# THE PROCESSING OF LONG-DISTANCE DEPENDENCIES IN NIUEAN*

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It is well documented that nominative-acccusative alignment coincides with a strong *subject-preference* in long-distance dependency formation, both in terms of processing (in particular, subject gaps in relative clauses are processed more easily than other types of gaps) and accesibility for extraction (there appears to be an implicational universal that the availability of relativization with a gap entails the availability of subject relativization with a gap (Keenan and Comrie 1977)). This subject preference does not, however, carry over uniformly to languages with ergative-absolutive alignment; in some morphologically ergative languages, the ergative subject cannot extract with a gap at the extraction site, a phenomenon termed *syntactic ergativity*. In this paper, we explore the viability of a processing-based explanation of syntactic ergativity. Much as has been proposed for various island phenonemona (Kluender 1998, Kluender 2004), the extraction of ergative arguments may simply be more taxing on the parser than corresponding absolutive extraction. If this is true, following Hawkins (2004, 2014), syntactically ergative languages could then be taken to differ from their morphologically ergative counterparts in their tolerance for difficult structure, eliminating the less efficient, more difficult ergative extraction. To test this account, we explore the processing of relative clauses in Niuean, a morphologically, but not syntactically, ergative language. Niuean is an ideal test case, given that it is closely related to the syntactically ergative Tongan, and thus might be expected to show an obvious bias against ergative extraction (a bias that Tongan turns into a categorical restriction). We present novel experimental data showing that ergative subject gaps in Niuean RCs do not impose any additional processing difficulty as compared to the processing of absolutive object gaps, thus calling into question the viability of the processing account in this domain.

# 1. Introduction

Subjects are special. Since at least the work of Keenan and Comrie (1977, 1979), it has been known that there is a pervasive cross-linguistic tendency to prefer them over other arguments and adjuncts from the perspective of a number of syntactic operations. In this paper, we take up one facet of this phenomenon: the fact that subject gaps in long-distance dependencies are interpreted more accurately and faster than other types of gaps (Kwon et al. 2013). This subject preference is captured in Keenan and Comrie's (1977) *Accesibility Hierarchy*, which rates grammatical function based on the relative ease with which they may form relative clauses and possibly, other A′-dependencies.

(1)     Accesibility hierarchy:
        Subject >> object >> indirect object >> oblique object >> possessor >> object of comparison
        (Keenan and Comrie 1977)

Of course, *subject* is itself a notion that encapsulates a number of variable and often unrelated properties, so that we might question exactly what is is about *subjecthood* that leads to this effect.

        In general terms, there are any number of factors that might be implicated in the subject preference, including: the thematic status of the subject (subjects tend to be agentive); the status of the gap associated with subject dependencies (subject and non-subject gaps might differ with respect to whether they are traces or bound pronouns); the morphological or abstract case associated with the gap (nominative vs. non-nominative, ergative vs. non-ergative); the general structural properties associated with either the subject-gap itself or the dependency chain more generally, and other factors. Even assuming all such properties play a role, there is reason to suspect that morphological case has a special status in the determination of the subject preference. Indeed, most of the languages included in Keenan and Comrie's (1977) initial survey, and that have been studied in this context since, have been *nominative-accusative* languages, where the grammatical function and (nominative) morphological case align in most clauses. If the basis of consideration is widened to include languages exhibiting an *ergative-absolutive* alignment, the neat pattern encapsulated in the accesibility hierarchy appears to break down. So-called *ergative* languages morphologically distinguish subjects of transitive verb, which surface with *ergative* case, to subjects of intransitive verbs and objects of transitive verbs, which surface with *absolutive* case.

(2)     Accusative alignment:                    Ergative Alignment

| Nominative | Accusative | | Ergative | Absolutive |
|---|---|---|---|---|
| -transitive subject -intransitive subject | -transitive object | | -transitive subject | -transitive object -intransitive subject |

Ergative subjects seem to have the typical properties we associate with subject (Anderson 1976, and much subsequent literature) and thus behave identically to nominative subjects with respect to binding (they bind structurally lower arguments but cannot be bound by them), imperative formation (they appear as the addressee of an imperative), accessibility to control and raising, and preferential status in maintaining coreference across clauses. However, despite their subject-like behavior, in a large number of languages with ergative-absolutive alignment, the ergative subject cannot be part of a long-distance dependency leaving a gap at the base position. Absolutive arguments, subject or object, display no such restrictions, freely participating in A′-dependency formation with a gap. This restriction on the extraction of the ergative is known as *syntactic ergativity*.

One can imagine approaching the problem of syntactic ergativity from at least two perspectives, roughly mirroring extant approaches to other restrictions on long-distance dependencies. First, we could seek to attribute the unavailability of ergative extraction to independently motivated syntactic principles. Under this style of approach, the syntax of languages with syntactic ergativity differs in some meaningful way from accusative languages and from morphologically ergative languages without syntactic ergativity (for varieties of this idea, see Aldridge 2008, Legate 2008, Polinsky et al. 2012, Coon et al. 2015). We'll refer to these analyses broadly as instantiating the *syntactic* account. An alternative approach, which we will refer to as the *processing account*, is to explain syntactic ergativity through processing constraints, much as has been proposed for various island phenonemona (Kluender 1998, Kluender 2004) and accessibility hierarchies. With respect to the latter, Hawkins (2014) writes:

> "that there are several hierarchies of *wh*-movement and relativization, with their systematic cut-off points in different languages and alternations between gaps and resumptive pronouns in easier and more difficult environments respectively, [can] be readily explained in terms of increasing processing complexity" (Hawkins 2014: 81)

Under such a view, extraction of ergative arguments would be held to be more taxing on the parser than corresponding absolutive extraction. Following the general conception developed by Hawkins (2004, 2014), syntactically ergative languages would then differ from their merely morphologically ergative counterparts in having a different "systematic cut off point," with the syntactically ergative languages requiring a resumptive pronoun in the ergative gap site.

Given that processing explanations have been successful in accounting for preferences in categorization or word order principles (Hawkins 2014), a processing approach to syntactic ergativity warrants serious consideration. In order to evaluate the processing account, it would be desirable to explore a pair of similar languages, where one has syntactic ergativity and the other does not. If the language without syntactic ergativity in the comparison set can be shown to impose a heavier processing load on long-distance dependencies with an ergative gap as compared to those with absolutive gaps, such a difference would lend credence to the notion that the related language – one with syntactic ergativity – simply eliminated the less efficient, more difficult structure. Polynesian languages offer an ideal test case in this regard. The closely related Tongan and Niuean are very similar in many ways, although they differ with respect to syntactic ergativity: Tongan is syntactically ergative and Niuean is not.

In what follows, we present novel experimental data on the processing of gaps in Niuean relative clauses. To anticipate our conclusions, we show that the processing of ergative gaps in Niuean does not impose any additional processing difficulty as compared to the processing of absolutive object gaps, thus calling into question the applicability of the processing account to syntactic ergativity.

The remainder of this paper is structured as follows. In Section 2 we sketch the basics of syntactic ergativity, as well as our motivation for comparing Tongan and Niuean. Section 3 comprises a presentation of our experimental methods, materials, and results. We discuss these results in Section 4, both for accounts of syntactic ergativity and for the related notion of the subject preference more generally. We offer a conclusion in Section 5.

## 2. Syntactic ergativity

### 2.1. The phenomenon

For the purposes of this paper, we will adopt the relatively restricted definition of syntactic ergativity provided in 3, setting aside the variety of related phenomena that have variously been grouped under the same header.

(3)     *Syntactic Ergativity*:
        The grouping together of intransitive subject and transitive object (absolutive arguments), to the exclusion of transitive subjects (ergatives), with respect to accessibility to A′-dependency formation.
        (Polinsky to appear a)

For the most part our investigation will be further limited to discussion of relative clause formation. There are several reasons for that. As we have already mentioned, the accessibility hierarchy (see 1) was expicitly formulated to reflect the ease of relative-clause formation, and syntactic ergativity emerges as a challenge to this hierarchy. Next, A′-dependencies in the two languages under discussion here, Ton-

gan and Niuean, are mostly confined to relative clauses. Somewhat more broadly, however, while there is significant cross-linguistic variation in the mechanisms invoked in question formation, topicalization, and other constructions usually taken to involve A′-dependencies in English, almost every language has an operation of relative clause formation that exhibits canonical A′-properties. Studying these constructions thus facilitates cross-linguistic comparison and offers the best prospect of discovering cross-linguistic trends.

       With this in mind, the examples below, from Tongan, demonstrate the phenomenon at stake here: relativization of an absolutive subject and an absolutive object leaves a gap in the base position of that argument; but under the relativization of an ergative subject, a resumptive pronoun is required in the relative clause. This resumptive pronoun is a second-position clitic which attaches to the tense marker (Otsuka 2000).

(4) a. e    fefine$_1$ [na'e alu __$_1$ ki Tonga]        *absolutive subject gap*
     DET woman PAST go     to Tonga
     'the woman who went to Tonga'

    b. e    fefine$_1$ ['oku 'ofa'i 'e   Sione __$_1$]       *absolutive object gap*
     DET woman PRES love  ERG S
     'the woman who Sione loves'

    c. e    fefine$_1$ ['oku *(ne$_1$) 'ofa'i 'a   Sione]          *ergative gap*
     DET woman PRES RP    love  ABS S
     'the woman who loves Sione'

The phenomenon of syntactic ergativity on display in Tongan is widespread across those languages showing an ergative-absolutive alignment system. In the WALS survey of thirty two ergative languages, only five were shown to permit long-distance extraction of the ergative subject with a gap, and all belonged to one of two families (see Polinsky to appear a for discussion).

(5) a. Nakh-Dagestanian: Hunzib, Ingush, Lezgian
    b. Pama Nyungan: Ngiyambaa, Pitjantjatjara

Again, ergative and nominative DPs pattern alike under all relevant diagnostics for subjecthood, so that his behavior is completely unexpected on the basis of Keenan and Comrie's (1977) accessibility hierarchy. That the relevant property at stake here is ergative alignment is confirmed by the fact that syntactic ergativity as a phenomenon appears to be limited to those languages that also exhibit morphological ergativity, either in their case or agreement systems. Keenan and Comrie's (1977) accessibility hierarchy thus appears to accurately describe the behavior of nominative-accusative languages, where we never find a broad-based restriction on the long-distance extraction of subjects if such a restriction does not also obtain for objects and other DPs.

The constellation of facts surrounding syntactic ergativity lends at least initial credibility to processing-based accounts. Because a large number morphologically ergative languages exhibit syntactic ergativity, morphologically but not syntactically ergative languages take on an immediate *outlier* status. If ergative gaps in these outlier languages can be shown to be more difficult to process than absolutive gaps, then variability in terms of the presence of syntactic ergativity, and the behavior of the outlier languages could be reduced to differential threshold for complex data sets. That languages differ in their tolerance for complex structure is well known, with one illustrative example being the acceptability of certain crossed-dependencies in the Scandinavian languages. Norwegian tolerates crossed-dependencies – which are notoriously complex, both formally and from a processing perspective (see Fodor 1978; Engdahl 1979; Pesetsky 1982; Creider 1986; Miller 1991) – formed via extraction from embedded questions without recourse to resumptive pronouns. In Swedish, on the other hand, a resumptive pronoun must appear in all gap sites except the hierarchically lowest in all instances of extraction leading to crossed-dependencies, but not if the corresponding dependencies are nested. Engdahl (1982) and Asudeh (2004) argue convincingly that the resumptive pronouns that appear in these cases serve as processing aides in Swedish, so that Norwegian, in not requiring such pronouns, can be seen to be more tolerant of complex structure parsing.

(6) a. [den här presenten]$_1$ kan du  säkert aldrig komma på vem$_2$ jag
       this here gift       can 2.SG surely never  arrive  at who  1.SG

   fick *(den$_1$) av    __$_2$
   got  3.SG.RP  from

   'this gift that you'll never guess who I got (it) from'          *Swedish*

 b. [denne gaven her]$_1$ vil du   ikke gjette hvem$_2$ jeg   fikk (den$_1$)
     this  gift  here  will 2.SG not  guess  who    1.SG  got  3.SG.RP

   fra   __$_2$
   from

   'this gift that you'll never guess who I got (it) from'        *Norwegian*
   (Maling and Zaenen 1982: 236)

Before examining a processing account, we will briefly survey the alternative accounts, which as we mentioned above, appeal to syntactic principles rather than processing.

2.2.   Existing accounts

In spite of the intuitive appeal of a processing-based account, until recently, most work on syntactic ergativity has taken the perspective that the phenomenon is syntactic in nature. Bittner (1994) and Bittner and Hale (1996) develop an account that hinges on the assignment of absolutive case, which they assume takes place in a vP-external A′-position. Under the further assumption that A′-movement for case

purposes takes precedent over all other types of A′-movement, the derivation will always prefer movement of absolutive to its vP-external case position over other A′-dependency formation. Consequently, A′-extraction of the vP-internal ergative will always be blocked if A′-movement is succesive-cyclic, given that the absolutive occupies the relevant left-peripheral A′-landing site (see Polinsky to appear a for more discussion). Languages without syntactic ergativity might then differ in permitting multiple A′-specifiers or in otherwise permitting A′-extraction past an occupied A′-position.

A related family of approaches also relies on movement of the absolutive to a position c-commanding the ergative as a means of deriving syntactic ergativity. The work of Legate (2006, 2008) and Aldridge (2004, 2008) best represents this take on the phenomenon. These authors assume that, in at least some ergative languages, absolutive case is assigned differently in transitive and intransitive clauses. They encode this differential behavior in the v head, so that transitive v assigns absolutive case, while intransitive v does not. Intransitive clauses thus involve movement of the sole argument to spec,TP for case purposes. In transitive examples, absolutive case is predicated on EPP driven movement of the object to an outer specifier of vP. This movement places the absolutive in a hierarchically superior position to the ergative, which presumably occupies either an inner specifier of vP or some other vP-internal position. With this structural configuration, A′-movement of the ergative can be blocked by the *attract closest principle* (see 7) under the assumption that the absolutive is also a suitable target for movement. These authors accomplish this by positing that A′-movement in syntactically ergative languages is driven by a probing EPP feature, for which presumably any DP is a suitable goal. A′-movement in non-syntactically ergative languages might then be said to involve, for example, [*wh*]-features, so that the ergative and absolutive need not both be potential candidates for a given movement operation.

(7)     *Attract closest principle*:
        A head which attracts a given kind of constituent attracts the closest constituent of the relevant kind
        (Richards 1997)

Coon and Preminger (2012) have proposed a related approach grounded in phase-theory (Chomsky 2001, 2008). Drawing on the behavior of a number of Mayan languages, they contend that at least in this family, ergative languages can be classified into two groups based on whether they license absolutive case vP-externally, the so-called *high*-absolutive languages, or vP internally, the so-called *low*-absolutive languages. It follows that the absolutive argument must move out of the vP for case purposes in high-absolutive languages, again leading to a configuration where the absolutive c-commands the ergative. Syntactic ergativity follows under this account from the proposal that the transitive v is a phase head: by assumption, phases have exactly one *escape hatch* through which arguments may move, so that movement of the absolutive to its vP-external case position effectively blocks any other extraction,

be it A or A′, from the vP.

All of the above analyses share a reliance on the properties of the absolutive argument in deriving syntactic ergativity. An alternative, taken up by at least Stepanov (2004), Markman and Grashchenkov (2012), and Polinsky (to appear b), is to treat the ergative argument itself as the locus of syntactic ergativity. These authors all propose to derive this behavior by treating the ergative argument in syntactically ergative languages as a PP. For Stepanov (2004), ergative subjects, which are PPs, are adjoined at a late stage in the derivation, crucially after the action of cyclic syntactic rules like A′-movement. This account predicts that syntactically ergative languages should also lack agreement with the ergative, which appears in the derivation after all agreement operations have taken place. There do, however, appear to be syntactic ergative languages which show genuine agreement with the ergative: Halkomelem (Gerdts 1988; Wiltschko 2006), Abkhaz (Hewitt 1979), Adyghe (Testelets et al. 2009), and Chukchi (Bobaljik and Branigan 2006; Polinsky to appear b). To avoid this pitfall, Markman and Grashchenkov (2012) and Polinsky (to appear b) reject the late-merge hypothesis and allow PPs to enter into agreement relationships with verbal heads. For Polinsky (to appear b), syntactic ergativity can then be seen to follow from the PP status of the ergative under the assumption that syntactically ergative languages are exactly those that do not have P-stranding or pied-piping.

Given the somewhat fragmented state that characterizes the space of syntactic accounts, it is appealing to think that a single, uniform processing explanation may supplant these accounts. To this end, as mentioned in the introduction, it would be ideal to find a pair of similar, closely related languages, where one but not the other is syntactically ergative. If the main idea underlying the processing account, that A′-dependencies involving ergative arguments incur a higher processing cost than equivalent dependencies involving absolutive arguments, is correct, we should expect to be able to observe it in the language without syntactic ergativity. Tongan and Niuean, members of the Tongic branch of Western Polynesian group, present an excellent pair for exactly this kind of investigation.

2.3.  Setting the stage: Tongan and Niuean

As example 4 demonstrates, Tongan exhibits syntactic ergativity. Niuean, on the other hand, *requires* a gap at the extraction site for relative clauses formed of both ergative and absolutive arguments (Seiter 1980).[1]

(8) a.  e      fifine$_1$  [ne    fano (*a      ia$_1$) ki Toga]    *Absolutive subject gap*
        ABS  woman  NFUT  go    ABS 3SG OBL to Tonga
        'the woman who went to Tonga'
    b.  e      fifine$_1$  [ne    ofaofa e    Sione (*a  ia$_1$)]    *Absolutive object gap*
        ABS  woman  NFUT  love    ERG Sione ABS 3.SG
        'the woman who Sione loves'

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[1]Note the near synonymy of the examples from Tongan and Niuean.

c. e    fifine$_1$  [ne    ofaofa (*e      ia$_1$) a     Sione]    *Ergative gap*
   ABS  woman  NFUT  love    ERG 3.SG  ABS  Sione
   'the woman who loves Sione'

Niuean is therefore an ideal test case for evaluating the processing account: if it can be shown that its ergative gaps are significantly harder to process than absolutive gaps, it would lend credence to the notion that the closely related Tongan has removed the difficult structure altogether. In addition to offering us a valuable opportunity to test the processing explanation of syntactic ergativity, Niuean warrants a processing examination in its own right; our knowledge of the processing of long-distance dependencies is generally limited to large, thriving languages (English, German, Japanese, etc.), and understanding the processing of such dependencies in a small, endangered language is valuable in and of itself (see Sperlich 1995; Sperlich 2005 for discussion of the endangered status of Niuean).

Let us review some of the key properties of Niuean.[2] Reports vary, but there are an estimated 7,000 speakers of Niuean, of whom perhaps 2,000 or 3,000 know the language fluently and use it on a daily basis. Most fluent speakers are over 40 years old, so the language is critically endangered (see also Sperlich 1995). The majority of Niuean speakers reside in Auckland, New Zealand; the number of speakers on the island of Niue has been declining precipitously, and currently there may be a thousand speakers left there. Niuean has a modest written tradition, with major literary sources confined to the Bible and various children's and instructional books created by the New Zealand Ministry of Education.

Niuean is universally verb- and predicate-initial, with alternate VSOX and VOSX word order (Massam 2000, 2001). The language exhibits ergative alignment in all clauses, marking this alignment with overt case morphology; there is no agreement morphology[3]. Case is marked by particles that precede the relevant noun phrase, and these particles are divided into two classes: pronominal (used with pronouns and proper nouns) and common.

(9)

|            | **Pronominal** | **Common** |
|------------|----------------|------------|
| Ergative:  | e              | he         |
| Absolutive: | a             | e          |

The table below summarizes the standard surface constituent order in a Niuean sentence.

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[2]Because our study involves the processing of A′-dependencies in Niuean, not Tongan, we focus here on the essential properties of Niuean only, although when relevant we point out similarities between the languages.

[3]The use of reduplicated or suppletive forms with some verbs that denote an event with plural subject is not agreement (pace Seiter 1980) but the marking of pluractionality Haji-Abdolhosseini et al. (2002).

(10)   **Niuean surface word order**

| Interjections, Responses | Discourse particles | Comp, Connectives | TAM | NEG | Modals | Predicate | Postverbal particles, adverbials | Noun phrases |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |

(Massam et al. 2006)

Relative clauses (RCs) in Niuean are post-nominal and introduced by the TAM particles *ne*, glossed here as NFT, and *ka*, glossed here as FUT. Relative clauses undergird a number of constructions, including wh-questions, which are pseudo-clefts (Potsdam and Polinsky 2011) and topicalizations.

Intransitive subjects, transitive objects, and crucially transitive subjects all relativize with a gap (see 11, repeated below), while obliques, including stative agents and middle objects, require a resumptive pronoun (Seiter 1980). The patterning together of subjects and objects with respect to relativization that is on display here is part of a broader phenomenon in the language whereby familiar subject-object asymmetries appear to be entirely absent (Larson et al. 2015, Longenbaugh and Polinsky 2015). Thus operations that are usually restricted to subjects, such as genitive-conversion in nominalizations, may equally target both subjects and objects. Familiar minimality-type effects also fail to obtain between subjects and objects, so that raising may target objects and subjects equally well, and an object *wh*-element may extract past a subject *wh*-element. Indeed under all relevant tests, the subject and object appear to be equally accessible to higher agremeent probes.

(11)   Relativization with a gap
   a.   e      fifine₁ [ne    fano ___₁ ki    Toga]        *Absolutive subject gap*
       ABS  woman  NFUT  go          OBL  to
       'the woman who went to Tonga'
   b.   e      fifine₁ [ne    ofaofa  e      Sione ___₁]        *Absolutive object gap*
       ABS  woman  NFUT  love    ERG  Sione
       'he woman who Sione loves'
   c.   e      fifine₁ [ne    ofaofa ___₁ a      Sione]        *Ergative gap*
       ABS  woman  NFUT  love          ABS  Sione
       'the woman who loves Sione'

(12)   Relativization with a resumptive pronoun
   a.   e      tau tagata ne    age  e      ia      *(ki  ai)      e      motoka
       ABS  PL  person  NFT  give ERG  3.SG  to    3.PL.RP  ABS  car
       'the people he gave the car to'
   b.   e      taga ne    tuku *(ai)      e      ia      e      uga
       ABS  bag  NFT  put   3.SG.RP  ERG  3.SG  ABS  crab
       'the bag in which he put the coconut crab'
       (Seiter 1980: 94)

In terms of structure, Niuean RCs do not appear to involve head-raising (Bhatt 2002, Hulsey and Sauerland 2006), as they fail to permit idiom chunk reconstruction (see 13) or relative-clause-internal scope for quantified head-nouns (see 14).

(13) a. Kua kai e ia haana a kokō.
     PFV eat ERG 3.SG 3.SG.POSS DET vomit
     '(S)he is a hypocrite' (lit. (s)he ate her/his vomit)

  b. e kokō$_1$ [ne kai e ia ___$_1$]
     DET vomit COMP eat ERG 3.SG
     'the vomit that (s)he ate', not 'her/his hypocrisy'

(14) a. Kua lagomatai he tolu ekekafo e tokoua faiaoga.
     PERF help ERG three doctors ABS two teachers
     'Three doctors helped two teachers.'
     3>>2, 2>>3

  b. e tolu ekekafo$_1$ [ne lagomatai ___$_1$ e tokoua faiaoga]
     DET three doctor COMP help ABS two teachers
     'the three doctors that helped two teachers...
     3>>2, ?*2>>3

  c. e tokoua faiaoga$_1$ [ne lagomatai he tolu ekekafo ___$_1$]
     DET two teachers COMP help ERG three doctors ___$_1$
     'the three teachers that two doctors helped...
     2>>3, *3>>2

These facts suggest an operator-based analysis of Niuean relative clauses is most appropriate. Whether the relevant operator moves to the left periphery, or is base-generated there and unselectively binds a null *pro*, as has been recently suggested for a number of related A′-dependency chains in Tongan (Polinsky to appear b) and various Formosan languages (Chen & Fukuda, this volume), is difficult to determine. For present purposes, what matters is that relativization of ergative and absolutive arguments obtains equally with a gap, and we leave the syntacic category of that gap (trace or pro) for further investigation. 15 summarizes our assumtpions regarding the structure of Niuean RCs.

(15)    NP [$_{CP}$ Op$_1$ ... $t_1$/pro$_1$]

    To determine the frequency of absolutive and ergative gaps in relative clauses, we completed a manual corpus survey conducted on 2,300 clauses from an interview text (courtesy Donna Sparks) and children's books from which we extracted relative clauses. The distribution of ergative, absolutive subject, and absolutive object gaps in the relative clauses in this mini-corpus was roughly as in 16. We provide comparable statistics from English for reference, based on the data in (Gordon and Hendrick

2005), and from Avar (Polinsky et al. 2012).

(16)     Niuean, English, and Avar relative clause distribution (percentages rounded off to integers)

|         | Intransitive subject gap | Transitive subject gap | Object gap |
|---------|--------------------------|------------------------|------------|
| *Niuean* | 38%                     | 31%                    | 31%        |
| *English* | 34%                    | 32%                    | 34%        |
| *Avar*  | 43%                      | 26%                    | 31%        |

The distribution of the three gap types that are of interest to us is comparable within Niuean and also comparable to other languages. This is a pleasing fact; if the number of a particular gap type were found to be significantly greater than the number of other gap types, our results could be explained simply in terms of frequency or familiarity of the structures. The distribution established here indicates that frequency or familiarity should not be cause for concern.

With this information in place, we now turn to outlining our experimental methods and procedures.

## 3.     Processing study: Niuean

To test the predictions of the processing account, we examined the relative ease of processing of absolutive subject gaps, absolutive object gaps, and ergative gaps in Niuean.

### 3.1.     Participants, materials, procedure

Forty seven speakers of Niuean, recruited in and around Auckland, New Zealand, participated in this study. Data from 6 subjects were excluded due to extremely long response times (>10s per question) and high error rates. The remaining forty one subjects, 27 female, had a mean age of 42;8. All the subjects were Niuean native speakers, the majority of them born in Niue, who continue to use Niuean on a daily basis. Subjects were screened for fluency with the aid of two native speaker consultants who travelled with the authors to identify subjects and who assisted in the experiment. All subjects also spoke English, with a small minority bilingual from birth.[4]

Because of the extremely modest reading tradition in Niuean (see our remarks

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[4]At least two studies have shown that bilingual speakers respond differently than their monolingual counterparts when exposed to identical stimuli (Zawiszewski et al. 2011, Clemens et al. 2015). Given that all of our subjects were bilingual and there are virtually no monolingual speakers of Niuean left, we have no way of confirming or controlling for aberrations related to this.

above), we opted to conduct an auditory picture-matching study that required no familiarity with written Niuean. The utility of picture-matching studies has been demonstrated in a similar experiment conducted with Mayan speakers in Guatemala and Mexico (Clemens et al. 2015).[5] In a within-subjects design, subjects saw pictures on a computer screen depicting three participants, then heard a question related to the picture that asked them to identify one of the participants.

The images were constructed according to the following general paradigm. All images depicted three participants $X_1$, Y, $X_2$, with $X_1$ and $X_2$ from the same general category, disparate from the category of Y. Thus the X participants were, variously, boys, ships, horses, dogs, etc., and the corresponding Y participants were girls, sharks, cows, cats, etc., respectively. Participants were selected so that each image contained either all human participants, all animal participants, or all inanimate participants. The participants depicted in the images were normed with three native speakers to ensure that they were culturally salient and easily recognizable. Participants were arranged sequentially along the horizontal axis, with $X_1$ to the left of Y to the left of $X_2$. In Class A (intransitive) images, $X_1$ and Y both carry out the same intransitive action (sleeping, laughing, crying, etc.), while $X_2$ carries out a distinct intransitive action. In the Class B (transitive) images, $X_1$ acts on Y, which acts on $X_2$, where the action carried out is the same for both $X_1$ and Y. Sample images appear below. Each of the twenty five images was computationally inverted about



(a) Class A ($X_1$, Y are sweeping, $X_2$ is smiling)  (b) Class B ($X_1$ is licking Y is licking $X_2$)

Figure 1: Experimental images

the vertical axis as well, producing a total of fifty images.

Auditory stimuli consisted of questions asking subjects in the experiment to identify one of the participants in the corresponding image. All questions made

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[5]In that study,Clemens et al. (2015) present a direct comparison between picture-matching and self-paced reading which presents the proof of concept showing that these two methodologies yield comparable results. See also our discussion below, of the two methodologies used in Avar.

use of a relative clause whose head noun referred to participant in the experimental images. The relative clauses varied according to transitivity and gap site, with each of transitive subject gap, intransitive subject gap, and transitive object gap attested. The duration of the experimental question was made comparable for transitive and intransitive stimuli; in order to make intransitive stimuli comparable to the transitive ones in duration, the relative clauses inside those included a PP or an adverb, as in example (19a).

Each Class A (intransitive) image was associated with questions of the following form, where the categories of participants are X, Y, and the relevant intransitive action is IV.

(17) a. Where is the X that is IVing Adv/PP?
    b. Where is the X that is not IVing Adv/PP?

Likewise, each Class B (transitive) image was associated with questions of the following form, where the categories of participants are X, Y, and the relevant transitive action is TV.

(18) a. Where is the X that is TVing the Y?
    b. Where is the X that the Y is TVing?
    c. Where is the Y that is TVing the X?
    d. Where is the Y that the X is TVing?

Twenty four stimuli were created along these lines, with eight questions per gap type (intransitive subject, transitive object, transitive subject). Of these eight questions per gap type, three involved pictures with human participants, three with animal participants, and two with inanimate participants. In addition to these stimuli, which always question one of the X participants, we also constructed twenty four stimuli questioning entity Y. Because such questions do not require resolution of the relevant filler-gap dependency (Y is the only entity of its type in the image), we treated these examples as fillers. All stimuli were normed with three native speakers and recorded by a fourth native speaker (female). Some actual stimuli corresponding to the images in Figure 1 appear below; relative clauses are in brackets.

(19) a. Ko fe e    tama fifine [ne mamali mogonei]?    *Intransitive subject gap*
        where DET girl      NFT smile    now
        'Where is the girl who is smiling now?'
    b. Ko fe e    puti [ne epoepo he    kulī]?        *Transitive object gap*
        where DET cat NFT lick    ERG dog
        'Where is the cat that the dog is licking?'
    c. Ko fe e    kulī [ne epoepo e    puti]?        *Transitive subject gap*
        where DET dog NFT lick    ABS cat
        'Where is the dog that is licking the cat?'

The experiment was designed and run using the Experigen software (Pillot et al. 2012) on a Macintosh computer in and around Auckland, New Zealand in January, 2014. Each subject saw the stimuli in a random order, and each image was randomly selected to appear either with the canonical order of participants $X_1$-Y-$X_2$, or the variant flipped about the vertical axis ($X_2$-Y-$X_1$ order). Prior to the experimental portion of the task, subjects were given detailed instructions, both visual (on the computer screen) and auditory, and had the option to replay these instructions indefinitely before moving on. Subjects were then provided with a practice portion of the task, consisting of images and stimuli identical to those that appeared in the experimental portion. They could move on only once they had correctly answered the trial question.

In the experimental portion of the task, the relevant image appeared on screen, followed five seconds later by the auditory stimuli asking the user to identify the relevant entity. Directly beneath each entity was a button that subjects could click to indicate their choice. Reaction times were measured by computing the time elapsed from the onset of the recording to the button click on the screen. Speakers pressed the space bar to progress through the experiment. A brief demographic survey was completed at the end of the survey.

## 3.2.   Results

Before presenting the results, it is important to note that direct comparison of accuracy percentages and response times to similar experiments in better studied languages is difficult. The vast majority of experiments reported in the processing literature have been conducted in the university setting, with researchers testing undergraduates. As has been repeatedly shown (see especially Gagliardi 2012; Clemens et al. 2015), reaction times (RTs) and accuracy rates are notably different in populations not familiar with the fundamentals of experimentation or testing (familiarity with computers, experience with test-taking, etc.). To compound matters, Niuean is not taught in schools or used for any testing purposes whatsoever; as an indication of that, many subjects who took our study were surprised to see the language being used outside a strictly colloquial or liturgical context.

With this disclaimer in mind, let us examine the results.

Data were trimmed according to reaction time, with responses taking longer than 30,000ms not included. The responses were further separated according to the type of extraction being performed in each instance: extraction of an absolutive subject (S EXT), extraction of an ergative subject (ERG EXT), and extraction of an absolutive object (ABS EXT). For each extraction type, we measured the proportion of trials in that extraction type for which the participant answered correctly, and we recorded the response times associated with each answer. Because there was no significant difference between all response times recorded in the experiment and response times for only those trials in which participants responded accurately (Wilcoxon test, p-value = 0.759), we will only report mean response times for trials in which participants

selected the correct response. For S EXT, participants selected the correct response in 72.1% of trials. The mean response time for these trials was 3481ms. For ERG EXT, participants responded accurately to 71.8% of trials. The mean response time for these correct responses was 4377ms. For ABS EXT, participants correctly answered 79.5% of trials. The mean response time for the these correct responses was 4419ms. There is no significant difference between the rate of accuracy in participants' response to S EXT, ERG EXT, and ABS EXT, although we observe a trend that participants are more accurate in ABS EXT trials (FisherâĂŹs Exact test, p=0.08). The mean response time for correctly answered S EXT trials (3481ms) is significantly lower than the mean response times for correctly answered ERG EXT (4377ms) and ABS EXT (4419ms) trials (Wilcoxon test, p<0.01). We find no significant difference between ERG EXT and ABS EXT response times, and there is no noticeable trend (Wilcoxon test, p=0.96).

(20)   Results summary

| Condition | Response Time | Accuracy |
|-----------|---------------|----------|
| S EXT   | 3481ms | 72.1% |
| ERG EXT | 4377ms | 71.8% |
| ABS EXT | 4419ms | 79.5% |

## 4.   Discussion of results

Consider first the main question we sought to answer with the experiment: do A′ dependencies involving ergative gaps incur a higher processing load than corresponding dependencies involving absolutive object gaps? In Niuean at least, the answer is definitively no. Both types of gaps in transitive clauses (ergative and absolutive object) took longer to process than absolutive subject gaps in intransitive clause, but crucially, there was no significant difference in response time among absolutive object gaps and ergative subject gaps. Returning to the central issue taken up in this paper, this result calls into question the tenability of the processing account to syntactic ergativity. Indeed the relative ease with which ergative gaps are processed in Niuean makes it unlikely that Tongan and Niuean differ merely in their tolerance for complex structures.

Given that it provides a clear-cut case of closely related languages differing in their tolerance for complex structure, crossed-dependency formation in Scandinavian is once again a relevant comparison. Recall that the differential behavior of Swedish and Norwegian with respect to A′-movement from embedded questions exactly mirrors the differential behavior of ergative arguments under A′-extraction in Tongan and Niuean: in Swedish but not Norwegian, all but the lowest extraction site involved in crossed-dependency formation must be occupied by resumptive pronouns. Crossed-dependencies of the sort on display here have been independently argued theoretically and experimentally to be both complex in a formal-language-theoretic sense (Miller 1991) and difficult to process (Fodor 1978; Engdahl 1979).

Additionally, there exist independent arguments that the relevant resumptive pronouns in Swedish are essentially devices to facilitate processing (see Engdahl 1982; Asudeh 2004), so that it follows that Norwegian and Swedish simply have differential tolerance for complex structure. The relevance of these data are that they show that processing-based accounts can be successful in explaining data that are similar to what we have observed in Tongan and Niuean. This, in turn, suggests that our failure to observe increased processing costs for the extraction of ergative arguments is truly because processing is not at stake here: in those cases where processing factors are actually implicated in differential extraction patterns, they are readily and immediately observable.

The results from our Niuean study are congruent with related results from Avar (Polinsky et al. 2012, Polinsky to appear b), a Nakh-Dagestanian language that also exhibits morphological but not syntactic ergativity. Unlike Niuean, Avar does not have a closely related language with syntactic ergativity that could be used for comparison, although the similarity of the results to those obtained in Niuean suggest we are dealing with pervasive cross-linguistic trends. Polinsky et al. (2012), Polinsky to appear b conducted both a self-paced reading study and a picture-matching study of the processing of relative clauses in Avar. The self-paced reading study revealed that Avar participants processed relative clauses with absolutive-subject gaps faster than the corresponding relative clauses with absolutive object gaps or ergative gaps– just as in Niuean. At the same time, the ergative and absolutive object gaps were processed at roughly the same reading speed, albeit with a different time course. The results from the picture-matching study were similar, with a clear preference, measured in terms of response time, for absolutive subject gaps. Ergative and absolutive object gaps showed no significant differences in terms of response time or accuracy.

Beyond their relevance for arguing against processing-based accounts, the results from these studies, especially when taken in conjunction, have ramifications for another well known issue in the processing literature. Specifically, it has been repeatedly noted that there exists a so-called *subject processing advantage*, which refers to the general, strong processing advantage, measured variously by reaction time, neuroimaging, etc., associated with A′-dependencies that involve a subject gap over those that involve an object gap. Such effects have been experimentally observed in at least English (King and Kutas 1995; Traxler et al. 2002 a.o.), German (Schwartz 2007, and further references therein), Dutch (Frazier 1987, 1989), Japanese (Miyamoto and Nakamura 2003; Ishizuka et al. 2003), Korean (Kwon et al. 2006, 2010, 2013), Russian (2011; Levy et al. 2013 and further references therein), and Turkish (Demiral et al. 2008; Özge et al. 2009). All of these languages exhibit nominative-accusative alignment, raising the question of whether the SPA is truly about subjecthood or rather has to do with morphological cueing effects associated with the alignment of case morphology in these lanuages. Specifically, the appearance of an accusative marked argument, an object, is contingent on the appearance of a nominative marked argument, a subject, so that accusative case is sometimes referred to as *dependent* case (Marantz 1984). This dependence relation between nominative and accusative case has been shown to provide a *cue* to the processor in

the parsing of certain filler-gap dependencies. The logic is as follows. The presence of an accusative argument in a given clause cues the processor that the clause is transitive and that a nominative argument should be projected. Accordingly, nominative gaps in, for example, relative clauses are predicted to be easier to parse because the presence of accusative case cues the parser to the presence of a nominative argument that, if absent, must be the head of the relative clause. Several studies provide empirical evidence in favor of this cueing effect in the processing of relative clauses, most notably in Korean (Kwon et al. 2006) and Japanese (Ueno and Garnsey 2008).[6] Because this morphological cueing effect intervenes to facilitate the processsing of nominative gaps, it is difficult to tease apart the relative import of morphological case and other *subject*-properties on the SPA. In other words, it is unclear whether the SPA exists independent of morphological cueing.

In this context, our results from the morphologically ergative languages Niuean and Avar have the potential to differentiate the relative import of morphological cueing and other subjecthood properties on the SPA. In these languages, it is the case borne by transitive subjects, ergative, that is dependent: it is only in those (transitive) clauses with an absolutive object that ergative case surfaces on the subject. Consequently, the case-cueing effect, if it exists in these languages, should be expected to be triggered by ergative case: the presence of an ergative argument informs the parser that there must be an absolutive argument projected in the clause. In contrast, if the SPA exists independent of case cueing, it should work in these languages to facilitate the processing of both ergative-subject gaps and absolutive-subject gaps, but not absolutive-object gaps. Case cueing and the SPA are thus at odds in these languages.

The results from Niuean and Avar seem to confirm, or at least are consistent with, the conclusion that morphological cueing and the SPA are two independent phenomena. Specifically, we observed that absolutive object gaps and ergative gaps, where the SPA (if it exists independent of morphological cueing) and morphological cueing are at odds, are more difficult to process than absolutive subject gaps, where the SPA is expected to advantage processing. That is, in those cases where the two effects are predicted to be at odds, we observed correspondingly slower processing than in the case where we would expect the SPA to advantage processing. Further support for this conclusion comes from results on processing of relative clauses in Mayan languages (Norcliffe 2009; Clemens et al. 2015). In the languages studied here, ergativity is encoded only on predicate heads, not via case marking, so that there is a corresponding lack of morphological cueing. Clemens et al. (2015) show that in the absence of such cueing effects, the SPA leads to a clear advantage for the processing of absolutive subject gaps and ergative gaps over absolutive object gaps.[7]

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[6]See also Bornkessel-Schlesewsky and Schlesewsky 2009 and Skopeteas et al. 2012 for evidence that morphological case is a strong cue in processing.

[7]The transitivity effect observed in Niuean and Avar, which held even though the intransitive conditions were of the same length as the transitive ones, with a PP in place of the object, has been replicated in studies on accusative languages as well (see, for example, **?**, who document a transitivity penalty in Russian). This suggests that morphological cueing and

## 5.    Conclusion

The explicit aim of this investigation was the determination of whether syntactic ergativity might yield to a processing-based account along the lines suggested by Hawkins (2014) for related phenomena such as accessibility of different constituents to relative clause or wh-question formation. The experimental evidence we gathered on the processing of ergative and absolutive gaps in Niuean casts doubt on a processing-based explanation of ergativity, especially when taken in conjunction with similar results in Avar (Polinsky et al. 2012) as well as Chol and Q'anjob'al (Clemens et al. 2015). In light of this conclusion, it is especially important to revisit the various syntactic approaches to syntactic ergativity, and in this domain too Niuean and Tongan present an excellent test case. It should be possible to isolate the source(s) of syntactic ergativity, whatever it may be, by comparing these two exceptionally similar languages.

Of course, restrictions on A′-extraction and the notion of subject constitute only a small fraction of the topics that experimental investigation into ergative languages has the potential to inform our understanding of. To list a few examples, our understanding of the distribution of ergativity, including a number of typological gaps (accusative languages with syntactic ergativity, languages with an accusative case system but an ergative agreement pattern, etc.), of the nature of ergative case (structural vs. inherent), of the heterogeneity of ergative languages (absolutive sometimes appears as a default case and sometimes as an analog of nominative) could all stand to benefit from further experimental investigation (see Longenbaugh and Polinsky to appear for more discussion). While these areas all ostensibly concern properties of ergative languages, as we saw in the study presented here, the results can have ramifications that reach far beyond the original questions. The work presented and discussed herein ought thus be viewed as a preliminary demonstration of the importance of the experimental study of ergative languages.

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the SPA may not be the only factors at play in these data, although more work is certainly needed.

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