-press latencies at the decision point of the picture verification task in each condition are provided along with the standard deviations in Table 4.4.

Table 4.4: Mean Button-Press Latency (msec.)

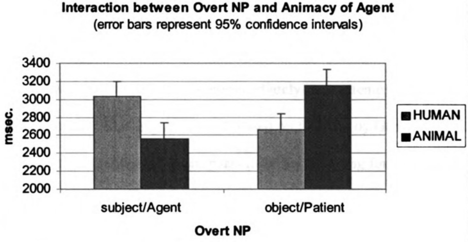
and Standard Deviation (in parentheses):

at Decision in Picture Verification Task

	human Agent	***animal Agent***	*M*
DIRECT			
overt subject	2906.28(669.55)	2759.36 (888.71)	2832.82
overt object	2537.20 (620.11)	3130.42 (703.50)	2833.81
M	*2721.74*	*2944.89*	
INVERSE			
overt subject	3146.70 (802.24)	2558.65(614.99)	2852.68
overt object	2585.64 (628.23)	3172.69 (764.93)	2879.17
M	*2866.17*	*2865.67*	
***Grand M*:**	***2793.96***	***2905.28***	

The within-subjects ANOVA revealed a lone significant effect, namely a two-way interaction between the grammatical function of the overt NP and the animacy of the agent, $F_1(1,22) = 41.749$, $MSE = 252600.6$, $p < .001$, which is plotted in Figure 4.6. This interaction was also reliable between items, $F_2(1,31) = 7.322$, $MSE = 249256.4$, $p = .012$.

Figure 4.6: Button-press Latencies at Picture Decision: Interaction between Overt NP and Animacy of Agent
(error bars represent 95% confidence intervals)



The two conditions resulting in fastest decision times were those containing an Animal-Agent, either overt or null. This pattern was also observed in the off-line data, and will be discussed more in §4.7.

4.7 Discussion of Experiment 3

Experiment 3 was conducted in order to investigate potential heuristic-based sentence interpretation processes, as well as to try to better understand how Odawa speakers assign reference to null pronominals, which are exceedingly common in the language. The materials for Experiment 3 differed substantially from those in Experiment 2 in two ways. First, the line drawings in Experiment 3 depicted events in which one "actor" (agent or patient) was human, and the other actor was animal. Although the grammatical gender system of Odawa makes no animacy distinction between human and animal NPs, the results from Experiment 1 along with native speaker acceptability judgments suggested that this manipulation would affect responses on the picture verification task. Second, whereas both NPs were overt in the stimuli in Experiment 2, only one was overt in Experiment 3. And since there was no prior context provided for these sentences, the reference of the null, or *pro*-dropped, NP could not be identified with certainty until the line drawing was displayed subsequent to the end of the sentence.

Without prior context, it was hypothesized that a variety of information sources—syntactic or otherwise—would be accessed immediately in an attempt to establish the reference of the null NP. This hypothesis was based on findings by García-Albea & Meltzer (1996), who found that Spanish speakers began searching for antecedents for *pro* as soon as its position in the input was encountered. In addition, work by Nicol (1988) provided evidence for two types of processing—tree-processing and coreference-processing. Nicol suggested that the latter type of processing might be able to utilize pragmatic/semantic information. Once again, since no prior context for these sentences was provided, the only "given" (Chafe, 1976) information about the referent of the *pro* and its relation to the overt NP in any sentence was the features that could be deduced from the overt NP (and possibly the verb, although the selectional restrictions of the verbs used were not controlled for). If "given" NPs tend to be topics (cf. Choi, 1999; Lambrecht, 1994), and topics tend to be *pro*-dropped (cf. Grimshaw & Samek-Lodovici, 1998), participants should have assumed that the null NPs were in some way more topical or "given" than the overt NPs (or conversely, that the overt NPs were less topical or "newer" than the null NPs). One potential information source available to decide exactly how the null NP was more "given" is the fact that various hierarchies of features tend to correspond with certain other hierarchies of features, e.g., thematic agents tend also to be syntactic subjects. When these hierarchies are misaligned such that typically corresponding features no longer correspond, this state of affairs, if not announced overtly by a speaker, might be difficult for a hearer to derive from the input. In essence, the hierarchical features observable for the overt NP and inferable for the null NP would, it was predicted, serve as heuristics for deriving an interpretation for the sentence. Since a complete, fully specified representation was impossible to construct before viewing the drawing at the end of each sentence, this heuristic-driven process might be counted among "good enough" processing strategies (Ferreira & Henderson, 1999; Ferreira et al., 2001; Ferreira, et al., 2002).

I hypothesized, then, that information about where the NPs—overt or null—in a given sentence ranked both individually and with respect to one another on the various relevant hierarchies might provide a sort of "internal context" for sentences consisting of just two words. The hierarchies I suspected to be of relevance were the animacy hierarchy, thematic hierarchy, discourse hierarchy, and obviation hierarchy, based on previous work by Aissen (1997, 1999a, b, 2001) and (Christianson, 2001 a, b, in press). Finally, based on results by Christianson, et al. (2001) and Ferreira (in press), I suspected that if ultimately incorrect features of the *pro* were incorporated into an initial interpretation of the sentence, this initial inaccurate interpretation would be difficult for participants to revise, even in sentences consisting of just two words.

The results of Experiment 3 strongly supported all of the above assumptions and hypotheses. I focus in what follows on the off-line picture verification task data, with passing reference to the on-line data (for reasons to be explained below).

Two of the three most accurate response rates occurred in conditions within the inverse form, as did two of the three lowest accuracy rates (see Figures 4.1a-b). It would appear then that despite functional (Givón, 1994; Valentine, 2001) and syntactic (Bruening, 2001) similarities between the Algonquian inverse and English passive, unlike

English speakers (Ferreira, in press), Odawa speakers do not have much more trouble comprehending the less frequent structure, contrary to what would be expected under most "constraint-based" parsing models (cf. MacDonald, et al., 1994; Trueswell, 1996; and the discussion of such models in Chapter 3 above). Note that this finding is similar to that of Ferreira (in press); English speakers had equal difficulty comprehending object clefts as they did passives, despite the infrequency of the former as compared to the latter.

One factor produced significantly more inaccurate picture verification rates in the inverse: animacy. Specifically, collapsing across the overt NP conditions, Figure 4.2 shows that when an inverse sentence contained a human agent (and an animal patient), accuracy dipped below 50%. This result confirms the native speaker acceptability judgments cited in (4.7), repeated here as (4.8), that the inverse is "odd" with human agents and animal patients. We will see, however, that this generalization is significantly modulated by the relative discourse status of the null and overt NPs in sentences of the type used as stimuli.

(4.8) a. nini gii-ns-aa-n moozw-an

man 3.sing-PAST-destroy(kill)-Dir.3>3'-Obv moose-Obv

'A/The man killed a/the moose

b. mooz gii-ns-aa-n niniw-an

moose 3.sing-PAST-destroy(kill)-Dir.3>3'-Obv man-Obv

'A/The moose killed a/the man'

c. nini moozw-an gii-ns-igoo-n

man moose-Obv 3.sing-PAST-kill-Inv.3'>3-Obv

'A/The moose killed a/the man'

d. #mooz niniw-an gii-ns-igoo-n

mooz man-Obv 3.sing-PAST-kill-Inv.3'>3.Obv

'A/The man killed a/the moose'

One of the research questions was whether obviation status is more tightly bound to discourse status than it is to grammatical function. Recall that in the direct form, the agent is proximate and the patient is obviative, and that in the inverse form, the morphological marking is reversed. Figure 4.3 (as well as Figures 4.1a-b) provides evidence of a preference for overt obviative NPs. Since proximate morphology is generally recognized as connected to topichood or "givenness" and obviative morphology to focus or "newness" (cf. Aissen, 1997, 2000; Christianson, 2001, a, b, in press), the pattern of results shown in Figure 4.3 is familiar: Participants were better at comprehending sentences in which topics/proximates were *pro*-dropped, and in which non-topics/obviatives were overt (cf. Grimshaw & Samek-Lodovici, 1998). Interestingly, this difference surfaced only in inverse sentences. Recall that one of the results in Experiment 1 was the curious absence of inverse sentences of the forms V, VO, and OV—all and only the set of inverse sentences lacking an overt subject/agent/obviative/non-topic. The results of Experiment 3 suggest that the lack of such sentences in Experiment 1 was no accident; speakers systematically avoid using *and* have trouble comprehending inverse clauses lacking the obviative NP. It is not clear why the same effect was not observed in the direct, in either production or comprehension.

The fact that the direct is so much more common than the inverse may present some explanation. This is but one of many issues which further research might fruitfully address.

Figure 4.4 is the first illustration of how animacy played a role in comprehension. I hypothesized above that, in general, comprehending a sentence that does not conform to expectations—expectations based at least partially on the ranking of the *pro* and the overt NP on a number of hierarchies—should be harder than doing so for a sentence that does conform to expectations. Specifically, in situations lacking prior context, people should have to rely on sentence-internal context to fix a reference for the *pro* element. A significant source of information in such situations can be derived from relevant hierarchies, applied in a heuristic fashion to derive a plausible interpretation of the sentence. In Figure 4.4, we can see that when the sentence contained an overt NP that was consistent with heuristic-based, hierarchy-dependent expectations, comprehension was worse, collapsing across verb forms (which, as discussed above, can be misleading with respect to the interaction of the discourse hierarchy and the relational and/or thematic hierarchies). Specifically, when the overt NP displayed an *expected* or default alignment of animacy and thematic features, comprehension was actually worse than when the overt NP displayed an *unexpected* alignment of features. Thus, when the agent was overt (less topical) and human, comprehension was worse than when the agent was overt and animal. Evidently, it was more difficult for participants to come to grips with a null animal patient NP than it was a null human paitent NP.

To put the pattern in terms of the accuracy with which the referent of a *pro* could be predicted, participants had less trouble predicting the features of the *pro* referent when the overt NP features were observed to be in a non-canonical combination (i.e., animal-agent or human-patient). When a misalignment of features was observed in the overt, less topical NP, participants appeared to have entertained the possibility that the features of the *pro* could also be misaligned. When the animacy and thematic features of the overt NP were aligned, however, participants seem to have been confused as to why it should have been non-topical. Alternatively, perhaps the overt NP's default combination of animacy and thematic features simply failed to provide a reliable clue as to the features of the *pro*: A non-topical (but extremely canonical) human agent, for example, would lead one to predict some combination of features for the null NP such that it would be even *more* canonical, or at least equally so (and thus more topical than the overt NP). Since no more canonical combination of animacy and thematic features occurred in the drawings, this prediction would never have been realized, though. And unfortunately, no baseline of human-human or animal-animal drawings was included in the stimuli. If the immediately preceding line of speculation is correct, we would expect sentences with overt human agents to result in better comprehension if the patient turned out to also be human, rather than to be animal, as was the case in the present experiment.

The three-way interaction plotted by the animacy of the thematic agent in Figures 4.1a-b provides the most complete picture of the results. The first point of interest is obvious from the means in Table 4.2: With the exception of direct sentences with overt patients, comprehension was better in sentences with animal agents than in those with human agents. Paired t-tests revealed that in inverse sentences with overt agents, comprehension was significantly better when the agent was animal than when it was human, $t(22) = 3.73$, $p = .001$. Likewise, when the overt NP in inverse sentences was the patient, comprehension was also better for inverse sentences with animal rather than human agents, $t(22) = 4.396, p < .001$. In direct sentences with overt agents, the difference in animacy was in the same direction, but failed to reach significance, $t(22) = 1.86, p = 076$. And in direct sentences with overt patients, the result was reversed: Comprehension was better for sentences with human agents than animal agents, $t(22) = 5.746, p < .001$.

These results support the native-speaker intuition that the inverse verb form is preferred in contexts with a less animate agent and a more animate patient, even when the difference in animacy is not reflected in the grammatical gender system. They do not provide any evidence for an across-the-board prohibition on or dispreference for sentences with animal agents and human patients. In this respect, then, Odawa seems to be somewhere between Maya-Mam (see §4.0 and Minkoff, 1994, 2000, 2001) and English. Although animacy seems to influence verb form choice, it does not drive strong acceptability judgments by itself, but rather in concert with discourse and thematic considerations.

Looking further at the results for sentences with an animal agent (acting upon a human patient) (Figure 4.1b), notice that the best performance in any condition (in both Figures 4.1a-b) occurred in inverse sentences when the agent was overt (Figure 4.1b, second bar from left). In this condition, participants were most effectively able to utilize hierarchy information to accurately ascribe features to the *pro*, as illustrated using the sentence in (4.9) as an example of this condition.

(4.9) *pro* mkwa-n gii-mnashkow-igoo-n

pro bear-Obv 3.sing-PAST-chase-Inv.3'>3-Obv

'A/The bear chased [3rd person animate]'

In sentences such as (4.9), participants knew that the thematic agent had, for some reason, been demoted with respect to "centrality" (Richards, 2000) or topicality (Christianson, 2001 a, b, in press); since the inverse is one means available for demotion of the thematic agent (Christianson, 2002; Givón, 1994; Valentine, 2001) in Algonquian languages. Given the lack of context, a good possibility for this demotion is a misalignment of the agent NP and the null NP on one or more hierarchies, the most obvious of which is the animacy hierarchy. Since animals are outranked on this hierarchy only by humans, participants could be fairly certain that the patient *pro* would have a human referent, the animacy ranking thus giving the *pro* the edge in topic status despite its lower thematic ranking. And when the line drawing appeared, they saw confirmation of this prediction. Adding to the good performance in this condition was the fact that the *pro*-dropped NP was proximate, a factor that led to better performance overall.

The two conditions with slightly lower accuracy rates were both in the human agent condition: Inverse sentences with overt agent NPs (4.10) (second bar from left, Figure 4.1a), and direct sentences with overt patient NPs (4.11) (third bar from left, Figure 4.1a).

(4.10) *pro* niniw-an gii-mnashkow-igoo-n

pro man-Obv 3.sing-PAST-chase-Inv.3'>3-Obv

'A/The man chased [3rd person animate]'

(4.11) *pro* mkwa-n gii-mnashkow-aa-n

pro bear-Obv 3.sing-PAST-chase-Dir.3>3'-Obv

'[3rd person animate] chased a/the bear'

Good comprehension of sentences like (4.11) was expected. The null NP is both proximate and predicted to be no lower than an animal with respect to animacy. This prediction turned out to be correct in the line drawings.

At first the relatively good performance on sentences such as (4.10) appears surprising, since it is exactly this sort of sentence native speakers judge as odd when both NPs are overt and the patient is an animal (as revealed in the line drawings). But (4.10) and (4.11) demonstrate the importance of both NPs' respective ranks on the obviation hierarchy: This rank must therefore be weighted more heavily than the ranks on the animacy hierarchy among the heuristics used to try to establish a referent for the null NP. In (4.10), the animacy hierarchy would lead one to predict that the referent of the *pro* should be human. Apparently it was easier to revise this prediction in sentences where the null NP was proximate (and therefore ranked more highly on the discourse hierarchy) than it was in sentences such as (4.12), where not only the animacy of the null NP was unexpected, but so was its discourse status and obviation status, given the bias against *pro* non-obviatives (Figure 4.1b, third bar from left).

(4.12) *pro* niniw-an gii-mnashkow-aa-n

pro man-Obv 3.sing-PAST-chase-Dir.3>3'-Obv

'[3rd person animate] chased a/the man'

Perhaps the difference between the accuracy rates for sentences like (4.10) vs. (4.12) is simply that the inverse form signals a non-canonical hierarchical alignment in one direction or the other with respect to animacy and discourse, more so than the direct does. So when participants discovered an animal agent in the drawings associated with direct sentences like (4.12), it was more of a surprise than it was for inverse sentences like (4.10). Now compare the comprehension of sentences like (4.11) to that of sentences like (4.12): In (4.11), the prediction is for the *pro* agent to be at least as animate as the overt patient, which turns out to be accurate. In (4.12), the prediction is the same, but in this case, it turns out to be an inaccurate prediction, since the *pro* agent turns out to be less animate than the overt patient.

The direct sentences with dispreferred null patients were equal with respect to difficulty, irrespective of the animacy of the agents (Figures 4.1a-b, first bar in each)—a human agent and animal patient (4.13) or an animal agent and human patient (4.14).

(4.13) nini gii-mnashkow-aa-n *pro*

man-Obv 3.sing-PAST-chase-Dir.3>3'-Obv *pro*

'A/The man chased [3rd person animate]'

(4.14) mkwa gii-mnashkow-aa-n *pro*

bear-Obv 3.sing-PAST-chase-Dir.3>3'-Obv *pro*

'A/The bear chased [3rd person animate]'

Finally, the two worst conditions for comprehension are represented in the fourth bars in Figures 4.1a-b, and exemplified in (4.15) and (4.16), respectively. In each, the verb is inverse, and the obviative NP has been *pro*-dropped. The poor comprehension of sentences like these is consistent with the data from Experiment 1 (Chapter 2) in which no inverse sentences were produced with null obviative NPs.

(4.15) nini *pro* gii-mnashkow-igoo-n

man *pro* 3.sing-PAST-chase-Inv.3'>3-Obv

'[3rd person animate] chased a/the man'

(4.16) mkwa *pro* Ø-gii-mnashkow-igoo-n

bear *pro* 3.sing-PAST-chase-Inv.3'>3-Obv

'[3rd person animate] chased a/the bear'

I can only speculate at this point about why there should be this aversion to inverse sentences with null obviative NPs. One possibility is that the function of the inverse is to demote the agent so far as to generally make it irrecoverable from the context. Yet, the agent is still important enough as to require identification, so it must be overt. If the context is such that the agent can be or should be demoted even further, speakers can use a passive construction (Rhodes, 1990; Valentine, 2001), which contains no syntactic agent at all (Christianson, 2002).

Turning to the on-line button-press latency data, we saw evidence for processing slow-down at the verb when the overt NP was proximate (and the null NP was obviative) (Figure 4.4), which is consistent with the off-line data discussed above. The wrap-up region produced no significant results. In Chapter 3, I attributed the several reliable on-line effects obtained in the button-press latencies in the wrap-up region in Experiment 2 to burdensome syntactic revisions. If this was correct, it is safe to assume that the argument presented in §4.3 was correct: The sentences in Experiment 3 were far less syntactically complex, especially with respect to revisions of initial parsing assumptions, than those in Experiment 2. In these two-word sentences, posited *pro*s did not need to be replaced with overt NPs, and elaborate adjunction structures were not required for scrambled overt NPs. Even in sentences such as (4.2d), where some revisions would need to be performed, no effect of these revisions were observed.

And finally the interaction of animacy and the grammatical function/thematic role of the overt NP illustrated in Figure 4.6 demonstrates again the preference observed for sentences with animal agents and human patients, as opposed to the other way around. Since these results collapse across verb form—and thus, crucially, obviation status of the NPs—they are somewhat difficult to interpret, however. What should be pointed out is that the conditions that yielded the longest decision times in each overt NP condition were also the harder to comprehend. This can be seen by comparing Figure 4.6 the corresponding interaction observed in the off-line data, shown in Figure 4.3. This relationship between longer decisions times and lower accuracy in the picture verification task suggests that the key to comprehending these sentences did indeed involve identifying the referent of the null NP, and implicates the mismatch between predicted and actual features of the referent as a main source of errors.

4.5.1 *Optimality Theory* and the *Competition Model*

The view presented above of how Odawa speakers go about predicting and then establishing a referent for a null pronominal when prior context is lacking highlights the interaction of several features attributable to both the overt and null NP. I believe that these data might be fruitfully integrated into a larger picture of sentence comprehension within the general framework of Optimality Theory (Prince & Smolensky, 1993). Furthermore, as pointed out by Stevenson & Smolensky (2001), doing so raises certain questions as to the degree to which the grammar and HSPM share certain properties. Bates & MacWhinney's *Competition Model* (1982; MacWhinney & Bates, 1989) actually resembles in many respects what an optimality theoretical model of sentence comprehension might look like. In this view of sentence comprehension, speakers of any given language exploit "cues" in the input stream to make parsing decisions and, ultimately, to derive an interpretation from the input. These cues can range from word order to case marking to animacy to frequency—essentially all the constraints suggested within the "constraint-based" models of sentence comprehension (cf. MacDonald, et al., 1994; Taraban & McClelland, 1990). What is important to note is that the hierarchies which I propose above to account for the pattern of results are assumed here to come into play precisely where syntactic processing ends: at the point where the coreference processor (Nicol, 1988) attempts to establish some concrete referent for the null pronominal. There was in fact no evidence that the same processes were at work in Experiment 2 (Chapter 3), until, perhaps, the processing load became too great and the alternative appositive-like interpretations were taken up. As such, although I think that heuristic or constraint-based processing holds promise for certain Odawa phenomena, its promise is likely limited to post-syntactic processing. Nevertheless, the common thread between Experiment 2 and Experiment 3 is the data in each that show when incorrect syntactic or heuristic-based analyses are made, it is difficult for the HSPM to jettison those analyses and the misinterpretations to which they initially lead.

4.6 Summary

In Experiment 3, I sought to explore the ways in which obviation status, thematic role, discourse status, and animacy interact to influence comprehension of Odawa sentences lacking prior context. To do this, I used sentences with one overt and one null or *pro* NP as stimuli and asked Odawa speakers to determine if the sentences they heard were accurate descriptions of line drawings presented upon completion of each of the stimuli sentences.

As suggested by the data collected in Experiment 1 (Chapter 2) and in subsequent discussions of those data (Christianson, 2001a, b, in press), the interaction between these factors is complex. obviation status is broadly determined by discourse status of the two NPs, specifically their relative topicality or "centrality" with respect to one another and other NPs in the discourse. Lacking any previous context, the features of the overt NP serve as a sort of "sentence-internal context" and lead to more or less specific predictions as to the features of the null or *pro* NP. Overt, and thus presumably less topical, NPs with non-canonical or misaligned features—such as animal agents or human patients—proved to be useful as predictors of similarly non-canonical *pro* features. Conversely, sentences with overt, non-topical NPs with canonical, aligned features proved more difficult to comprehend, possibly because they led to ultimately inaccurate predictions of null NPs with similarly canonical featural combinations. The use of heauristics based on a number of different feature hierarchies in deriving an interpretation for sentences provides converging evidence for a "good enough" mode of comprehension/interpretation. The main findings of Experiments 2 and 3 suggest that any model of sentence comprehension and interpretation need should incorporate a heuristic-based processor which may take over at least some of the responsibilities of the structural parser in cases of extreme processing load or extreme paucity of context.

CHAPTER 5

Summary and Future Directions

5.0 Summary

The three experiments reported here dealt with sentence processing in the "nonconfigurational" language of Odawa. Experiment 1 was an investigation of sentence production, and Experiments 2 and 3 were investigations of sentence comprehension. All three lent some insight into issues relevant to the structure of Odawa itself, as well as to issues relevant to sentence processing. It is hoped that the results reported here will prove compelling enough to spur future psycholinguistic research in lesser-studied, endangered languages. The experiments demonstrate that such research (termed "field psycholinguistics") is methodologically, logistically, and culturally feasible, that data from languages exhibiting "exotic" linguistic phanomena can inform processing theory, and that processing data can add useful information to debates regarding the underlying syntax of a language.

First I will begin by describing my assumptions concerning the syntax of Odawa. The Pronominal Argument Hypothesis (PAH) (Jelinek, 1984; Baker 1996) was argued to be unable to easily account for certain configurational aspects of Odawa, such as the fixed word order of subordinate clauses with two overt obviative NPs. I adopted as a configurational alternative to the PAH the analysis by Bruening (2001) for of Maliseet-Passamaquoddy, an Algonquian language related to Odawa. Bruening proposes that a functional head [H] above vP attracts the nearest proximate NP in any transitive clause to check the strong [+PROX] feature (which may be related to or analogous to a case feature). In direct clauses, the proximate NP is the subject/agent; in inverse clauses, it is the inverted object/patient. This results in basic SVO word order in direct clauses, and basic OSV word order in inverse clauses.

Both the production data from Experiment 1 and the comprehension data from Experiment 2 are consistent with this configurational analysis of Odawa. In the production experiment, participants were much more likely to use SVO word order in direct clauses. This preference for SVO order was above and beyond any effect that could have been predicted by the experimental conditions. In Experiment 2, not only did SVO result in the best comprehension in direct sentences, but the OSV order resulted in the best comprehension in inverse sentences. This latter result cannot easily be attributed to the frequency of the OSV order in inverse clauses. No frequency data exist to suggest that OSV is the most frequent order used in inverse clauses. Finally, the broad parsing predictions that could be drawn from a PAH account of Odawa were not supported by the results of Experiment 2, as is discussed in greater detail below.

The goals of Experiment 1 were to collect basic frequency data for the various sentence types and word orders in Odawa, and to address the issue of incrementality in language production. The frequency data were not only important in predicting and interpreting the results of the subsequent comprehension experiments, but also in evaluating the configurational account of Algonquian syntax (based on Bruening [2001]) adopted for Odawa in Chapter 1. The basic SVO word order proposed for independent direct clauses was supported by the production data, as discussed above. In addition, several previous researchers' text-based observations about production patterns in Algonquian languages were shown to be accurate for Odawa oral production as well. First, direct verbs were far more common than inverse verbs. Second, transitive clauses with two overt NPs were much less common than transitive clauses with one or two null pronominals. Third, obviation status was tightly bound to discourse status, such that the more topical NP was more likely to be proximate, and the less topical NP was more likely to be obviative. It was thus the proximate NP, irrespective of grammatical function or thematic role, which was more likely to be *pro*-dropped in any given sentence.

A further interesting implication of Experiment 1 is that the results failed to support a strictly incremental view of language production. Despite the fact that Odawa's flexible word order would allow speakers to place any highly accessible concept sentence-initially without consequently having to use a less frequent verb form, Odawa speakers' sentence production patterns were quite similar to those that have been observed in English. When a thematic patient was topicalized (made more accessible) via a question, Odawa speakers tended to describe line drawings with passive sentences, in which the accessible concept was both syntactic subject and discourse topic. There was no evidence that speakers simply wanted to place the accessible NP string-initially, or to make it the discourse topic without making it also the syntactic subject. These results were interpreted as supporting a model of production in which accessible concepts are preferably mapped into higher syntactic positions. Conceptual/lexical topicalization thus appears to trigger the search for a verb form or syntactic frame that will accommodate this preference. In this way, the data point toward some level of syntactic planning in production.

Experiment 2 was conducted to try to determine the relative effects of verb form, word order, and the distance between thematic assigners and assignees on sentence comprehension. The results were interesting in that they were not entirely consistent with the frequency data gathered in Experiment 1. Instead, the results strongly suggested not only that the configurational account of Odawa syntax adopted here is correct, but also that when Odawa speakers are faced with complex revisions of initial syntactic analyses, they often abandon revision, deriving interpretations instead from heuristic strategies with a "good enough" flavor (Ferreira, in press; Ferreira & Henderson, 1999; Ferreira et al., 2001, 2002).

The first significant result from Experiment 2 was that the data supported the claim that basic word order in direct clauses is SVO, and that basic word order in inverse clauses is OSV. The accuracy of participants' interpretations as measured by a picture verification task was rather robustly predicted by the degree to which other word orders differed from these basic word orders, with respect to the amount of structural revision required to incorporate the input into a licit syntactic structure. When one adverb was included after the initial element, this revision became harder, except in verb-final orders. When two adverbs were introduced, comprehension improved, however, except in verb-final orders, where it decreased. The non-linear effect of distance between thematic assigners and assignees on comprehension was not predicted by any of the theories of sentence comprehension surveyed here (or by the widely held nonconfigurational account of the language's syntax).To account for this pattern of results, I proposed that, when faced with having to revise structure and replace posited null pronominals with overt NPs, the human sentence processing mechanism (HSPM), being a least effort mechanism, prefers to leave initial structural analyses alone if possible and seek an alternate, heuristic, or "good enough" way to derive a plausible interpretation (cf. Christianson et al., 2001). The syntax of Odawa allows speakers to avoid syntactic revision by providing for an appositional or elliptical interpretation of verb-initial and verb-medial sentences in which one or both NPs are separated from the verb by two adverbs, which appears to increase parsing difficulty, as predicted by Gibson's SPLT (1998). In these cases, null pronominals appear to be posited in canonical argument positions as soon as those positions become available in the input string. When overt NPs in non-canonical positions are eventually encountered, they are matched up with the coreferential null pronominals in the structure via a linear heuristic. Interestingly, this heuristic appears to be sensitive to the argument structure of the verb, rather than the phrase structure of the initial parse.

This observation is based on the fact that sentences in which subjects preceded objects were comprehended more accurately than those in which objects preceded subjects, irrespective of the verb form used. According to the account of Odawa syntax adopted here, both direct and inverse verbs assign agent roles to their subjects and patient roles to their objects. But in inverse clauses, the object/patient A-moves to some position higher than the subject [Spec,HP] (i.e., it gets inverted). The heuristic coreferential process which the data obtained in Experiment 2 lead me to propose does not appear to be sensitive to this movement, however. The preference for SO orders over OS orders suggests that the process is sensitive only to the argument structure of the verb, which is the same for both direct and inverse verbs.

In Experiment 3, the focus of attention was on the way in which Odawa speakers would utilize arguably non-syntactic information in deriving an interpretation for sentences containing one null pronominal (*pro*). Also of interest was the extent to which these interpretations could easily be revised when they were discovered to be incorrect.

The results revealed a complex interaction between verb form, the relative discourse status of the overt and null NPs, and the relative animacy of the overt and null NPs. First, participants had more difficulty deciding if drawings presented after each sentence were consistent with the sentence's meaning when the null NP was obviative than when it was proximate. This was interpreted to reflect the close connection between the obviation morphology and the relative discourse status of the NPs. Following Nicol (1988) and García-Albea & Meltzer (1996), it was assumed that speakers of any language faced with locating a referent for a null NP would immediately search the preceding context for an appropriate antecedent. Since the stimuli used here were lacking prior context, it was assumed that the only way participants could assess the discourse status of the NPs was to use features of the overt NP to predict the relevant features of the null NP. One salient feature was the animacy of the NP. When participants were presented with non-canonical combinations of discourse, thematic, and animacy features in the overt NP, they were more likely to predict similarly non-canonical combinations of features of the null NP, and consequently had higher accuracy rates in the picture verification task. When presented with an overt NP with a canonical or expected combination of features, participants were less able to predict non-canonical combinations of features for the null NP, and consequently performed more poorly on the picture verification task. I interpreted this pattern of results as suggesting that when interpretations are built according to heuristics, revision of initial incorrect interpretations proves difficult, despite the relative simplicity of the underlying syntactic analysis and/or reanalysis of the sentence. In this way, the data from Experiment 3 were consistent with those provided by Ferreira (in press) regarding the interpretation of English passives and object-clefts.

5.2 Future Directions

5.2.1 Odawa Syntax

In Chapter 1, as well as throughout the experiments presented here, I relied heavily on Bruening's (2001) account of Maliseet-Passamaquoddy, evoking several similarities between that Algonquian language and Odawa as support for a configurational account of Odawa syntax. Although I do believe that this account of Odawa syntax is correct, I do not want to give the impression that it fits all relevant Odawa data seamlessly, nor that all substantial questions about the syntax of Odawa have been answered. In this subsection, I would like to briefly address some of the central issues, which will occupy my investigations of Odawa in the immediate future.

One of the main premises of Bruening's analysis of Passamaquoddy is that there exists some functional head [H] that checks a strong [+PROXIMATE] feature in Algonquian languages. The movement that results from this feature-checking is posited to be A-movement, which, crucially, in inverse clauses allows the object/patient NP to move from its base position to a position higher than the subject. This movement hase several consequences, including the lack of weak cross-over (WCO) effects in inverse clauses. The movement also allows the patient NP in inverse clauses to become visible to the next phase of the derivation and thus able to raise to object in raising-to-object constructions. Among the evidence for this object inversion in the inverse is the fact that only in inverse clauses can an patient variable bind a null pronominal in a sentential adjunct clause. Both Bruening and Lasnik (2001) point out that it is a reasonable, although not uncontested, assumption that objects in base position are too low to bind into sentential adjuncts. The only way, therefore, for the (variable) object of an inverse to bind into a sentential adjunct is for that object to A-move. (A'-movement does not affect binding in Passamaquoddy or Odawa.)

Variable binding effects have proven to be a useful test when applied to certain Odawa constructions, as well. For example, in Christianson (2002), I argued that the two "passive" constructions in Odawa display very different syntactic properties, in addition to their more obvious morphological differences. It was argued in that paper that the passive signified with the *–igaazo* morpheme ("lexical" passive [Valentine, 2001]) is a true passive, in which the one licensed NP is base-generated in object position. Due to a proposed weak EPP feature, this object does not move to subject position until after spell-out (Chomsky, 1995). As such a variable in this position cannot bind into an adjunct clause, as shown in (5.1). (5.1a) demonstrates how the variable cannot bind a null pronoun, represented by the singular agreement on the subordinate verb. (5.1b) demonstrates that there does exist a licit *coreference* interpretation (signified with italics) between the variable and a plural null pronoun. Bruening argues that this relationship is not one of binding, but of coreference of the sort that holds even across sentence boundaries (Bill *walked in. No one noticed* him *until* he *screamed.*) (Reinhardt, 1983).

(5.1) a. *Gaa-gweya$_i$ gii-jiim-igaa-sii jiibwa gii-gjibowe-yid$_i$

no one 3.PAST-kiss-Pass-Neg before 3.PAST-run.away-3.Sing.Conj

'No one$_i$ ran away before s/he$_i$ was kissed'

b. *Gaa-gweya* gii-jiim-igaa-sii jiibwa gii-gjibowe-*yaad*

no one 3.PAST-kiss-Pass-Neg before 3.PAST-run.away-3.Pl.Conj

'No one$_i$ ran away before they$_i$ were kissed'

In contrast to the *–igaazo* passive, the *-aa-* passive ("inflectional" passive [Valentine, 2001]), which is built with the direct (X>3) morpheme, allows a variable NP to bind a null singular pronoun in an adjunct clause (5.2). This suggests that the NP in these "passives" A-moves to Spec,HP to check its [+PROX] feature. This construction, I argued, is in fact analogous to the English middle, as analyzed by Stroik (1999). In answer to why the syntactic subject of this construction cannot check the [+PROX] feature, I followed Stroik in positing a PRO in subject position, which by assumption is unmarked for the proximate feature. Some support of this analysis can be seen in (5.3), where it is shown that an agentive adverb (Roberts's Type II adverb [1987]) cannot appear in an *–igaazo* construction, but can in an *-aa-* construction, as would be expected if the latter, but not the former, contained a (null) syntactic subject.

(5.2) a. Gaa-gweya$_i$ gii-jiim-aa-sii jiibwa gii-gjibowe-yid$_i$

no one 3.PAST-kiss-Pass-Neg before 3.PAST-run.away-3.Sing.Conj

'No one$_i$ ran away before s/he$_i$ was kissed' (or '...before someone kissed him/her')

b. *Gaa-gweya* gii-jiim-aa-sii jiibwa gii-gjibowe-*yaad*

no one 3.PAST-kiss-Pass-Neg before 3.PAST-run.away-3.Pl.Conj

'No one$_i$ ran away before they$_i$ were kissed' (or '...someone kissed them')

(5.3) a. Maaba kwe-zens gii-gnajiibin-aa wewiib

that woman-diminutive 3.PAST-tickle-Dir.X>3 quickly

'That girl tickled quickly' (as opposed to some other girl who was not ticklish)

b. ??/* Maaba kwe-zens gii-gnajiibin-igaazo wewiib

that woman-Diminutive PAST-tickle-Passive quickly'

'That girl was tickled quickly'

Turning to intransitives, a similar pattern emerges, although intuitions of native speakers are less clear. Unaccusatives (or "undergoer" intransitives) pattern with passives (5.4) (see also Froud, 1998). Detransitivized intransitives pattern with middles (5.5). Intuitions about unergatives (5.6) are murky; so far, one native speaker has said that varible NPs in these can bind null pronouns in sentential adjuncts, one has said they cannot, and two were uncertain.

(5.4) a. *Gaa-gweya$_i$ gii-aakoozi-sii jibwaa gii-gjibowe-yid$_i$

no one 3.PAST-be.sick-Neg before 3.PAST-run.away-3.Sing.Conj

'No one$_i$ was sick before s/he$_i$ ran away'

b. *Gaa-gweya* gii-aakoozi-sii jibwaa gii-gjibowe-y*aad*

no one 3.PAST-be.sick-Neg before 3.PAST-run.away-3.Pl.Conj

'*No one* was sick before *they* ran away'

(5.5) a. Gaa-gweya gii-naadmaa-ge-sii jibwaa gii-gjibowe-yid$_i$

no one 3.PAST-help-Detrans-Neg before 3.PAST-run.away-3.Sing.Conj

'No one$_i$ helped before s/he$_i$ ran away'

b. *Gaa-gweya* gii-naadmaa-ge-sii jibwaa gii-gjibowe-y*aad*

no one 3.PAST-help-Detrans-Neg before 3.PAST-run.away-3.Pl.Conj

'*No one* helped before *they* ran away'

(5.6) a. ?Gaa-gweya$_i$ gii-nokii-sii jibwaa gii-gjibowe-yid$_i$

no one 3.PAST-work-Neg before 3.PAST-run.away-3.Sing.Conj

'No one$_i$ worked before s/he$_i$ ran away'

b. *Gaa-gweya* gii-nokii-sii jibwaa gii-gjibowe-*yaad*

no one 3.PAST-work-Neg before 3.PAST-run.away-3.Pl.Conj

'*No one* worked before *they* ran away'

Let us look now at the Odawa direct and inverse, which are of most relevance with respect to Bruening's analysis. The Odawa data look at present to be extremly consistent with the Passamaquoddy data, and thus supportive of the configurational account assumed here. A variable object in a direct clause cannot bind a pronoun in a sentential adjunct (5.7); a variable object in an inverse clause can (5.8).

(5.7) a. Nini$_i$ gii-jiim-aa-sii-n gaa-gweya$_k$ jiibwa gii-gjibowe-yid$_{i/*k}$

man 3.PAST-kiss-Dir.3>3'-Neg-Obv no one before 3.PAST-run.away-3.Sg.Conj

'A/the man kissed no one before s/he ran away'

b. Nini gii-jiim-aa-sii-n *gaa-gweya* jiibwa gii-gjibowe-*yaad*

man 3.PAST-kiss-Dir.3>3'-Neg-Obv no one before 3.PAST-run.away-3.Pl.Conj

'A/the man kissed no one before they ran away'

(5.8) a. Niniw-an$_i$ gii-jiim-igoo-sii-n gaa-gweya$_k$ jiibwa gii-gjibowe-yid$_{i/k}$

man-Obv 3.PAST-kiss-Inv.3'>3-Neg-Obv no one before 3.PAST-run.away-3.Sg.Conj

'A/the man kissed no one before s/he ran away'

b. Niniw-an gii-jiim-igoo-sii-n *gaa-gweya* jiibwa gii-gjibowe-*yaad*

man-Obv 3.PAST-kiss-Inv.3'>3-Neg-Obv no one before 3.PAST-run.away-3.Pl.Conj

'A/the man kissed no one before they ran away'

Intuitions regarding sentences such as (5.7-5.8) are extremely slippery, though, and I have noticed some inconsistentcies even within speakers. In addition, it is not clear why, for example, proper names in object position of direct clauses seem to be judged as acceptable with singular agreement on the subordinate verb. Or, to take another example, a variable subject (and obviative) in an inverse clause appears not to be able to bind into an adjunct clause (at least according to some speakers). These questions, however, highlight the need for more syntactic investigations in Odawa, especially with respect to the status of subjects and objects, and the ways in which grammatical function might interact with the obviation system. Related to these issues is the status of the direction and/or obviation systems with respect to case (Déchaine & Reinholtz, 1998), since these Algonquian systems appear to have a great deal in common with the case systems of other indigenous North American languages (e.g., Inuktitut) (cf. Bobalijk, 1993).

5.2.2 Sentence processing in other "nonconfigurational" languages

The research presented here represents the first known psycholinguistic study to be carried out in one of the indigenous languages of the Americas. As such, there are many more questions to be answered in future work. For example, along with the 620 sentence tokens of experimental interest collected in Experiment 1, there were also approximately 2,600 descriptions of the filler line drawings collected. At over 3,200 total sentences, this database of spoken Odawa represents one of the largest known corpora of spoken language in an Algonquian language. Research is planned using this corpus to examine the interaction between topic-focus structure, word order, and prosody in Odawa. The systematic, semi-controlled way in which the data were collected makes the corpus particularly well suited to quantitative analyses. The data have also already proven invaluable in addressing questions of age-related language change in this endangered language (Christianson, 2002), and represent a substantial repository of information about the lexicon of a language that will most likely be extinct within the next two or so generations. In order to share these resources with the people of Wikwemikong and the Odawa community at large, I have digitized the spoken corpus and will be providing it along with the stimuli drawings and a copy of this dissertation to the Wikwemikong Band Council. I will also be traveling to Wikwemikong to report the results of the present research in an open forum to the people of the community.

Regarding additional questions that remain to be addressed, the issue of the effect of context on comprehension of sentences like these is particularly interesting. Native Odawa speakers reported that sentences of the sort used in Experiments 2 and 3 seemed somewhat odd out of context; however, when placed in a context, they seemed natural. This state of affairs is not unique to Odawa: Clifton & De Vincenzi (1990), for example, report systematic comprehension errors by Italian speakers when presented with non-contextualized sentences containing *pro*s. There is the possibility that this intuition on the part of native speakers represents a deeper difference between languages with more flexible word order and *pro*-drop and ones with more rigid word order and lacking *pro*-drop. It would be interesting to run Experiments 2 and 3 again, including a short context before each sentence. The context (in Odawa of course) would be something like 'I saw

X'. The subsequent sentence would contain the NP denoting 'X', but its obviation status, position in the sentence, and overt vs. null occurance would vary. In this way, initially posited *pro*s might be easier to revise in certain orders (if they corresponded to the non-topicalized NP), but harder in others (i.e., topicalized NPs occurring late in the sentence).

The data from verb-final sentence processing in Experiment 2 above raise some interesting questions with respect to the strructural requirements for integrating lexical items into the current parse. One current debate in the processing literature has to do with whether or not a licensing lexical head must be encountered before that head's dependents can be integrated into the structure. Ths so-called head-projection strategy has been proposed by, e.g., Abney (1989) and Pritchett (1992).

Some recent research on languages with verb-final orders has questioned the accuracy of strict head projection. In German, in which subordinate clauses are required to be verb-final, Konieczny et al. (1997) found some evidence that ambiguous dative-case NPs in verb-final clauses are reanalyzed as arguments of the verb even before the verb is encountered. The authors also cited data from Bader & Lasser (1994), which showed that German speakers seem to make some strong attachements of (or at least predictions about) NPs before verbs are encountered. Yamashita (2000) obtained similar results in Japanese, another verb-final language. Yamashita found that Japanese speakers appeared to utilize the case-marking of NPs in parsing verb-final sentences, even though the case-marking was ambiguous. Yamashita's subjects were also able to use the ambiguous case-marking surprisingly effectively. These results suggested to Yamashita that perhaps semantic information encoded in the NPs themselves allowed for highly accurate probablistic guesses as to what the eventual grammatical functions (and thematic roles) of the NPs would be. Japanese data presented by Hirose (2002), Kamide & Mitcell (1999), and Miyamoto, Gibson, Pearlmutter, Aikawa, & Miyagawa (1999) also support a strictly incremental parse, whereby each word in the input is incorporated into the structure (i.e., pre-head attachment) before (potentially) disambiguating material is encountered.

Now, recall the SOV and OSV data from Experiment 2 above: It was not clearly the case that inverse verbs were more difficult to integrate into the parse than direct verbs were, despite the fact that inverse forms are so much less frequent in the language than direct forms. Button-press latencies at the verb in SOV and OSV orders (Figures 3.10e-f) showed an advantage for direct forms in both SOV and OSV orders in the 0-adverb condition. In the 1-adverb condition, the direct maintained an advantage in SOV, but not OSV. And there was no difference in the key 2-adverb condition. At the wrap-up region (Figures 3.14e-f), button-press latencies showed the expected advantage for the direct form in both orders in the 2-adverb condition, but no difference in the 1-adverb condition and mixed results in the 0-adverb condition. And finally with respect to accuracy in the picture verification task (Figures 3.3e-f), there was only a slight preference in the SOV order for the direct form in the 2-adverb condition. In OSV order, there was no difference in either adverb condition, and an expected inverse preference at the 0-adverb condition (expected if OSV is the basic inverse word order, as is assumed here). One explanation for these results is that in fact predictions as to grammatical functions and thematic roles of the NPs are either not entertained at all, or at least not weighted very heavily. Only upon encountering the verb are the NPs integrated into the structure. This interpretation, which is consistent with the head projection strategy (but not with the German and Japanese results summarized above), does not handle the 1-adjunct data well, however.

Why should the direct advantage only appear in the 2-adverb condition? Moreover, if integration of the NPs is performed immediately upon encountering the verb, why were there no differences at the verb itself? If, on the other hand, predictions were made earlier as to the status of the ambiguous NPs, and these predictions need to be revised, one would expect to see effects farther downstream in the wrap-up region. An interesting difference between Odawa and German and Japanese is that in Odawa, verb-final orders are optional, whereas in the other two languages, they are manditory. This optionality in Odawa (combined with the properties of the obviation system, as opposed to a clear case-marking system) not only provides a new testing ground in which this issue can be explored. It also raises the possibility that speakers of different languages weight various parsing strategies according to the relative robustness of the available information in their language. The language-specific application of (arguably) universal parsing principles has been proposed by Cuetos & Mitchell (1988), Mitchell, Cuetos & Zagar (1990), and Mitchell et al. (1995) in their so-called "tuning hypothesis."

The role of notional animacy (and syntactic animacy, where animacy is encoded in the grammatical gender system, as it is in Odawa) in sentence processing is intriguing, and can be explored in a number of ways in languages that have yet to be explored by psycholinguists. Minkoff (1994, 2000, 2001) has proposed a theory whereby apparent animacy-based restrictions on subjects observed in many of the world's languages (see §4.2.2) result from an interaction between the syntactic features of certain languages as innate specifications of the HSPM. This view of so-called "animo-asymmetries" represents a processing-based alternative to many current accounts of these phenomena, which place the source of the asymmetries in the grammars of the languages themselves.

As is well documented, speakers of many languages balk at sentences in which a less animate (e.g., animal) subject/agent occurs with a more animate (e.g., human) object/patient. Minkoff's proposal says that this fact derives not from the ungrammaticality of these sentences, but rather the fact that in such cases, speakers of certain languages are torn between conflicting processing requirements: (1) The subject of any transitive verb must be at least as animate as its object; (2) Choose as the subject/agent the NP in canonical subject position; and (3), Choose as the agent the argument that is the most animate potential agent. These requirements conflict in what Minkoff terms "late-decision" sentences with less-animate subjects and more-animate objects. In these, the processor must wait (due to the syntax of the language) to unambiguously determine the subject of the sentence. But when the time comes to do so, it is conflicted between requirements (2) and (3) above. In "early-decision" sentences, the processor can determine the subject of the sentence after encountering only one NP, so the requirements in (2) and (3) do not conflict. However, this characterization of animacy-based restrictions on the co-occurrence of subjects and objects implies a time-course for processing which is not obviously supported by psycholinguistic literature. First, there is good evidence suggesting that thematic roles are assigned as soon as both thematic assigner and assignee are encountered (e.g., Ferreira & Henderson, 1990; Fodor & Inoue, 1998), in an extremely incremental fasion. The results of Experiment 2 above and of De Vincenzi (1991) suggest that in *pro*-drop languages, thematic assignment occurs immediately at the verb (to a *pro*), even when no NP is encountered. Minkoff's proposal that thematic roles are not assigned in late-decision sentences until *both* argument NPs are assigned is not easily amenable to these data. Second, there is no online data to support the claim that speakers of "late-decision" languages actually find animo-asymmetric sentences ambiguous while they are waiting for the second NP in the input. It could be that speakers initially incorrectly assign a thematic role at the verb, and then need to revise this assignment when a more animate NP is encountered. If true, however, the question arises again why certain languages prohibit (or at least are not amenable to) such revision, while others (which do not display animo-asymmetries, like English) do not. As pointed out in Chapter 4, Odawa appears to contain some animo-asymmtrical phenomena, but may not be suitable for testing Minkoff's theories experimentally. The research presented here does, however, demonstrate that psycholinguistic investigations in "exotic" languages in remote locations are feasible to conduct. Without such investigations, it is very difficult to judge the merits of theories that include processing components.

The data from Experiment 3 also seem to suggest that in at least some areas of sentence processing, an optimality-theoretic account may be useful in understand the ways in which various factors influence sentence interpretation. As proposed in Christianson (2001a, b, in press), Optimality Theory (Prince & Smolensky, 1993) has potential to account for and predict the features relevant to Odawa speakers during sentence production, when they are deciding which of two overt third-person NPs should be proximate and which should be Obviaitive. Constraints similar to the ones proposed in that previous work might be applicable in sentence comprehension as well, when listeners are trying to establish the referent for a null pronominal. Error rates should be predictable based on the number of constraints violated in any given context/sentence. Using the results from Experiment 3 as a starting point, the first step in this line of inquiry will be to determine the nature of the constraints and their ranks with respect to each other.

Perhaps the largest question raised by the present research has to do with the nature and cognitive status of so-called "good enough" processes in sentence comprehension. I have proposed above (and in previous research, see Christianson et al., [2001]) that when the human sentenc processing mechanism (HSPM) becomes overly burdened, sentence interpretations can be derived that are not necessarily faithful to the content of the input. The means by which these interpretations are derived, however, appear at present to consist of a number of heuristics, such as lexical and structural frequencies, verb argument structure, linear strategies, plausibility, etc. Major questions need to be answered before a "good enough" mechanism or "shallow processing" (Barton & Sanford, 1993) mode can be seriously recognized as part of the HSPM (or as part of the HSPM's interpretive component). One such question has to do with what constitues a sufficient trigger for shallow processing to take over. Perhaps, as suggested by Townsend& Bever (2001), some sort of pseudo-parse runs concurrently with a structurally determined parse. In situations when the stuructral parser runs into difficulty, the pseudo-parser keeps working, overtaking the structural parse and outputting an interpretation first, which is checked against the output of the structural parser only if time and/or resources permit. Alternatively, the shallow processor might be triggered by processing difficulty imposed by structural complexity or memory burden. When the shallow processor is initiated, the structural parse is simply abandoned, not to be re-started unless the interpretation computed by the shallow processor seems incongruent with the context or one's world knowledge. One intuitively appealing aspect of this "good enough" processing is that it seems to rely on the same sorts of contraints as constraint-based models of processing (e.g., MacDonald, et al., 1994). If the "good enough" or shallow processor runs concurrently with the structural parser, it would explain why, under certain circumstances, the effects of context, frequency, etc. appear to affect the earliest stages of the parse (cf. Tanenhaus et al., 1995), while under other circumstances they do not (cf. Frazier, 1995).

Interestingly, the present research began as an attempt to better understand how speakers of an apparently exotic type of language go about producing and comprehending sentences that, on the surface, appear quite different from those that generally serve as the focus of psycholinguistic investigations. The results obtained in the experiments reported here, however, paint a picture of "nonconfigurational" sentence processing that is not much different from "configurational" sentence processing. And of course, this is not surprising, given that I have argues that Odawa syntax is configurational. Just as a restricted number of basic, universal linguistic principles are manifested by various means in the world's languages, it seems that the HSPM is also determined by the cogitive architecture common to all humans. This dissertation research, along with previous related research, has shown in particular that the extent to which syntactically-driven initial parses can be successfully revised is limited by the computational complexity of the syntactic revisions, perhaps universal limitations and coping strategies of the HSPM, and the requirements of real-time communication. What remains to be seen is how the various "exotica" specific to any given language are accommodated by the processing mechanisms that are taken here to be universal.

Appendix A

Instructions for Experiment 1 (Odawa "P" Experiment)
and Experiments 2 and 3 (Odawa "C" Experiment)

Odawa "P" Instructions
(Production Experiment)
(to be presented in English and/or Odawa, depending on the wishes of the participant)

Thank you for agreeing to participate in this experiment. Your session will last approximately one hour, and you will be paid $20 (Canadian) for your time. You are free to quit at any time, and you will still receive payment.

I am investigating language production (speech). In order to do this, I am collecting Odawa descriptions of simple drawings. During your session, you will hear a question and then be shown a drawing. Please state in one sentence what is happening in the drawing you see. Describe each drawing as if you were describing it to someone who could not see it. Begin your description as soon as you can after you are shown the drawing. Your descriptions will be recorded on tape.

We will begin with several practice trials. If you have any questions, please ask. We will continue the practice trials until you fee comfortable with the procedure.

Thank you again for your participation!

Odawa "C" Instructions
(to be presented in English and/or Odawa, depending on the wishes of the participant)

Thank you for agreeing to participate in this experiment. Your session will last approximately one hour, and you will be paid $20 (US) or $30 (Canadian) for your time. You are free to quit for any reason at any time, and you will still receive payment.

I am investigating language comprehension. In order to do this, I am comparing various Odawa descriptions of simple drawings. During your session, you will hear a number of sentences through headphones connected to a laptop computer. The sentences will be played one word or phrase at a time. After you have understood each word or phrase, press the CENTER button on the button box (marked with an arrow) to hear the next word or phrase.

When you press the CENTER button after the final phrase of the sentence, a drawing will appear on the computer screen. If the sentence that you heard was an accurate description of the drawing that you see, press the YES button (far left) on the button box. If the sentence that you heard was not an accurate description of the drawing that you see, press the NO button (far right) on the button box. Some drawings will match the sentence that you heard, some will not. After you have pressed either YES or NO, the picture will disappear and instructions will appear telling you to press the SPACE BAR on the computer to go to the next sentence. When you are ready for the next sentence, press the SPACE BAR. There will be a short pause, and another sentence will begin.

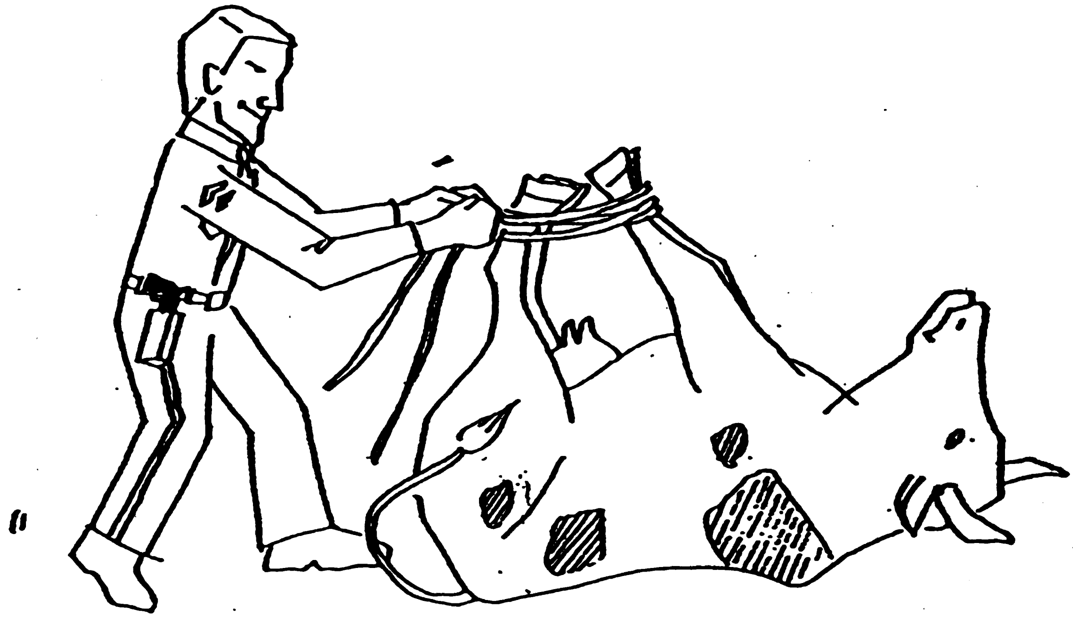
Some of the sentences you hear may sound odd, or seem to describe things that would not normally happen in the real world, but do not worry about that. Just do your best to understand each one and decide if the sentence you heard describes the drawing you see.

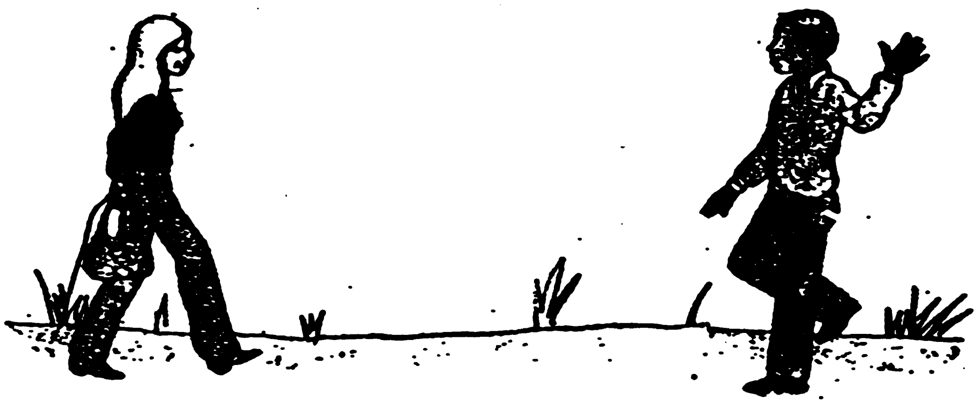
We will begin with several practice trials. If you have any questions, please ask. We will continue the practice trials until you feel comfortable with the procedure.

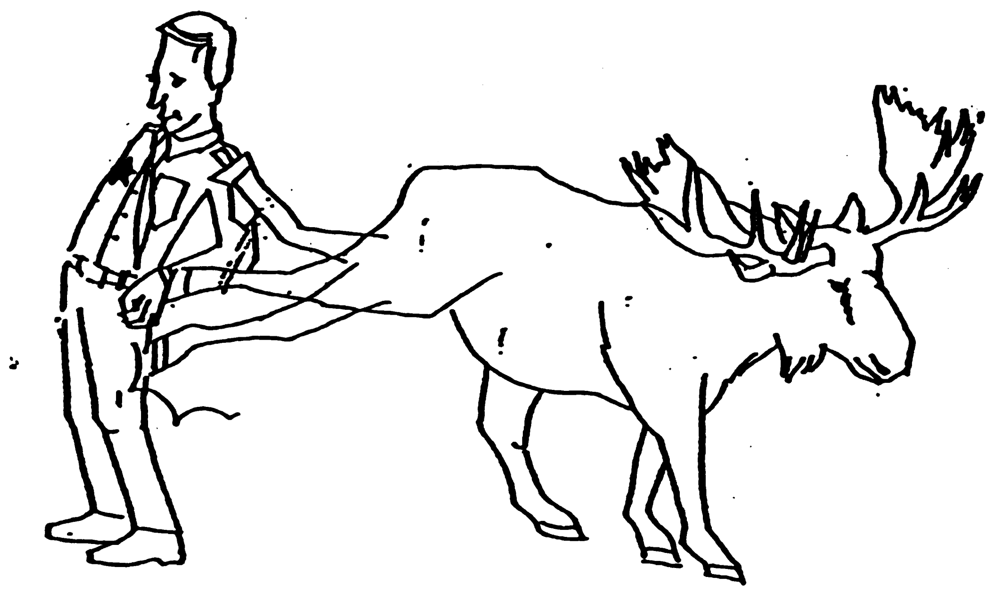
Thank you again for your participation!

Appendix B

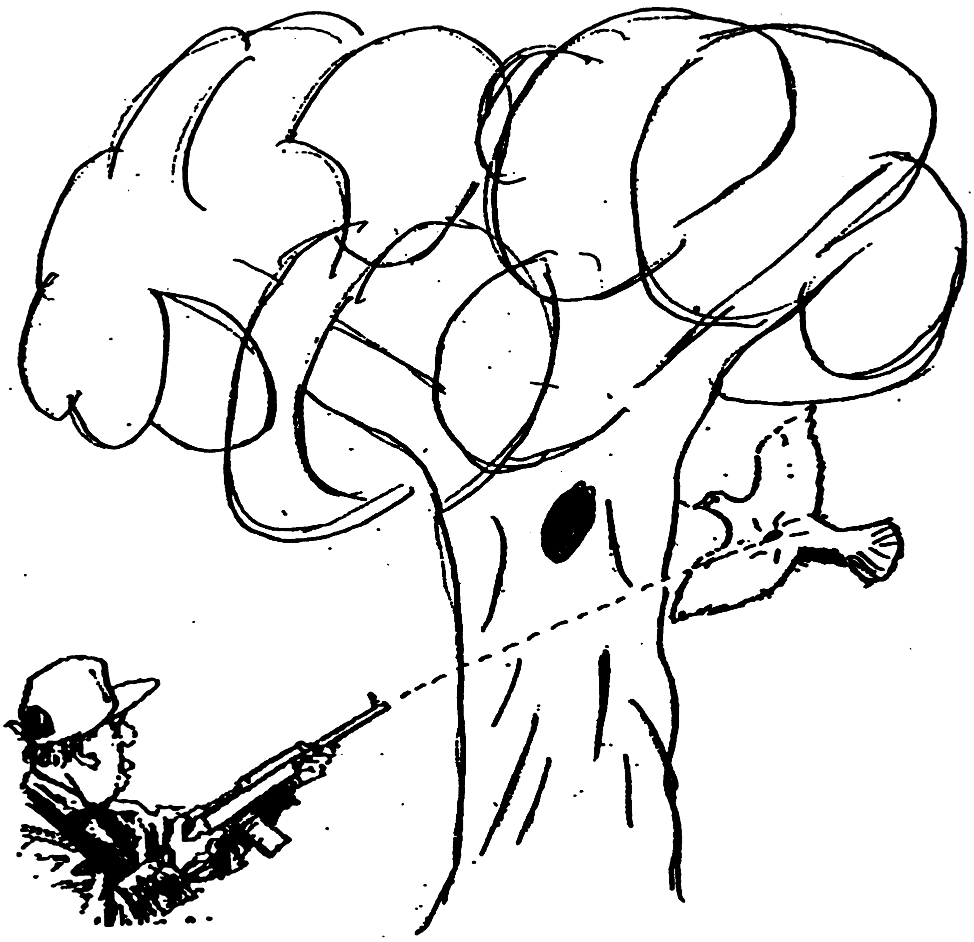
Stimuli for Experiment 1 (33 drawings)

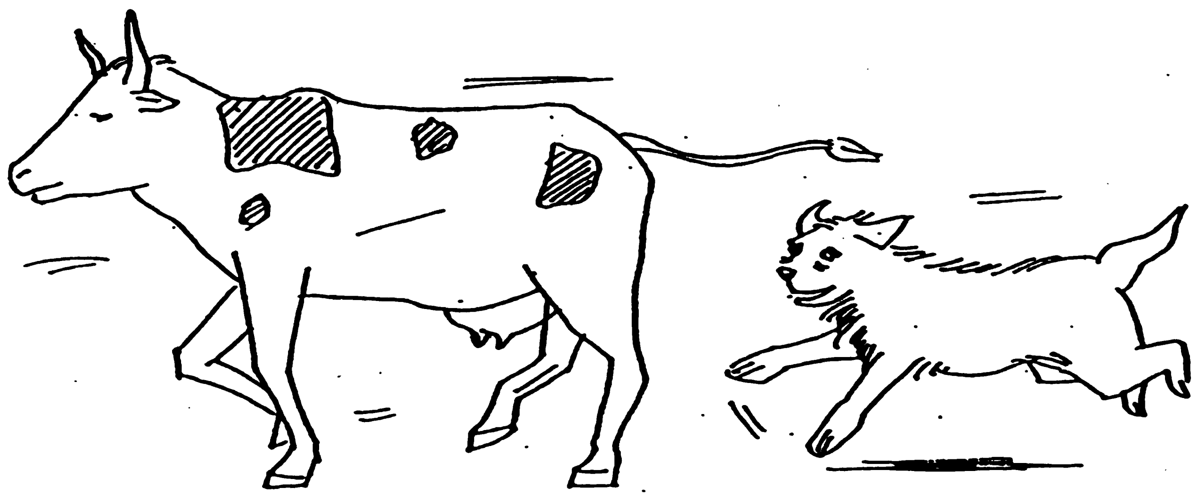


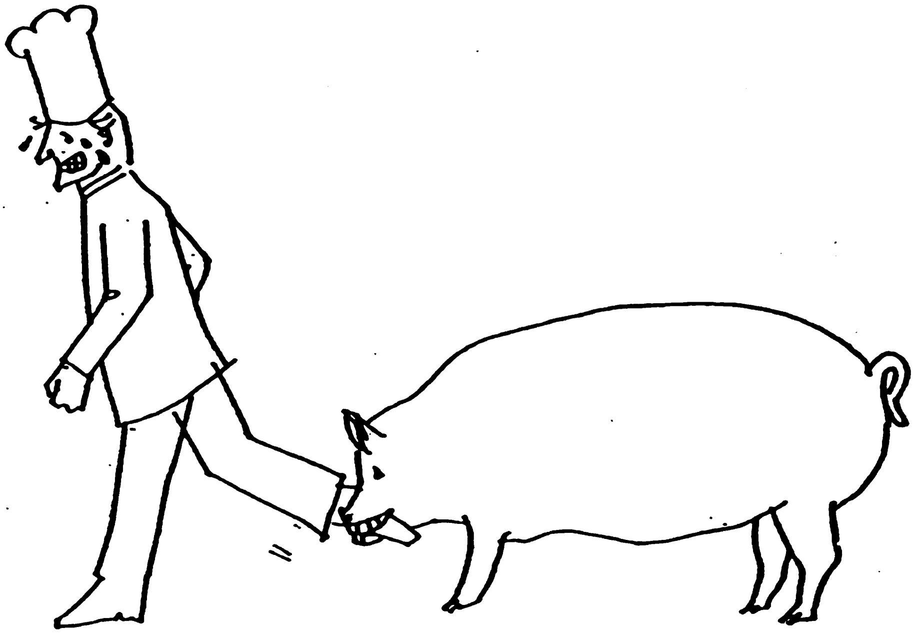




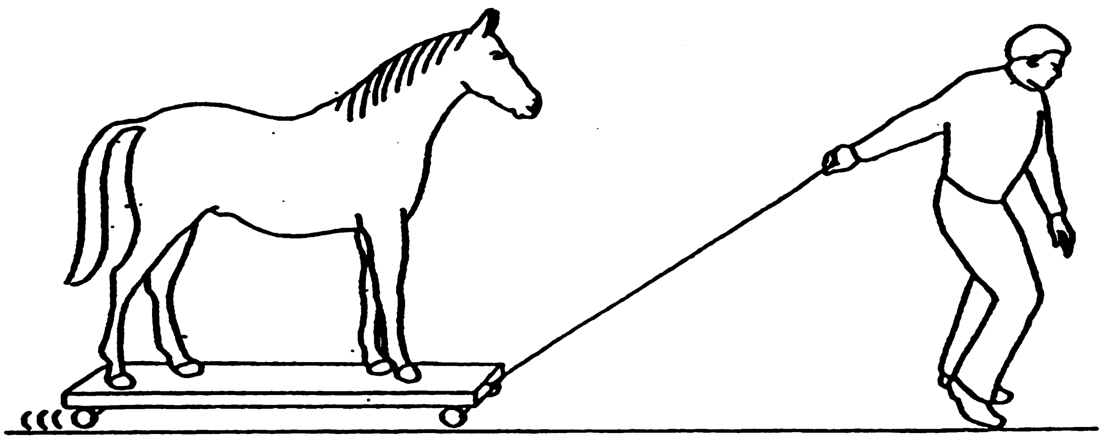
DRAWING OF A BOY SPRAYING A WOMAN WITH WATER NOT AVAILABLE







DRAWING OF A MAN DRESSING A BOY UNAVAILABLE



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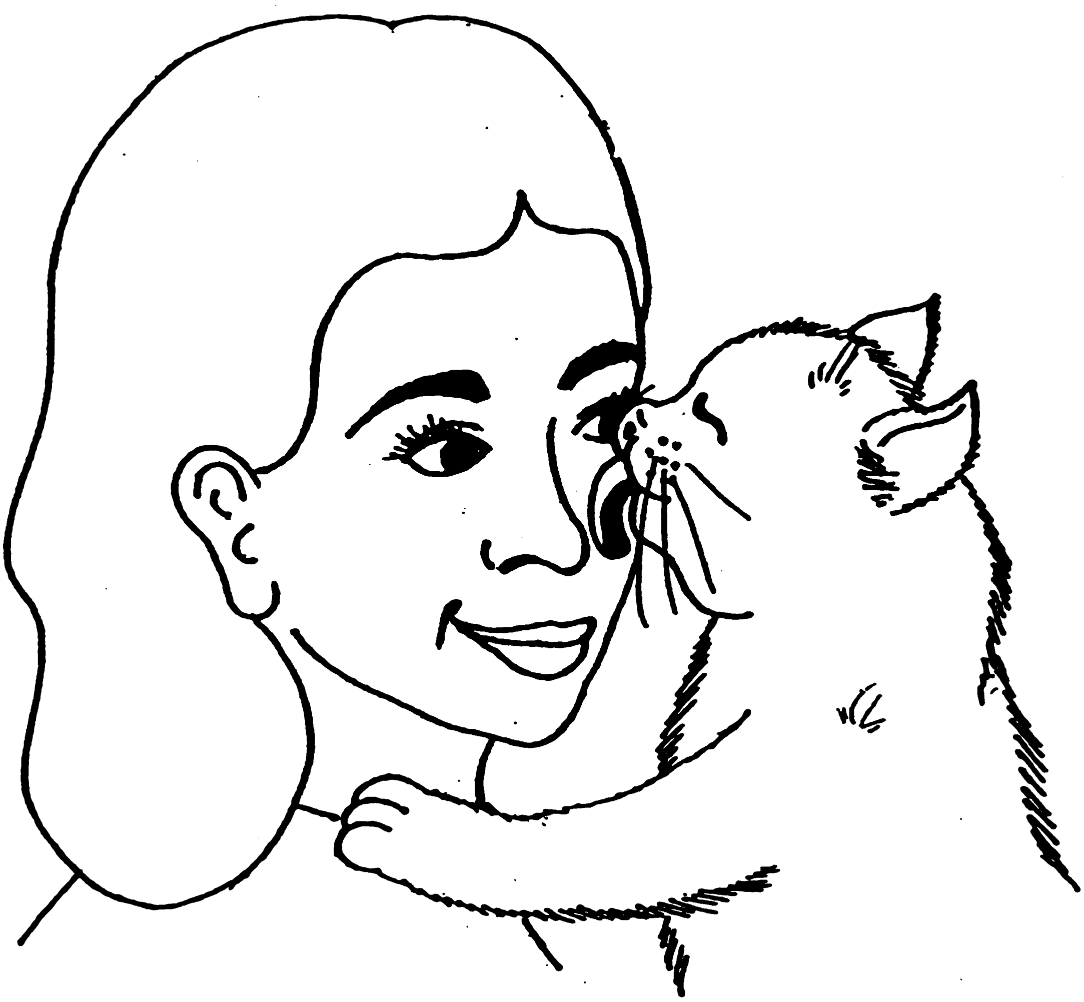
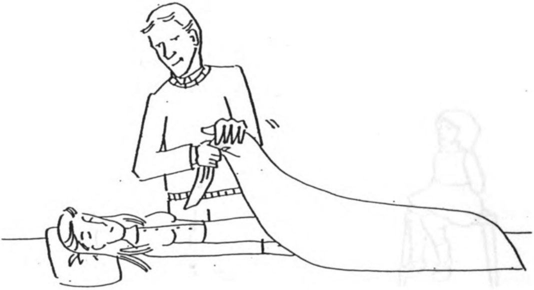
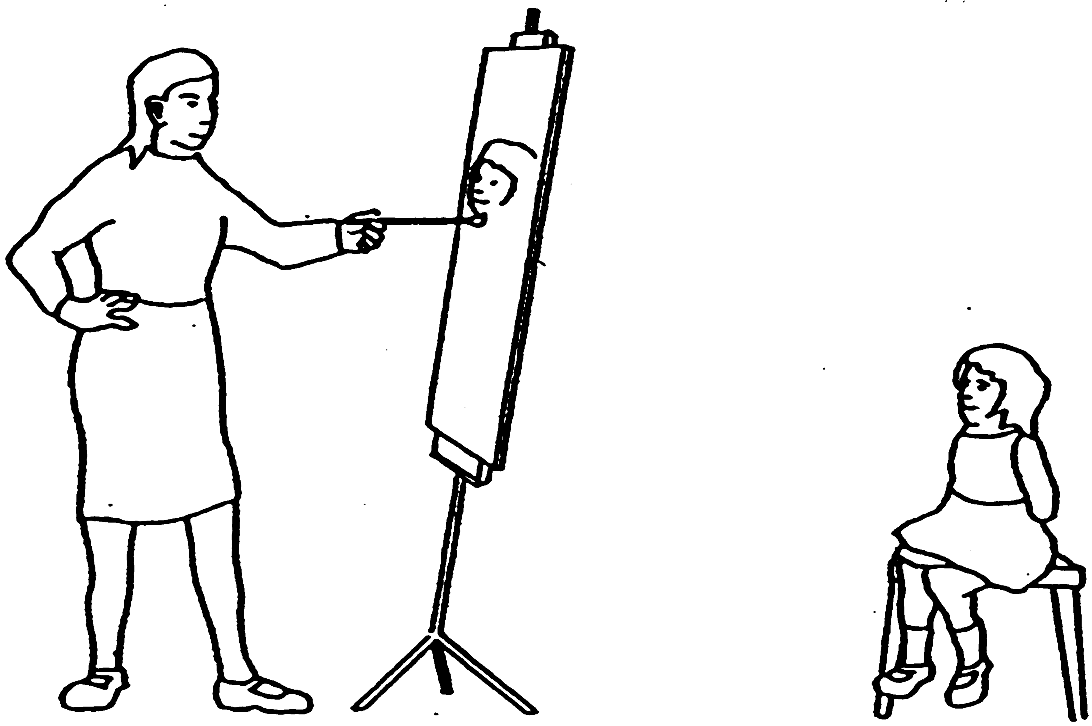
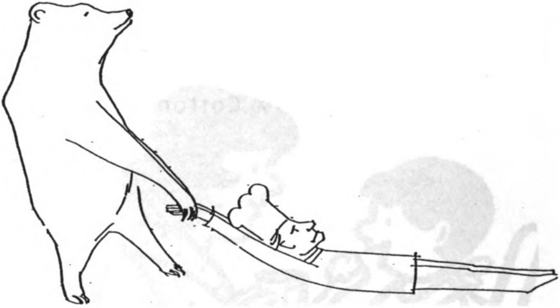








Appendix C

Stimuli for Experiment 2 (sentences and drawings)

and

Stimuli for Experiment 3 (sentences and drawings)

THESIS

Experiment 2: Stimuli with word-by-word translations (A=agent, P=patient, D=direct, I-inverse)

1 gii-jiismaabinaan gwiizens kwezensan ndinendam 'pinched-D boy-A girl-P'

2 nini gii-gozhe'aan kwewan ndinendam 'man-A cover-D woman-P'

3 kwe kwezensan gii-mzinbii'aan ndinendam 'woman-A girl-P draw-D'

4 gii-tikomigoon gnebigan gaazhag ndinendam 'bite-I snake-A cat-P'

5 gwiizensan gii-zegegoon nini ndinendam boy-A frightened-I man-P'

6 niniwan kwe gii-mnaa'igoon ndinendam 'man-A woman-P give drink-I'

7 gii-nooskwanaan mkwan waashkesh ndinendam 'lick-D bear-P deer-A'

8 mooshweniniwan gii-mznaazowaan dakoniwinini ndinendam 'barber-P photograph-D cop-A'

9 mkwan mooz gii-nsaan ndinendam 'bear-P moose-A kill-D'

10 gii-bnebnigoon kwe niniwan ndinendam 'choke-I woman-P man-A'

11 gwiizens gii-ziigwepidaa'igoon kwezensan ndinendam 'boy-P spray-I girl-A'

12 gwiizens binoojinsan gii-jiimigoon ndinendam 'boy-P baby-A kiss-I'

13 gii-binaan zhmaaganish mashkikininiwan mii sa genii gaa-goowaanh 'lift up-D soldier-A doctor-P'

14 kwe gii-dbaabiignaan mashkikininiwan mii sa genii gaa-goowaanh 'woman-A weighed-D doctor-P'

15 gookookhoo mgiziwan gii-miigaanaan mii sa genii gaa-goowaanh 'owl-A eagle-P fight-D'

16 gii-bakskingwe'igoon gwiizensan kwezens mii sa genii gaa-goowaanh 'slap-I girl-P boy-A'

17 dakoniweniniwan gii-bashkezwigoon zhmaaganish mii sa genii gaa-goowaanh 'cop-A shoot-I soldier-P'

18 zhagaagwan mik gii-gzhipinigoon mii sa genii gaa-goowaanh 'skunk-A beaver-P scratch-I'

19 gii-nimkowaan zhigeniniwan binoojiins mii sa genii gaa-goowaanh 'wave to-D construction worker-P baby-A'

20 niniwan gii-bwaanaan kwe mii sa genii gaa-goowaanh 'man-P dream about-D woman-A'

21 niniwan kwe gii-bjibwaan mii sa genii gaa-goowaanh 'man-P woman-A stab-D'

22 gii-mnashkawigoon bizhiki gookooshan mii sa genii gaa-goowaanh 'chase-I cow-P pig-A'

23 mooz gii-dankskwigoon bezhgoognzhiin mii sa genii gaa-goowaanh 'moose-P kick hard-I horse-A'

24 nini kwewan gii-giikaamigoon mii sa genii gaa-goowaanh 'man-P woman-A yell at-I'

25 gii-tokinaan jinaago kokodakenini gigoonhkeniniwan gii-keda Maanii 'carry-D yesterday baseball player-A fisherman-P'

26 mshkikininikwe daabaaning gii-aptojinaan shoskwadeniniwan gii-keda Maanii 'nurse-A near-the-car hug-D hockey player-P'

27 gookoosh oosnaago mashtaanishan gii-moomaan gii-keda Maanii 'pig-A the-other-day goat-P carry-on-back-D'

28 gii-gaasgnoota'igoon jiibakwegamigong giiseniniwan dwechigeninikwe gii-keda Maanii 'whisper-to-I in-the-kitchen hunter-A female-musician-P'

29 gaagwan mtigong gii-bwaanigoon baakaakwenh gii-keda Maanii 'porcupine-A in-the-tree dream-about-I chicken-p'

30 bineshinsan megwegemewang jidimooh gii-mnashka'igoon gii-keda Maanii 'bird-A in-the-rain squirrel-P chase-I'

31 gii-ngamtowaan jiinaago mzinbiigeniniwan ktegenini gii-keda Maanii 'sing-to-D yesterday artist-P farmer-A'

32 shoskwadeniniwan gdaake gii-mbinaan zhigenini gii-keda Maanii 'hockey-player-P on-the-hill lift-up-D construction-worker-A'

33 gwiizensan oosnaago binoojins gii-boojaapinaan gii-keda Maanii 'boy-P the-other-day baby-A poke-in-the-eye-D'

34 gii-giikaamigoon ziibiiying dakoninini gigoonhkeniniwan gii-keda Maanii 'yell-at-I by-the-river cop-P fisherman-A'

35 mik ziibiinsing gii-tikomigoon niimoonsan gii-keda Maanii 'beaver-P by-the-stream bite-I puppy-A'

36 bizhikiwan dibikong mashtaanish gii-ptakshkegoon gii-keda Maanii 'cow-A last-night goat-P bump-into-I'

37 gii-webinaan mtigong kwezens gwiizensan ndinendam 'swing-D by-the-tree girl-A boy-P'

38 gigoonhkenini jiigeskodeng gii-naadmowaan zhigeniniwan ndinendam 'fisherman-A by-the-fire help-D construction worker-P'

39 dakoniwinini kchisinging giiseniniwan gii-bashkezowaan ndinendam 'cop-A by-big-rock hunter-P shoot-D'

40 gii-bangdebe'igoon daabaaning mooshweniniwan mzinaazogenini ndinendam 'hit-on-head-I by-the-car barber-A photographer-P

41 kokodakeniniwan dibikong gii-gnowaamigoon mzinbiigenini ndinendam 'baseball player-A last-night watch-I artist-P'

42 jidimoohsan ziibiinsing baakaakwenh gii-wiikibinigoon ndinendam 'squirrel-A by-the-stream chicken-P pull-I'

43 gii-tsakwe'aan jiibakwegamigong kwezensan kwe ndinendam 'comb-D in-the-kitchen girl-P woman-A

44 ktegeniniwan kchisining gii-mna'aan gwiizens ndinendam 'farmer-P by-the-big-rock give-drink-D boy-A'

45 gaazhagwan zhebaa zhagag gii-nsaan ndinendam 'cat-P this-morning skunk-A kill-D'

46 gii-ngamta'igoon jiigbiik jiibakwnini mashkikininiwan ndinendam 'sing-to-I on-the-beach cook-P doctor-A'

47 mkwa megwegemewang gii-moomigoon gookoshan ndinendam 'bear-P in-the-rain carry-on-back-I pig-A'

48 zhmaaganish jiinaago dwechigeniniwan gii-dbaabiiginigoon ndinendam 'soldier-P yesterday musician-A measure-I'

49 gii-nagaabinaan oosnago ziibiiying gigoonhkenini giiseniniwan gii-keda Maanii 'stopped-D the-other-day by-the-river fisherman-A hunter-P'

50 bezhgoognzhii zhebaa megwegemewang gii-digishkowaan bizhikiwan mii sa genii gaa-goowaanh 'horse-A this-morning in-the-rain kicked-D cow-P'

51 jidimooh oosnago mtigong zhagaagwan gii-aptojinaan ndinendam 'squirrel-A last-night by-the-tree skunk-P hugged'

52 gii-giikaamigoon jinaago jiibakwegamigong binoojinsan kwezens gii-keda Niksan 'yelled-at-I yesterday in-the-kitchen baby-A girl-P'

53 nimoonsan oosnago daabaaning gii-nooskwanigoon gaazhagens mii sa genii gaa-goowaanh 'puppy-A the-other-day by-the-car licked-I kitten-P'

54 mshkikininiwan zhebaa kchisining zhigenini gii-midaabaanigoon ndinendam 'doctor-A this-morning by- -big-rock construction-worker-P dragged-I'

55 gii-mzinazowaan jinaago jiigeskodeng gookooshan nimoons gii-keda Maanii 'photographed-D yesterday by-the-fire pig-P puppy-A'

56 kwezensan oosnago jiigibiik gii-moomaan gwiizens mii sa genii gaa-goowaanh 'girl-P the-other-day on-the-beach carried-on-back-D boy-A'

57 gookookhoowan dibikong mtigong gaag gii-ngamtowaan ndenemdan 'owl-P last-night in-the-tree porcupine-A sing-to-D'

58 gii-wiikbinigoon zhebaa ziibiiying mkwa kaadi-gnebigwan gii-keda Maanii 'pulled-I this-morning by-the-river bear-P crocodile-A'

59 ktegenini jinaago megwegemewang gii-bangdebe'igoon zhmaaganishan mii sa genii gaa-goowaanh 'farmer-P yest. in- -rain hit-on-head-I soldier-A'

60 mashkikinini oosnago daabaaning jiibaakweniniwan gii-bjibwa'igoon ndinendam 'doctor-P the-other-day by-the-car stabbed-I baker-A'

61 gii-bashkezowaan dibikong mtigong kwe niniwan gii-Maanii 'shot-D last-night by-the-tree woman-A man-P'

62 baakaakwenh zhebaa gdaake gii-dbaabiiginaan mikwan mii sa genii gaa-goowaanh 'chicken-A this-morning on-a-hill measured-D beaver-P'

63 mzinbiigenini jinaago jibaakwegamigong mshkikininikwewan gii-jiimaan ndenedam 'artist-A yesterday in-the-kitchen nurse-P kissed'

64 gii-gnowaamigoon oosnago ziibiinsing mashtanishan waashkesh gii-keda Maanii 'watched-I the-other-day by-the-stream goat-A deer-P'

65 waashkeshwan dibikong megwegemewang gii-tikomigoon gookoosh ndinendam 'deer-A last-night in-the-rain bit-I pig-P'

66 gwiizensan zhebaa kchisining kwezens gii-nimkaa'igoon mii sa genii gaa-goowaanh 'boy-A this-morning by-the-big-rock girl -P waved-to-I'

67 gii-ptakshkowaan jinaago jiigibiik gigoonhkeniniwan mzinazogenini gii-keda Maanii 'bumped-into-D yesterday on-beach fisherman-P photog.-A'

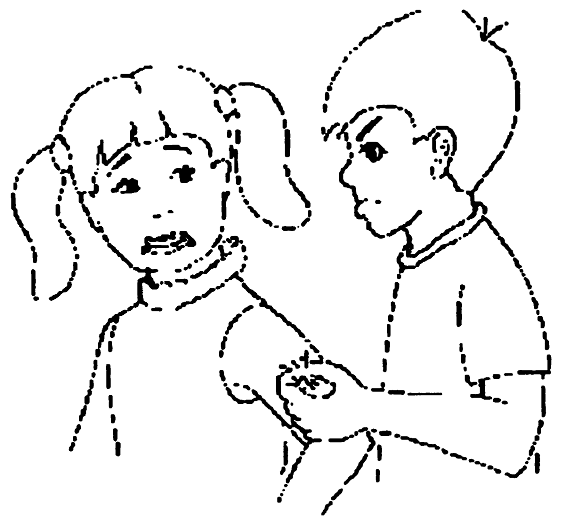
68 mooskadoowan oosnago mtigong gii-ziigwepidowaan waabgonoojiinh mii sa genii gaa-goowaanh 'turtle-P -other-day by -tree squirted-D mouse-A'

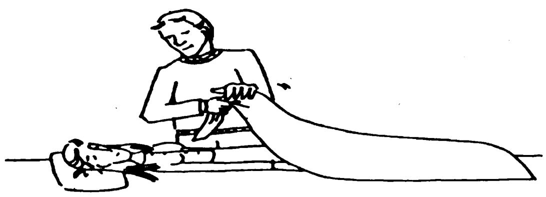
69 niniwan dibikong jiigeskodeng dwechigeninikwe gii-mnashkowaan ndinendam 'man-P last-night by-the-fire female-musician-A chased-D'

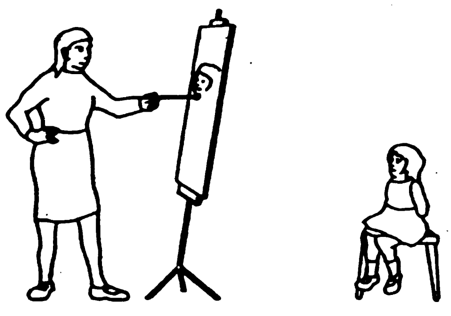
70 gii-mbinigoon zhebaa jiibakwegamigong dakonwnini kokodakeniniwan gii-keda Maanii 'lift-up-I this-morning in- -kitchen cop-P B-ball-player-A'

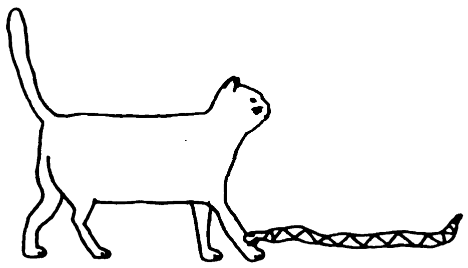
71 gnebig jinaago daabaaning gii-mnashka'igoon mikwan mii sa genii gaa-goowaanh 'snake-P yesterday by-the-car chased-I beaver-A'

72 mgizi oosnago kchisining bizhikiwan gii-gaasgnoota'igoon ndinendam 'eagle-P the-other-day by-the-big-rock cow-A whispered-to-I'

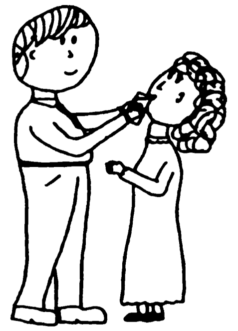




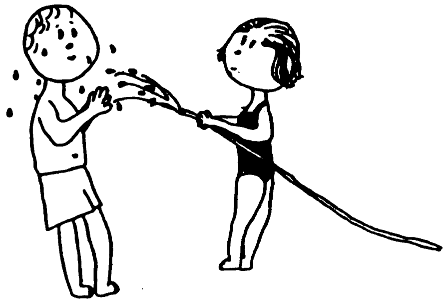


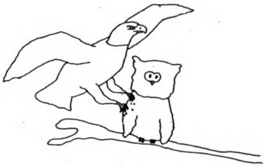


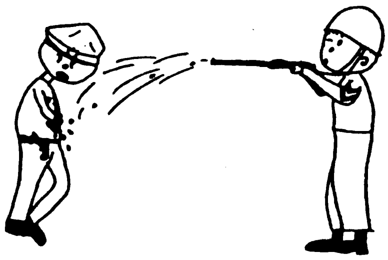
DRAWING # 5 OF A BOY FRIGHTENING A MAN NOT AVAILABLE

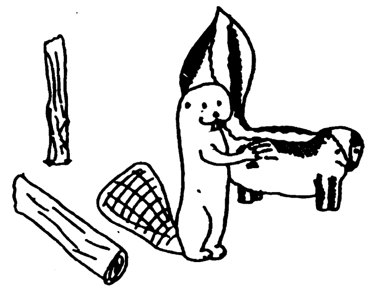


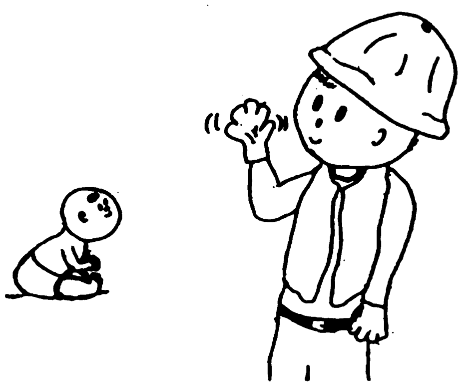
 

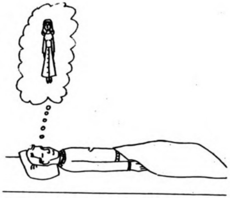


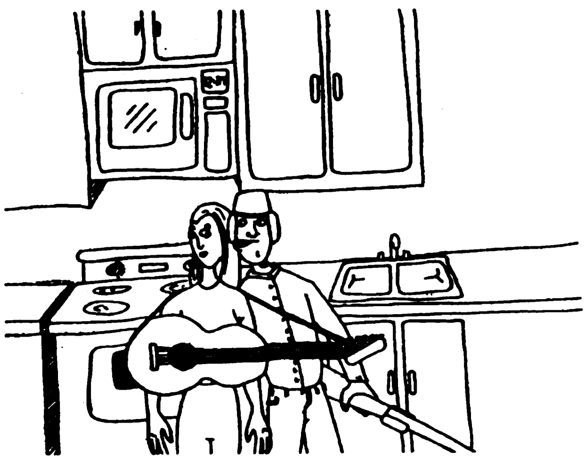


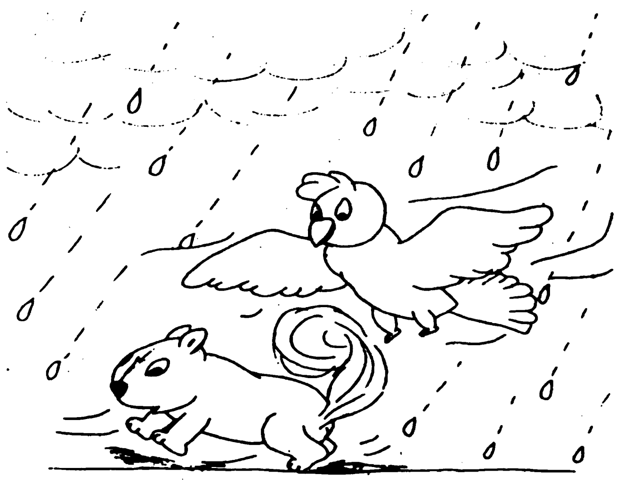


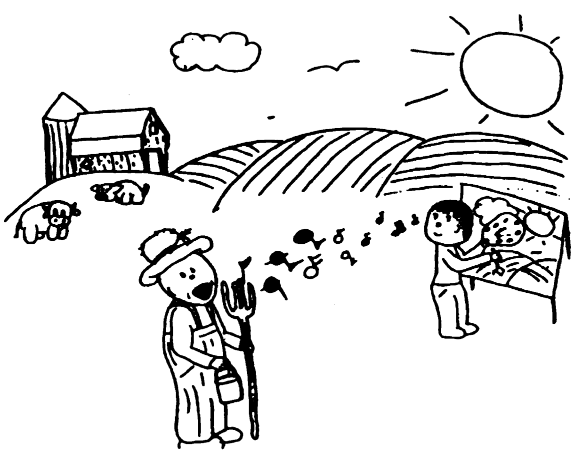


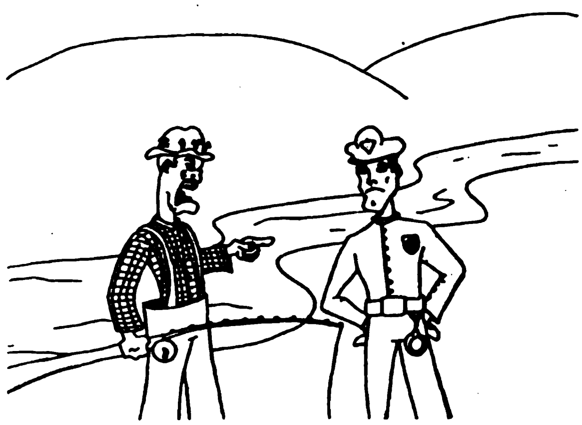


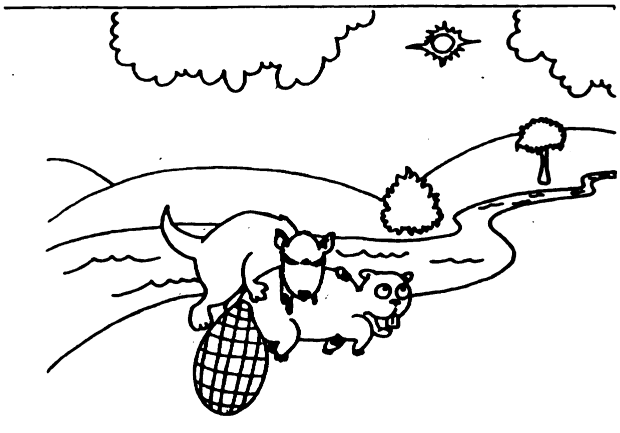


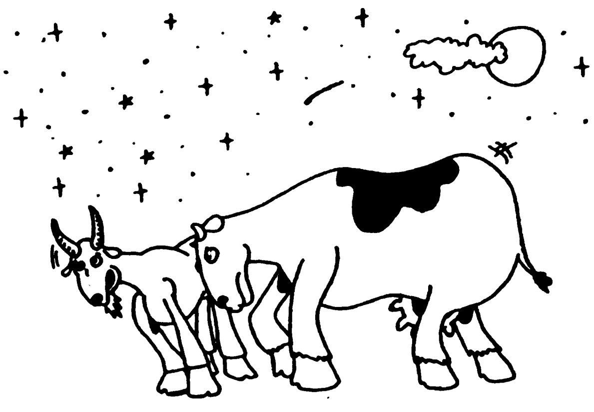


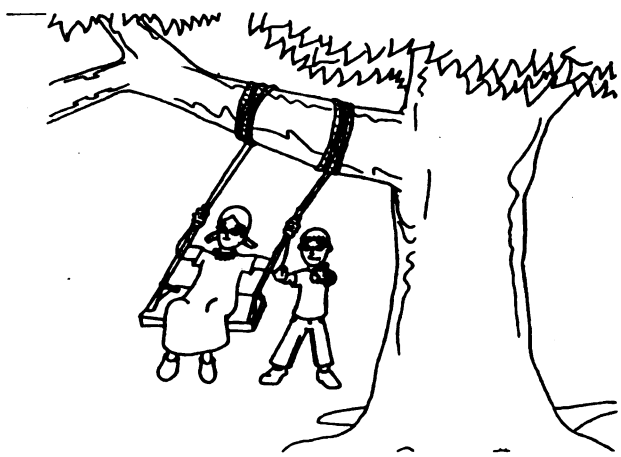












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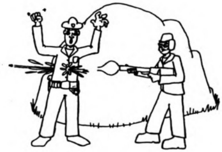
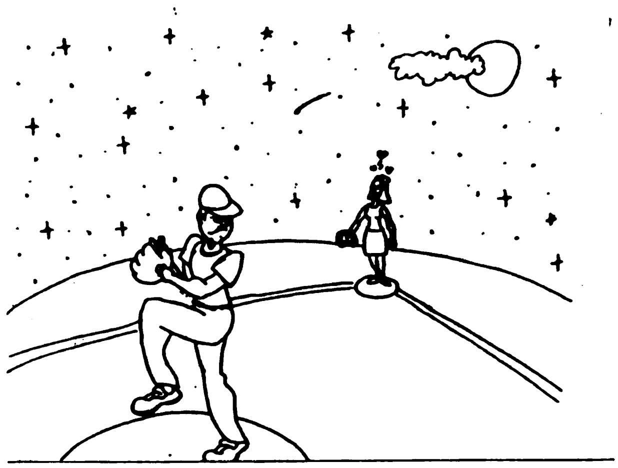
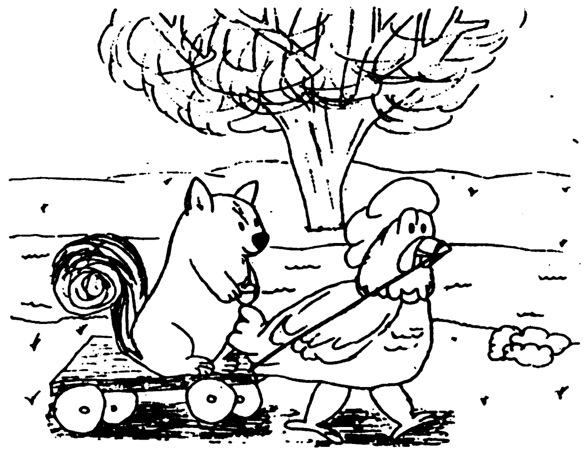
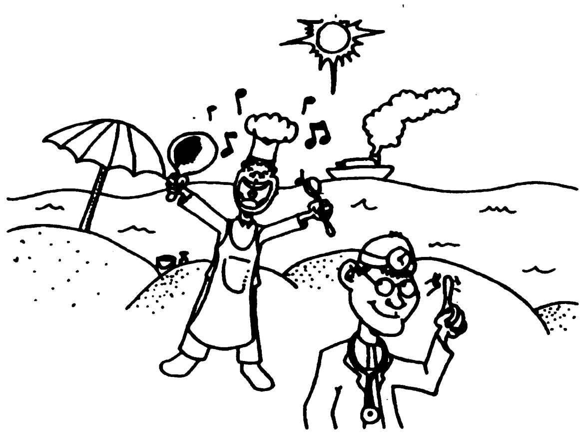
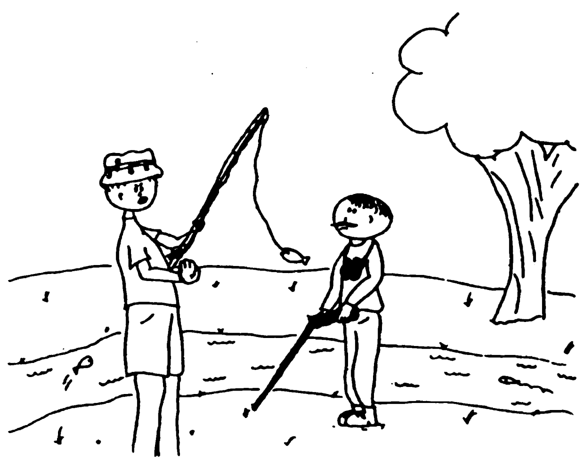
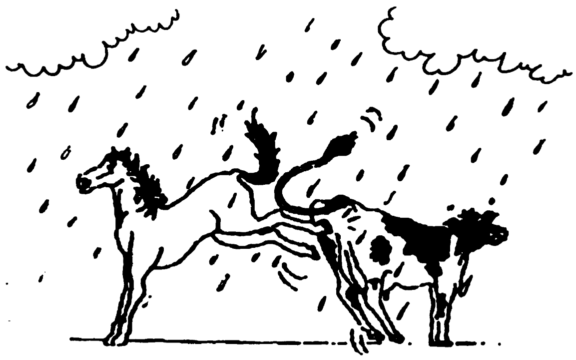


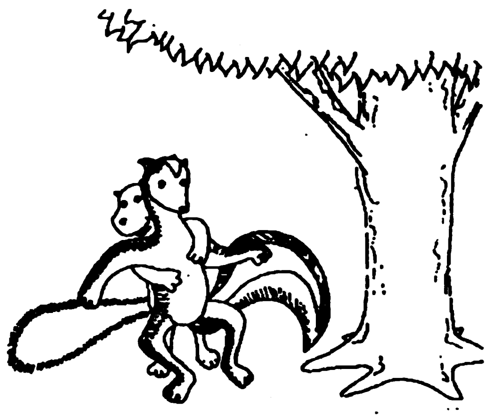


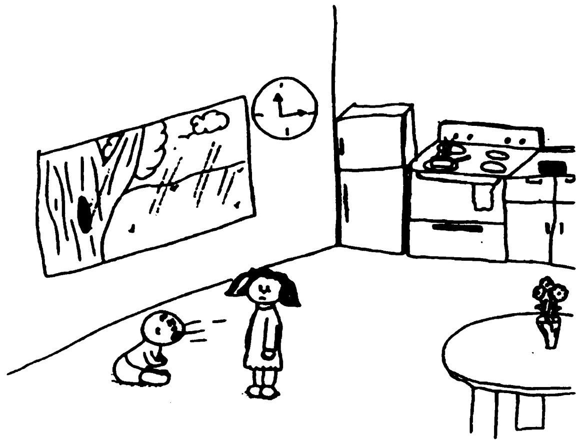


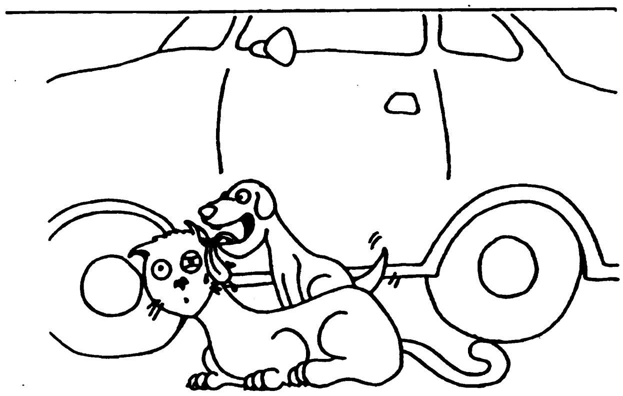


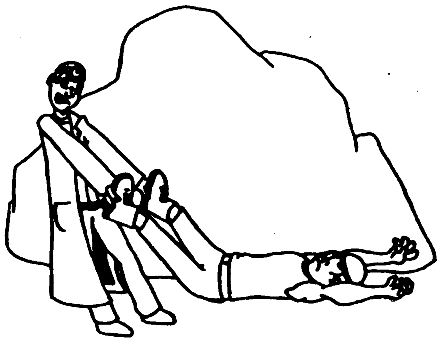


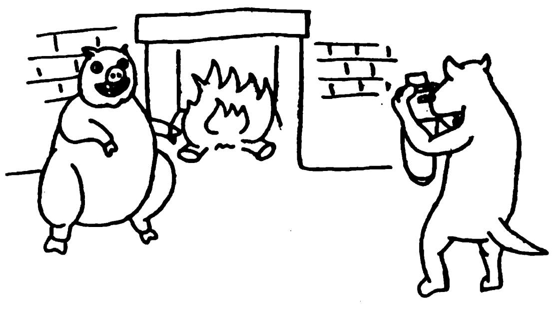


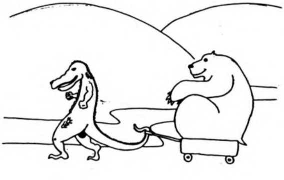


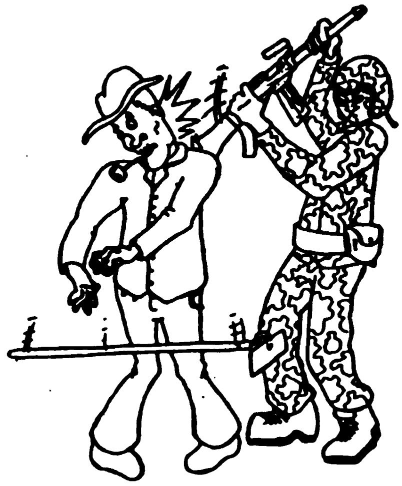


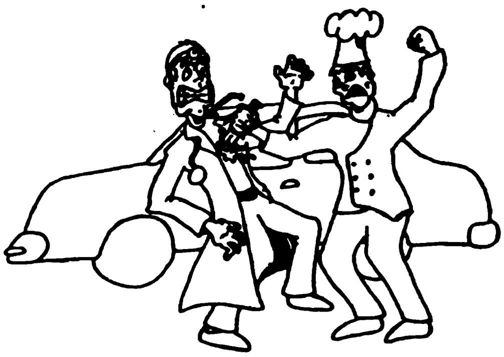


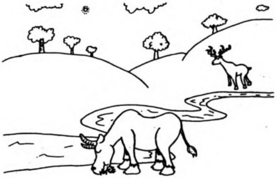


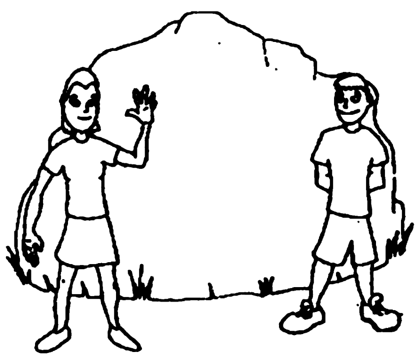


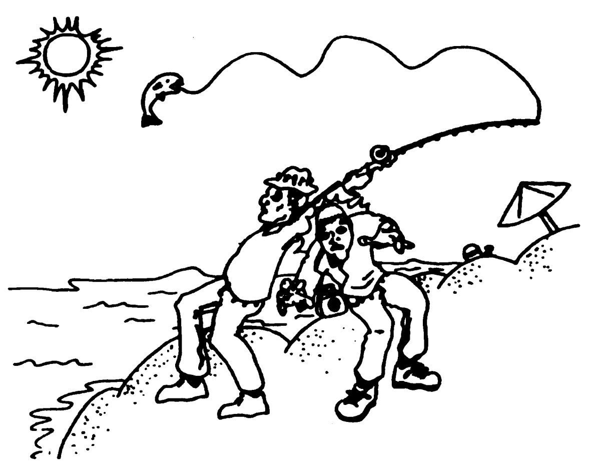


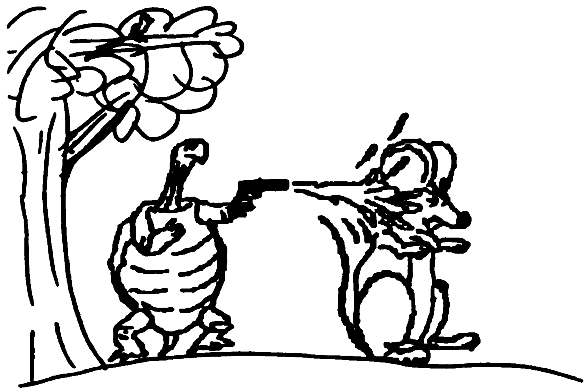


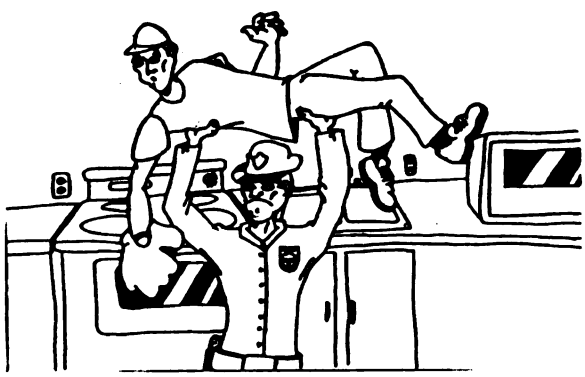


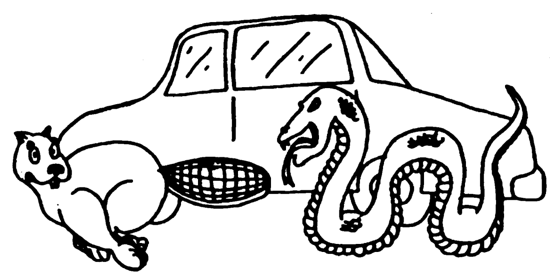


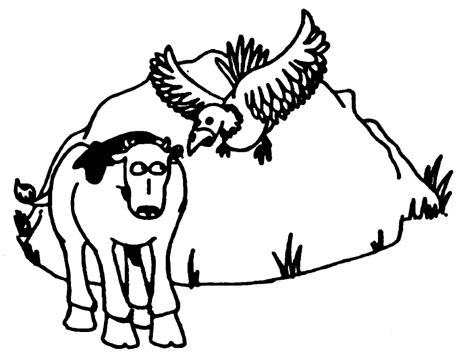












Experiment 3: Stimuli with word-by-word translations

1 bizhikiwan gii-takobinaan gii-keda Maanii '[3rd person animate] cow-P tied-up-D'

2 bezhgoogndzhiin gii-wiikbinaan mii sa genii gaa-goowaanh '[3rd person animate] horse-P pulled-D'

3 mkwan gii-mbinaan ndinendam '[3rd person animate] bear-P lifted-up-D'

4 mooswan gii-ganjwebinaan gii-keda Niksan '[3rd person animate] moose-P pushed-D'

5 nini gii-mnashkowaan gii-keda Maanii '[3rd person animate] man-A chased-D'

6 jiibakwenini gii-tikomaan mii sa genii gaa-goowaanh '[3rd person animate] cook-A bit-D'

7 kwe gii-jiimaan ndinendam '[3rd person animate] woman-A kissed-D'

8 jiibakwenini gii-nsaan mii sa genii gaa-goowaanh '[3rd person animate] cook-A killed-D'

9 niniwan gii-naadmowaan ndinendam '[3rd person animate] man-P helped-D'

10 dakoniwininiwan gii-tankshkwaan mii sa genii gaa-goowaanh '[3rd person animate] cop-P kicked-hard-D'

11 gigoonhkeniniwan gii-zgaan ndinendam '[3rd person animate] fisherman-P frightened-D'

12 kwezensan gii-gnowaabmaan gii-keda Niksan '[3rd person animate] girl-P watched-D'

13 mkwa gii-midaabaanaan gii-keda Maanii '[3rd person animate] bear-A dragged-D'

14 gookoosh gii-moomaan mii sa genii gaa-goowaanh '[3rd person animate] pig-A carried-on-back-D'

15 mashtanish gii-ptakshkowaan gii-keda Maanii '[3rd person animate] goat-A bumped-into-D'

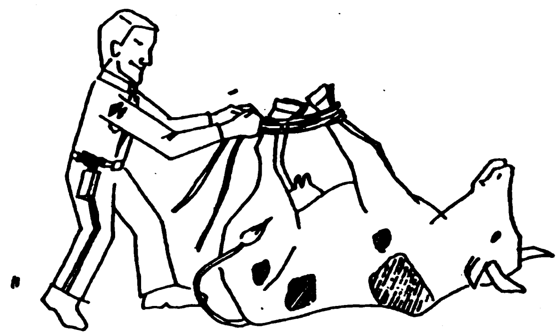
16 mkwa gii-bgnenaan ndinendam '[3rd person animate] bear-A strangled-D'

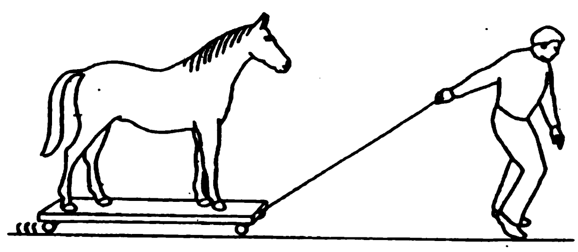
17 bineshins gii-ngamta'igoon mii sa genii gaa-goowaanh '[3rd person animate] bird-P sing-to-I'

18 gookookhoo gii-ziigwepidaa'igoon ndinendam '[3rd person animate] owl-P sprayed-I'

19 bezhgoognzhii gii-mzinbiigoon gii-keda Maanii '[3rd person animate] horse-P drew-I'

20 makhkii gii-gaasgnoota'igoon mii sa genii gaa-goowaanh '[3rd person animate] frog-P whispered-to-I'
21 dwechigeniniwan gii-nimkaa'igoon gii-keda Maanii '[3rd person animate] musician-A waved-to-I'
22 mashkikininiwan gii-webinigoon ndinendam '[3rd person animate] doctor-A swung-I'
23 gigoonhkeniniwan gii-giikaamigoon miisenegenigaagowah '[3rd person animate] fisherman-A yelled-at-I'
24 zhmaaganishan gii-tokinigoon ndinendam '[3rd person animate] soldier-A carried-in-arms-I'
25 kwe gii-bwaanigoon mii sa genii gaa-goowaanh '[3rd person animate] woman-P dreamed-about-I'
26 gwiizens gii-bgnebinigoon gii-keda Maanii '[3rd person animate] boy-P strangled-I'
27 ktegeninikwe gii-mwegoon mii sa genii gaa-goowaanh '[3rd person animate] k female-farmer-P made-cry-I'
28 kwezens gii-gozhe'igoon ndinendam '[3rd person animate] girl-P covered-I'
29 nimoshan gii-mzinazogoon mii sa genii gaa-goowaanh '[3rd person animate] dog-A photographed-I'
30 mkwan gii-mnashka'igoon gii-keda Maanii '[3rd person animate] bear-A chased-I'
31 gaagwan gii-gnagjiibinigoon mii sa genii gaa-goowaanh '[3rd person animate] porcupine-A tickled-I'
32 mikwan gii-jiimigoon gii-keda Maanii '[3rd person animate] beaver-A kissed-I'





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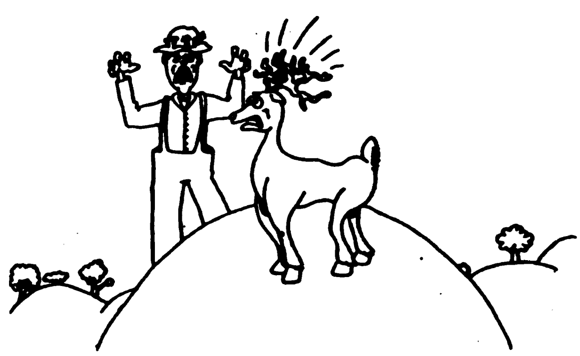

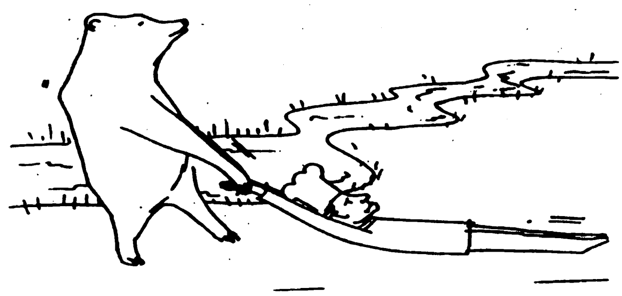

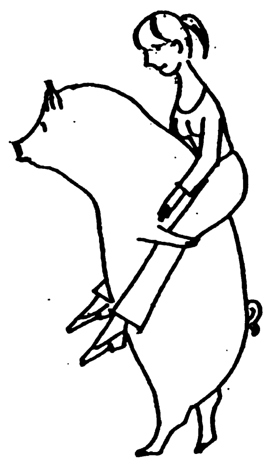

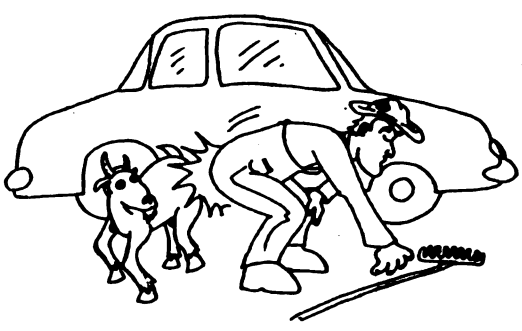

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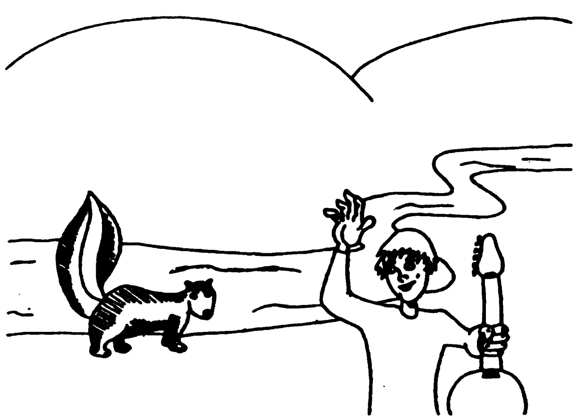

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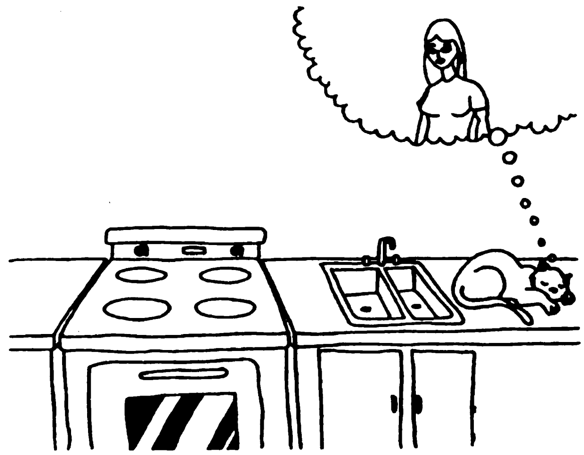

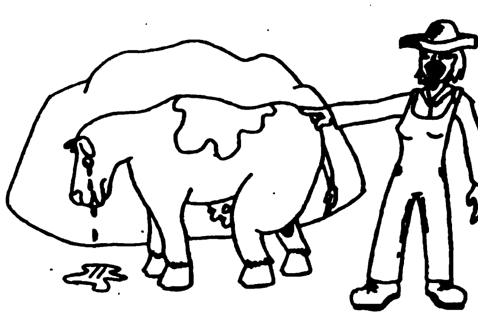

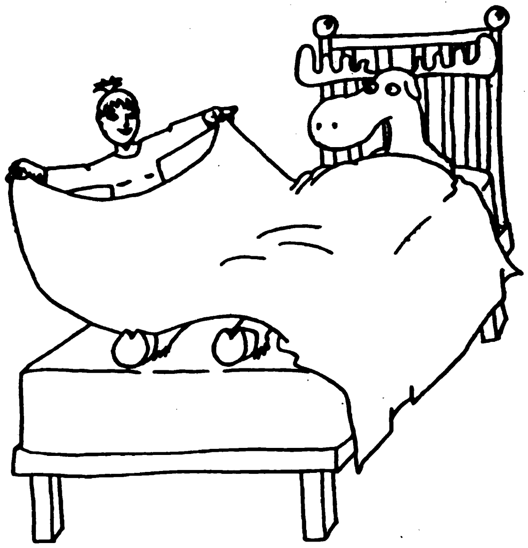

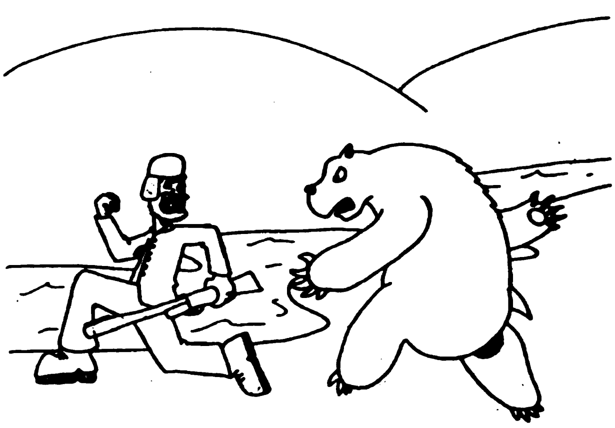

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