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Polysynthesis
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The term POLYSYNTHESIS was coined 200 years ago by Duponceau for constructions in indigenous North American languages “in which the greatest number of ideas are comprised in the least number of words” (Duponceau 1819:xxx). Polysynthesis is especially common not only in the languages of the Americas, but also in those of northern Australia, New Guinea, Siberia, and the Caucasus (cf. the language sketches in Fortescue, Mithun, & Evans 2017; also De Reuse 1992 for North America). Useful recent references include Mattissen (2008), Evans & Sasse (2014), Murasugi (2014), and the handbook edited by Fortescue, Mithun, & Evans (2017). Zuñiga (2019), however, cautions that the term polysynthesis is too ill-defined to be of use for typological generalizations; indeed, for specific languages there may be disagreement whether the classification of polysynthetic is apt or not.

For the purposes of the present chapter Mattissen’s informal characterization is a good starting point: “Roughly speaking, [polysynthesis] is characterized by complex word forms which integrate information in the form of morphemes which in European languages would be encoded by several separate words in a clause.” (Mattissen 2008:287). Given this expansive view of polysynthesis, the material in this chapter necessarily overlaps with other chapters of this volume, as indicated below. The discussion in this chapter not only surveys work done specifically within the LFG framework but also points out features of polysynthetic languages of possible interest for future LFG analyses. I begin by considering issues of agreement and incorporated pronouns, followed by binding and switch-reference. Special attention is paid to the phenomenon of noun incorporation, as well as other mismatches seen between word and predicate in polysynthetic languages, such as control and raising phenomena expressed within a single verb. The chapter closes with brief consideration of the significance of polysynthesis for other subfields of linguistics, namely child language acquisition and computational linguistics.

1. Agreement, incorporated pronouns, and binding

Polysynthetic languages are nearly always headmarking (Nichols 1986) and overwhelmingly POLYPERSONAL: that is, at least two grammatical functions, typically SUBJ and OBJ, are expressed morphologically on the verb.¹ More than two are possible: see, for example, Foley (1997:358) on Yimas, a polysynthetic language of New Guinea in which OBJ_θ is also expressed on ditransitive verbs. The Northwest Caucasian language Adyghe allows up to four participants to be expressed on the verb (Korotkova & Lander 1990:301), presumably SUBJ, OBJ, and two thematically distinct OBJ_θs. For languages in which verbs inflect for only two grammatical functions the second, non-SUBJ function is not always OBJ: the Algonquian language Unami exhibits SUBJ and OBJ_θ inflection on ditransitives if the OBJ_θ is definite; OBJ is expressed on ditransitives only if the

¹ Note that the presence of polypersonalism on its own is not a sufficient reason to label a language as polysynthetic: Bantu languages often indicate both subject and object features on the verb but are not polysynthetic. Rather, polypersonalism is one of a bundle of characteristics typically found in polysynthetic languages.

OBL_θ is indefinite (Goddard 1974:319). Algonquian languages register the requirement for an OBL_θ of a specific thematic type on the verb stem and can allow more than one OBL_θ for a given verb (Dahlstrom 2014a), but do not exhibit agreement morphology for the oblique(s) on the verb itself. Subordination as a complement or adjunct clause may be overtly indicated on the verb (cf. Evans 2006 on Dalabon). With the wealth of morphological marking of grammatical functions on the verb, it is not surprising that polysynthetic languages tend to be nonconfigurational in their syntax. [See chapter on CLAUSE STRUCTURE AND CONFIGURATIONALITY.] It is also common for the argument morphology and other inflectional categories such as tense/aspect/mood to be expressed in an inflectional template with multiple slots: see, for example, Nordlinger (2015) on the northern Australian language Murrinhpatha.

In polysynthetic languages the morphological expressions of subject, object, and other grammatical functions on the verb may function simply as agreement with a lexical argument, or they may function as incorporated pronouns, contributing the information that the predicate of the grammatical function in question is pronominal. [See chapter on PRONOUN INCORPORATION.] Evans (1999) presents arguments against Baker's (1996) view that argument morphology in polysynthetic languages is necessarily of the incorporated pronoun type.

The expression of subject and object in the verbal morphology of polysynthetic languages ranges over all possible alignment types. For example, Labrador Inuttut (Woodbury & Sadock 1986:230) uses a nominative-accusative pattern for its agreement suffixes, although the casemarking on lexical subjects and objects in Inuttut is ergative-absolutive, while Adyghe displays an ergative pattern both in nominal case and in verbal agreement (Lander and Testelets 2017:950). Caddo verb morphology is of the active type (i.e. Dixon's (1994) split-S pattern) and there is no casemarking on lexical arguments (Melnar 2004:31, 37ff). The hierarchical type of alignment (Nichols 1992:66; 100ff) is found among some polysynthetic languages, in which the agreement morphology expresses the relative ranking of subject and object on a hierarchy of person and animacy, resulting in marked inverse morphology for the instances where the object outranks the subject (cf. Zuñiga 2006). The inverse system of Plains Cree is discussed in Dahlstrom (2014b [1991]), with a proposal by Alsina & Vigo (2017) for a modification of LFG to handle the Plains Cree data. Other hierarchical polysynthetic languages given LFG treatments are Mapudungun (Arnold 1994) and Lummi (Bresnan, Dingare, & Manning 2001).

The polypersonal nature of polysynthetic languages may extend even further, allowing morphological expression on the verb of referents which are not strictly speaking arguments of the verb. The verb of a relative clause in Meskwaki (Fox) is inflected not only for the local arguments of the lower verb but also for features of the head of the relative clause (Goddard 1987). Long distance agreement in Meskwaki and Innu-aimun has been analyzed as a matrix verb agreeing with the topic of a complement clause (Dahlstrom 1995, Branigan & MacKenzie 2002, respectively). The relational verb forms or "ghost participants" in East Cree described by Junker & Toivonen (2015) register the presence of a third person participant who may be affected by the verb's action, similar to the ethical dative found in Romance languages. See also the discussion in the noun incorporation section below of Wubuy possessor raising, in which the possessor of a theme/patient argument is expressed as the athematic object of a verb.

The overwhelming tendency for polysynthetic languages to be headmarking is seen as well in the expression of reflexives and reciprocals, which often are of the verbal reflexive or synthetic type (cf. Sells, Zaenen, & Zec 1987). Verbal reflexives can be associated with a reduction in the verb's valence, with the verb's subject understood to bind the reflexive or reciprocal argument. See, for example, the Meskwaki reflexive and reciprocal forms given in the

discussion of valence-reducing processes in Dahlstrom (2009:228). For such detransitivized forms an argument-structure binding approach similar to that proposed by Alsina (1996) for Romance reflexive clitics may be promising. Other polysynthetic languages indicate reflexive and reciprocal binding with affixes appearing in the same slot as non-bound verbal arguments: see, for example, Choctaw (Broadwell 2006:98ff). Interestingly, Choctaw permits a prefix expressing a reflexive argument of a complement clause to appear on the matrix verb in place of, or in addition to, its expression on the verb of the complement clause (Broadwell 2006:102ff).

Another binding phenomenon found in a subset of polysynthetic languages is SWITCH-REFERENCE, a grammatical opposition marking coreference or disjoint reference between the subject (usually) of two conjoined or adjoined clauses (cf. Broadwell 2006:263ff for switch-reference in Choctaw; McKenzie 2016 for an annotated bibliography of work on switch-reference generally). In LFG work Willgohs & Farrell (2014) refer to switch-reference in Imbabura Quechua as a test for subjecthood but do not present an analysis of the binding properties of Imbabura Quechua switch-reference. The detailed account of switch-reference in Warlpiri by Simpson & Bresnan (1983) may provide a useful model for investigating switch-reference phenomena in polysynthetic languages.

2. Noun incorporation

NOUN INCORPORATION, the best known feature of polysynthetic languages, is the appearance of a nominal morpheme within a verb stem, typically expressing the object of the verb's predicate.² The syntactic status of the incorporated noun has long been controversial; see Sadock (1991:79ff) for a summary of the debate between Kroeber and Sapir in the early 20th century. More recently, Mithun (1984), in a paper proposing a classification of noun incorporation types (discussed further below), asserts that noun incorporation is always lexical: that is, the incorporated noun is not available for syntactic processes. In response, Sadock (1986) points to data from West Greenlandic and Southern Tiwa in which external elements such as numerals and possessors can modify the incorporated noun, evidence that the incorporated noun is visible to the syntax. Manning (1996:118ff) briefly discusses the relevant data from Greenlandic in the context of a larger LFG treatment of syntactic ergativity in Greenlandic and other languages. Manning's solution for Greenlandic external elements modifying an incorporated noun is to allow a sublexical constituent structure rule to annotate the nominal part of the verb as associated with a grammatical function (OBL in his examples), and to allow the head noun in the NP rule to be optional.

Mithun (1984) argues for a four-way classification of noun incorporation: type I is detransitivizing, in which the notional object of a two place predicate is incorporated into the verb and the resulting complex verb stem is intransitive. Type II does not alter the number of arguments required by the verb but promotes an oblique or a possessor to be object of the verb. For example, if the notional object is a body part noun and is incorporated into the verb, the possessor of the incorporated nominal is then expressed as the object of the verb. Type III is not defined in syntactic terms: rather, type III incorporation is the use of verbs containing an incorporated noun as a backgrounding strategy in connected discourse. Type IV incorporation is

² The phenomenon of analytic or pseudo noun incorporation has also received LFG attention (e.g. Ball (2004) on Niuean, Duncan (2007) on Chuj and K'ichee' Mayan), but is not relevant in this discussion of polysynthesis, since pseudo noun incorporation involves two separate items in the c-structure, not the incorporation of a nominal element into the verbal word.

incorporation of a nominal element functioning as a classifier. In type IV incorporation the incorporated element does not block the appearance of an external element specifying the object: for example, the incorporated noun may be glossed ‘fish [in general]’ while the external object names the specific type of fish. According to Mithun, the four types form an implicational hierarchy from types I to IV: if a language has incorporation of one type on the hierarchy, it also exhibits incorporation of all types labelled with a lower number. Norcross (1993:180-196) uses the LFG framework to analyze Mithun’s types I and II in the Algonquian language Shawnee: an unusual aspect of her approach is to assume that the constructions exhibiting incorporation are the unmarked form, analyzing their counterparts which do not involve incorporation as having the nonincorporated NP mapped to TOPIC.

In a paper quite influential for later work in LFG, Rosen (1989) presents a lexical analysis of two types of noun incorporation, which correspond to Mithun’s type I and type IV: compound noun incorporation, which reduces the number of arguments required by the verb by one, and classifier noun incorporation, which does not affect the verb’s valence. Compound noun incorporation does not permit external modification of the incorporated noun. In classifier noun incorporation, on the other hand, the incorporated element does not fulfill the verb’s requirement for an object (or other grammatical function); instead, the incorporated noun places a selectional restriction on what the object may be. The incorporated element in classifier noun incorporation may be doubled by an external NP argument, or may be modified by external elements expressing adjectival meanings, number, or possession. Evans (1990:400ff) provides numerous examples of doubling and stranded modifiers in the Northern Australia language Mayali, which exhibits the classifier type of noun incorporation. It should be noted that Rosen (1989) extends her analysis of the classifier type of incorporation to also account for the Greenlandic and Southern Tiwa data presented in Sadock (1986) against Mithun’s (1984) claim that all noun incorporation is lexical: in other words, even the Greenlandic and Southern Tiwa constructions are lexical, according to Rosen.

In a series of papers, Sadler & Nordlinger (2006), Nordlinger & Sadler (2008), and Baker, Horrack, Nordlinger, & Sadler (2010) present a comprehensive approach to classifier type noun incorporation in northern Australian languages, relating noun incorporation to the set notation independently needed in LFG to handle coordinate structures. The first paper, Sadler & Nordlinger (2006), examines data from several non-polysynthetic Australian languages to establish that appositive constructions can be handled with a mechanism similar to that needed for coordination. Sadler and Nordlinger’s use of the term *apposition* is wide-ranging, including not only nominal apposition in the familiar sense but also combinations of generic and specific nouns (e.g. ‘elasmobranch’, ‘shark’), part-whole appositions (e.g. ‘fighting stick’, ‘bundle’), and independent pronouns construed with a wholly or partly coreferential noun. Their proposal is to treat all such appositions in the same way as coordination is represented at f-structure, with a hybrid f-structure as the value of a single grammatical function. The semantic differences among coordination, generic-specific constructions, part-whole constructions, etc, are expressed in the mapping to semantics, not at f-structure, and the different types vary in their feature resolution patterns (e.g. coordination of two singular nouns gives dual as the value for number, while apposition produces a value of singular). Australian languages are famous for their tolerance of discontinuous constituents and the appositional types surveyed by Sadler & Nordlinger allow the members of the apposition to appear separated in the c-structure, a point which is important for their later analysis of incorporation.

Nordlinger & Sadler (2008) extend their earlier analysis of generic-specific appositions to account for noun incorporation of the classifier type in Bininj Gun-wok and other polysynthetic northern Australian languages. (Part-whole appositions involving incorporation of body parts are also briefly mentioned.) Such languages also exhibit generic-specific constructions, but the generic noun is often realized as an incorporated nominal within the verb stem, while the specific noun appears as an external argument. This type of generic-specific construction can be handled by the earlier Sadler & Nordlinger (2006) solution by allowing the f-structure set expressing the apposition to have access to the morphology of the verb: optional annotations expressing set membership with a GF such as OBJ are associated with both the verb containing the incorporated noun and the external NP position. Here, the mechanism for handling discontinuous appositions developed in Sadler & Nordlinger (2006) for separate constituents in the c-structure is extended to apply as well to a “discontinuous” expression of an apposition involving a c-structure constituent and an incorporated morpheme; the semantic interpretation of apposition already developed applies as well to the incorporated noun construction.

It may be noted that although Nordlinger & Sadler (2008) assume Rosen’s (1989) typology of compound vs. classifier incorporation, their analysis actually departs from Rosen’s in a significant way: Rosen claims that the incorporated element in classifier incorporation is not the syntactic object, but rather indicates a selectional restriction on what the verb’s object may be. In Nordlinger & Sadler (2008), on the other hand, a verb containing an incorporated classifier in Bininj Gun-wok includes an equation contributing the PRED value of the GF OBJ, either satisfying the verb’s requirement for an OBJ at f-structure on its own, or forming part of the set that does so. Another point worth mentioning is that Nordlinger & Sadler (2008) view incorporation of body-part nouns (Mithun’s Type II) as a variety of classifier incorporation, patterning like the part-whole appositions analyzed in Sadler & Nordlinger (2006); Rosen (1989:296) assumes that Mithun’s Type II incorporation is compound incorporation, though no specific examples are presented.

The third paper of the series, Baker, Horrack, Nordlinger, & Sadler (2010), presents a even more detailed account of noun incorporation in northern Australian polysynthetic languages and its interaction with other syntactic phenomena, focusing here on body part incorporation in Wubuy (Nunggubuyu). Besides incorporation, Wubuy exhibits a construction known as external possession or possessor raising, in which both the possessor and the possessum are arguments of the verb, as opposed to internal possession, in which the possessum is an argument of the verb and the possessor is expressed only as an argument of the possessum. In both internal and external possession the possessum (the body part) may be expressed by an incorporated noun, but noun incorporation is not obligatory for either possessive construction. Incorporation of the possessum in both the external and internal possession construction is of the classifier type: the evidence for this comes from the absence of valence reduction and the possibility of doubling or modifying the incorporated noun with external elements. The lexical entry and f-structure of an internal possession construction with noun incorporation is analyzed in an identical way as the generic-specific type of incorporation discussed in Nordlinger & Sadler (2008), with the incorporated noun functioning as OBJ and a doubled external NP appearing in direct (unmarked) case. In the external possession construction, however, the possessor is an athematic OBJ, appearing in direct case and the possessum is an OBL. If the possessum is incorporated it may be doubled by an NP bearing oblique case. As Baker et al. note, the morphological operation creating verbs containing an incorporated nominal must allow the nominal to be associated with either OBJ or OBL to account for the two types of possessive constructions in Wubuy. Evidence

for Wubuy incorporated nouns bearing different GFs depending on the type of possessive construction comes from their behavior under coordination: an incorporated noun in internal possession may be coordinated with another OBJ, while an incorporated noun in the external possession construction may be coordinated with an external OBL.

3. Other types of incorporation

Many polysynthetic languages exhibit incorporation of additional elements besides nouns. For example, polysynthetic verbs frequently specify various adverbial notions as part of the verb stem: Mattissen (2008:297) lists a number of ontological domains, including direction, position, motion, manner of action, degree, scale/focus, quantification, among others. As mentioned above, Algonquian languages register the requirement for one or more oblique arguments with special morphology on the verb stem (Dahlstrom 2014a); similar phenomena are analyzed as incorporation of a postposition into the verb by Craig & Hale (1988) for several languages of the Americas, including the polysynthetic Siouan language Winnebago.

Of particular interest are polysynthetic verbs which appear to contain more than one argument-taking predicate, where, for example, one predicate of the verb corresponds to a raising or control verb in a nonpolysynthetic language. [See chapters on RAISING AND CONTROL and COMPLEX PREDICATES.] Various approaches have been taken in analyzing such verbs: Grimshaw & Mester (1985) argue that Labrador Inuttut complex verbs express control relationships in the argument structure, not in the f-structure; in a response, Woodbury & Sadock (1986) present additional data which they claim cannot be handled by Grimshaw & Mester's approach. Dahlstrom (2000) argues that Meskwaki causatives and depictive secondary predicates are functional control constructions involving incorporation of XCOMP, based upon scope of aspectual marking and negation, plus binding facts. (See also the discussion of incorporated 'tough' predicates in Dahlstrom 1994:69ff.) More recently, Dras et al. (2012) provide a useful description of complex predicates in the polysynthetic Australian language Arrente: their analysis (as part of a computational project) for at least some of the complex predicate types in the language is to represent the predicates separately at f-structure, combining them at s-structure via glue semantics.

4. Implications for other subfields

To close the discussion of polysynthesis, brief mention will be made of the implications of polysynthetic languages for other subfields of linguistics. The complex morphology of polysynthetic verb stems and the accompanying templatic inflectional morphology raise significant questions about how children go about acquiring such systems. Research into this issue is hampered by the fact that many polysynthetic languages are endangered, with few or no children currently speaking the languages. Nevertheless, acquisition studies have been carried out on some polysynthetic languages such as Inuktitut and Northern East Cree: the review article by Kelly, Wigglesworth, Nordlinger, & Blythe (2014) provides a useful summary of current research in this area.

Polysynthetic languages are likewise challenging for the field of computational linguistics, where models for generation, parsing, and processing have typically been developed

for languages with less complex morphology. For a report on a project parsing Aymara, see Homola (2011). Seiss (2011) uses a morphological parser on the templatic inflectional morphology of Murrinh-Patha but a separate syntactic component to model the dependency between the two components of the verb stem. As mentioned above, Dras et al. (2012) uses a glue semantics approach to handle complex predicates as part of their computational project to generate Arrente. For work in frameworks other than LFG, see the recent ACL workshop on computational modeling of polysynthetic languages which brought together papers on Arapaho, Kwakw'ala, Chukchi, Kanyen'kéha (Mohawk), and other polysynthetic languages (Klavans 2018).

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