Nicaraguan Sign Language as a Realization of the Language Bioprogram

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Abstract

This study compares Nicaraguan Sign Language (ISN) and Hawaiian Creole English (HCE) in order to validate the realization of the Language Bioprogram in environments that lack linguistic input. Bickerton (1981) proposed the existence of such a Bioprogram that acts as a mechanism that gives humans the innate sense of what for a language should take. Some (Kegl & McWhorter, 1997) have argued that sign languages are better candidates for studying the Bioprogram because deaf children are linguistically isolated because of their inability to hear spoken language and often their lack of access to deaf and sign language education. ISN is especially suited for a study about the Language Bioprogram because its de novo emergence in the late 20th century has been documented. In this work, it is hypothesized that if HCE and ISN were both products of the Language Bioprogram, then they should have structural similarities. And overall, there is evidence that ISN and HCE do have similar underlying structures. First, both languages feature SV as the basic word order and allow for topicalization of constituents by moving them to the front of the sentences. Both languages also exhibit similar behavior in terms of relative clauses, in that such clauses are subject to the A-over-A principle as described by Chomsky (1964). Second, both languages make similar basic distinctions with regards to definiteness of NPs, tense, mood, and aspect. Third, both languages feature similar mechanisms for negation, forming interrogatives, and expressing the existential and possessive. There were some supposed Bioprogram parameters that are found in HCE, but not in ISN, but this may be explained by modality-specific effects, environmental and social effects, or language contact. The similarities between HCE and ISN may be further evidence for an innate mechanism common to all humans that sets linguistic parameters. Conversely, the differences between HCE and ISN suggest that social and environmental factors may have lasting effects on cognition and language acquisition.

1 Introduction

Language and the capacity to learn it are some of the defining features of humanity, but its origins have eluded people for millennia. Some have hypothesized that humans are innately endowed with some sense of what form a language should take. For example, Herodotus wrote of Psammetichus, an Egyptian king from the 7th century BCE, who isolated two infants from language to discover its origins. A couple of years later, the children were allegedly heard
babbling bekos, which was coincidentally the Phrygian word for ‘bread.’ Because the children had seemingly acquired language, despite lacking any outside linguistic input, Psammetichus concluded that language is innate and that the “first language” was Phrygian. While the veracity of this account is highly questionable, it does raise some important questions: How do children learn language? Are there certain features of language that are innate to humans? What would happen if a child did not acquire language?

In modern times, documented cases of early childhood language deprivation have given insight into these questions about the origins of language. For example, the case of Genie is often cited as evidence for a critical period for language acquisition; this critical period refers to a hypothetical stage in development in which the ability to acquire language is at its peak (Johnson & Newport, 1989; Lin, et al., 2016). Genie was a child who had been confined to a small room for most of her life. Because her abusive father prohibited the rest of the household from speaking to her, Genie did not acquire a first language until she was rescued at the age of thirteen. The critical period for language acquisition is generally thought to start in infancy and end around puberty. Thus, because Genie had began to learn language after the stage in her life when it would have been ripe to do so, she was never able to fully master complex English syntax or morphology (Fromkin, et al., 1974; Senghas, 1986; Lin, et al., 2016). There is now evidence for separate language acquisition critical periods for L1 and L2 languages (Pallier, 2007).

Simply comparing the structural features of the world’s languages has also given some insights into the origins of language. For example, languages have been found to be organized according to a hierarchy of structures. The specific relationship between these structures are
generally language-specific, but that language is organized in this way is universal (Cook, 1988). In general, every language has rules that govern how phonological features combine to form morphemes and words, which are themselves combined to form phrases and sentences according to another set of rules. The language learning process is also generally the same for different languages (Gleitman, 1993).

Evidence that humans are born with an innate sense of what form a language should take, and with the mechanism to learn language, has also come from the study of creole languages. In general, a creole is a language that developed from a pidgin. A pidgin is a simple means of communication between multiple groups that speak mutually unintelligible languages; pidgins incorporate some elements from the native languages of its speakers. The main difference between the two is that creoles have a full grammar, while pidgins are limited in terms of lexicon, morphology, and syntax (Trask, 2015). More thorough definitions of *pidgin* and *creole* are introduced later in this work. Many creole languages were the result of European colonialism between the 15th and 19th centuries: Europeans occupied territories around the world and establish plantations that were maintained by enslaved people from Africa or, in later centuries, immigrants from Asia. A pidgin would often arise in these plantation societies to facilitate communication between the colonizers and plantation workers, and between the plantation workers among themselves. The colonizers spoke European languages, such as English or French; these languages were the *superstrate languages* in their respective societies, which means they were the language of prestige. Those who worked on the plantations came from different linguistic and cultural backgrounds, and thus spoken a variety of mutually unintelligible languages; the languages of the plantation workers were the *substrate languages*, i.e., those of
lower prestige. The slaves from Africa spoke Yoruba, Igbo, Fon, etc. and the immigrants from Asia spoke Cantonese, Japanese, Tagalog, etc. (Bickerton, 1983; Holm, 1988).

According to Bickerton (1981; 1983; 1983), children born in those plantation societies were deprived of linguistic input because they were mainly exposed to a linguistically impoverished pidgin. Most other children who acquire language are exposed to at least one language with a full grammar. Bickerton asserts in the Language Bioprogram Hypothesis that creoles emerged via the innate language ability of children in pidgin-speaking communities. The Bioprogram is the innate mechanism from which language acquisition is realized. As evidence for the Bioprogram, Bickerton (1983) cites the typological similarities between creole languages that are spoken thousands of miles from each other, arose centuries apart, and have different substrate and superstrate languages. Comparing Hawaiian Creole English (HCE) to other creoles, Bickerton identifies twelve common features among them that may be the linguistic parameters encoded in the Bioprogram:

1. SVO as the basic word order
2. Articles that distinguish between definite and indefinite noun phrases; an additional specific-nonspecific distinction is also made for indefinite NPs
3. TMA system that uses pre-verbal morphemes to express anterior-posterior, irrealis-real, and nonpunctual-punctual distinction
4. Distinction between realized and unrealized complements
5. Relativization and subject copying
6. Negation
7. The existential and possessive being expressed using the same lexical item
Before exploring the Bioprogram Hypothesis further, some terms must be more thoroughly defined: A *pidgin*, as defined by Bickerton (1983), is an “auxiliary contact-language” whose defining feature is that it has no native speakers. Pidgins are used as a simple means of communication between groups that speaking mutually unintelligible languages; and they usually serve some purpose, such as facilitating trade between different language groups. Because of this, pidgins are grammatically impoverished: Pidgins lack morphological and lexical complexity because their use is usually restricted to a certain context. Syntax in pidgin languages are quite variable, being influenced by the syntaxes of the native languages of the pidgin users (Bickerton, 1981; Bickerton, 1983; Trask, 2015). A *creole* is narrowly defined by Bickerton as a language that arose from a pidgin that had not existed for more than a generation; in Bickerton’s model, no more than 20 percent of a pidgin-speaking community were native speakers of the superstrate language. This narrow definition of creole excludes some languages that are analyzed as creoles in other models, such as Tok Pisin and African-American Vernacular English (Trask, 2015). For the purposes of this work, a *creole* is defined as any stable language that arose from a pidgin. The defining feature of a creole is that it has both a full grammar and first language speakers, neither of which are found for pidgins. Finally, in this work, one *acquires* a first language and *learns* a second language. For a population to *develop* a language is for the
language to arise in that population via activation of an innate mechanism; in this work, “to develop a language” does not denote the purposeful construction of a language.

2 Literature Review

Responses to Bickerton’s Bioprogram Hypothesis have aimed to refine the original theory. Kegl and McWhorter (1997), for instance, argue that the creoles that Bickerton examined are not ideal models for studying the Bioprogram because of the tenuous circumstances in which those languages arose. Kegl and McWhorter first noted some faults in the assumptions made by Bickerton about HCE. It was assumed that the people interviewed by Bickerton in the 1970s were the first generation of HCE, i.e., those who defaulted to Bioprogram parameters because their parents used Hawaiian Pidgin English (HPE), which was lacking in syntax. But Kegl notes that there are newspaper articles dating to the mid-19th century that describes a language that was most likely HCE (Kegl & McWhorter 1997). Thus, the people that Bickerton interviewed were most likely not from the generation of people who had to access the Bioprogram. Bickerton also pointed to the emergence of Caribbean plantation creoles as evidence for the Bioprogram. But, Kegl and McWhorter argue that the enslaved African people on the Caribbean plantations may have learned the language of the European slavers as a second language. And the first generation of African slaves must have surely taught their children some of their native language. Kegl and McWhorter also argue that even children with only pidgin input will be exposed to enough linguistic structure (indirectly from the native language of the parents) that they would not need to use the Bioprogram parameters (Kegl & McWhorter 1997). Thus, in order to have a greater understanding of the Bioprogram, children who had even less linguistic
input should be studied. Deaf people who had not been taught a sign language, nor had extensive contact with a spoken language, meet this criterion.

A seemingly obvious choice of a sign language to analyze for evidence of the Language Bioprogram is American Sign Language (ASL). ASL is considered by some to be a creole, having arose from contact between French Sign Language and Martha’s Vineyard Sign Language. Furthermore, some note that ASL undergoes a process of re-creolization with each new generation of signers because native ASL-signing deaf children often learn their language from non-natively ASL-signing hearing people (Fisher 1978, cited in Kegl 2002). Despite these observations, ASL would not be a suitable model to study the Bioprogram because the language already has a full grammar; ASL has existed for about two centuries and has since developed complex syntax and morphology, as well as a wide lexicon. Thus, native ASL-signing deaf children would not have to access the Bioprogram because there is no lack of grammatical structure that would necessitate it (Kegl 2002).

The emergence of Nicaraguan Sign Language (Idioma de Señas Nicaragüense; ISN) in the early 1980s provided the opportunity to study de novo language emergence. Following the Nicaraguan Revolution, the newly installed government established public schools for special education, which included an oralist curriculum for deaf Nicaraguan children. Deafness was highly stigmatized in Nicaraguan society, thus deaf children were generally kept away from public view. Because of this ostracization and lack of educational resources, the deaf children had neither spoken nor sign language exposure prior to their admission to the public schools. Instead, the children communicated with their families via idiosyncratic homesign systems that were devoid of any morphosyntactic structure. Homesigns are non-linguistic gestures that a deaf
person might use to communicate with their hearing family members. The children enrolled in these schools eventually developed a sign pidgin, now termed *Lenguaje de Señas Nicaragüense* (LSN), independent of any other language (Senghas 1986; Kegl and McWhorter 1997). Concurrently, a separate sign pidgin developed to facilitate communication between deaf and hearing people; this is now termed *Pidgin de Señas Nicaragüense* (PSN). The following generation of students who attended these schools learned both LSN and PSN, and ultimately developed ISN (Kegl, et al. 1999). It is reasonable to ask then whether this process of grammaticalization that resulted in the shift from dozens of idiosyncratic home sign systems, to sign language pidgins, then finally to ISN was a manifestation of the Bioprogram. Kegl (1997) not only suggests that the children in Nicaragua accessed the Bioprogram, but also compares the development of ISN to the development of HCE and the Caribbean plantation creoles. In the plantation scenarios, the development of a creole involved multiple full language inputs that underwent leveling and regularization in the pidgin. There was no need for children in this situation to access the Bioprogram because there were many linguistic parameters and structures to choose. In the case of ISN, the children had to access the Bioprogram because enrollment into the public schools brought forth the need to communicate, but students’ individual homesign systems were lacking in structure (Kegl 1997).

The creolization model for ISN as proposed by Kegl, et al. (1999) is as follows: Spanish can simply be considered a marginally influential superstrate. The situation with the potential substrates, though, is much more difficult: The idiosyncratic homesign systems can each be considered a substrate, but it should again be noted that these did not constitute full linguistic input in the same way that Japanese, Hawaiian, etc. were substrates that contributed to HCE.
Breaking away from the typical creolization model, the two sign language pidgins mentioned above also acted as substrate languages; LSN and PSN are modeled as pidgins because they are the result of contact between the different homesign systems, but they are also modeled as substrate languages to ISN because new students were eventually enrolled in the special education schools and these children learned LSN from the older students. Additionally, PSN is also considered to have acted as a superstrate language because it was used by the hearing teachers in conjunction with Spanish as a way to communicate with the students. Finally, there is evidence that the development of ISN occurred rapidly because young children (who were well within the critical period for language acquisition) accessed their innate Bioprogram parameters. Another, less favored hypothesis says that ISN slowly developed from the gradual conventionalization of homesign systems brought by each deaf student (Kegl, et al. 1999).

If there is an innate Language Bioprogram that directs language acquisition in humans, then it can be supposed that HCE and ISN would be structurally similar, despite having developed independently. HCE and ISN should have some similarities because the children in Hawaii and Nicaragua are of the same species and thus have the same Language Bioprogram. In this work, ISN is compared to HCE with respect to the linguistic features common among creoles, as described by Bickerton (1983), to determine whether there is a Language Bioprogram that promotes the de novo creation of a language under environments with minimal linguistic input.
Comparison of Hawaiian Creole English and Nicaraguan Sign Language

Word order and Movement

HCE and other creoles typically have a basic SVO word order and focused constituents are moved to the beginning of the sentence in marked word orders. Object-fronting occurs when a speaker wants to contrast NPs or contradict a previously made inference. In the following example, a HCE speaker is asked whether he had ever seen supernatural phenomenon:

(1) a no si [of ghosts]
    I NEG see
    ‘I didn’t see it’

(2) daet wan a si [of akualele fireballs]
    that one I see
    ‘That one, I saw it.’

    (Bickerton, 1981:19)

Predicate-fronting occurs when the subject is implied or has been previously stated, but the predicate contains new information:

(3) in daet hil dea no moa iz
    in that hill there NEG more tree.PL
    ‘In that hill, there are no more trees’

    (Bickerton, 1981:20)

The passive voice is rare amongst creoles, including HCE. Passive constructions involve only movement and no morphological changes. The active object is fronted and becomes the passive subject.

(4) de wen te k foa boad
    they PST take [four board]_{obj}
    ‘They took four boards’

(5) foa boad wen te k
    [four board]_{subj} PST take
    ‘Four boards were taken’

    (Bickerton, 1981:71)
For most of the sign languages that have been studied so far, the basic word order has been found to either be SVO or SOV. Topicalization generally occurs by fronting, but some sign languages (e.g., German Sign Language), have been found to use eyebrow-raising and other non-manual markers (Roland & Bos, 2016). Word order was found to vary depending on verb class in the first generation of ISN signers. The word order for Verb Class 1, which is comprised of verbs that take only one argument, was found to be SV, though there were instances in which the SUBJ could be dropped. Verb Class 2 involves a two arguments, one animate and one inanimate; the word order for this class was found to be either SOV or OSV (Senghas, et al., 1997).

(6) MAN CRY
‘A man cries’

(7) MAN CUP TAP
CUP MAN TAP
‘A man taps a cup’

(Senghas, et al. 1997:553)

Verb Class 3 involves two animate arguments, such as in the English sentence *A man pushes a woman. In English, man is the SUBJ and woman is the OBJ. In ISN, events such as this are often expressed using two verbs because sentences with one verb and two animate nouns are ungrammatical:

(8) MAN PUSH WOMAN FALL
*MAN PUSH WOMAN
‘A man pushes a woman’

(Senghas, et al., 1997:554)

The basic word order for this word class is $N_1V_1N_2V_2$, where $N_1$ is the agent, $N_2$ is the experiencer, and $V_1$ and $V_2$ are their respective verbs (Senghas, et al., 1997).
Verb Class 4, which involves two animate arguments and one inanimate argument, patterns with Verb Class 3 in terms of word order. The basic word order for Class 4 was found to be $N_1OV_1N_2V_2$, where $O$ is the inanimate object (Senghas, et al., 1997). An example of Verb Class 4 is shown below:

(9) MAN CUP GIVE WOMAN RECEIVE

'A man gives a cup to a woman'

(Senghas, et al. 1997:555)

ISN does not have a grammaticalized passive. Furthermore, as with other sign languages, determining the word order in sentences featuring topicalization is difficult because elements are often repeated. Topicalization has been found to usually occur through fronting (Kegl, 2002).

With respect to Verb Classes 3 and 4, if the sequences $N_1(O)V_1$ and $N_2V_2$ are analyzed as separate clauses, and if $N_1$ and $N_2$ are analyzed as the SUBJ for each of those clauses, then one finds that ISN in general exhibits SV word order. HCE and ISN have independently developed SV word order, with variation in terms of the position of the OBJ. Additionally, VS word orders are rare among both spoken and sign languages (Roland & Bos 2016). SV word order may thus be an innate parameter in the Language Bioprogram.

Specificity and Definiteness

Plantation creoles have been found to use articles to distinguish NPs by specificity and definiteness (Bickerton, 1981). In HCE, specific and definite NPs take the article *da* (from English *the*), while specific and indefinite NPs take *wan* (from English *one*). Examples of *da* and *wan* are shown:

(10) *da* a a ga z wz wari z

*ART.DEF* other guys *COP.PST* warriors

'The other guys [who were mentioned earlier] were warriors'
Nonspecific NPs do not take an article, even if the NP is in a singular form. For example, in the example below, an interviewer asked “Which is smarter, the horse of the dog?” to which a consultant responded:

(13) *dag smat*
    *dog smart*
    “The dog [in general] is smart”

(14) *jaŋ fela de no du dæt*
    *young fellow PM NEG do that*
    “Young fellows do not do that”

(ISN appears to not have articles, but it does distinguish between definite and indefinite NP through the use of deictic expressions, which are elements whose meaning depends on contextual information. Deictic expressions in English include the demonstratives, locatives *here* and *there*, and pronouns (Diessel, 1999). Deictic expressions in ISN are formed through simultaneous pointing and eye gaze towards a referent. If the referent is not in the immediate environment, the deictic expression is directed towards empty space, such that the referent is indexed (IX) to that location in space (Coppola & Senghas, 2010). Definite and specific NPs are marked as such through the use of deictic expressions, while indefinite or nonspecific NPs are left unmarked (Senghas, et al., 1997):

(15) *IX:left BIRD*
    “the bird”
Though the methods are different, HCE and ISN are similar in that the two languages mark specific and definite NPs, while leaving nonspecific NPs unmarked. HCE differs from ISN in that it also marks specific and indefinite NPs, while ISN does not. Bickerton (1981) posits that ARTICLES are found in most creoles, and thus may be encoded in the Bioprogram. But ISN uses deictic expressions to perform the same functions that ARTICLES do in the plantation creoles. It may be a specific-nonspecific distinction is encoded in the Bioprogram, but the specific mechanism through which this occurs is determined through other means and may be specific to modality.

Tense-mood-aspect system

The following section compares the tense-mood-aspect (TMA) systems in HCE and ISN. The literature on HCE (Bickerton, 1981; Bickerton, 1984) typically use the term modality to describe expressions that indicate reality, intent, desire, or obligation, but in this work the term mood is used instead, in order to distinguish from modality referring to the spoken or sign method of communication.

While the TMA systems of different creoles contrast with each other, there are also some structural similarities that are ascribed to influence from the Language Bioprogram. The unmarked, basic form of verbs in many creole languages are in a realis or indicative mood; unmarked action verbs tend to be inherently past tense, while stative verbs are present tense. In addition to other auxiliaries specific to each language, creoles have been found to commonly
express TMA through pre-verbal free morphemes, distinguishing anterior tense (ANT), irrealis mood (IRR), and nonpunctual aspect (NPUN). Bickerton (1981) notes three of the TMA auxiliaries in HCE that originate from English lexical items: *bin* is an ANT marker (from English *been*), *go* marks the IRR mood (English *go*), and *ste* marks the NPUN aspect (English *stay*; Bickerton 1981). The auxiliary *bin* has since become *wen* through normal phonological changes, while *go* can be also found in the forms *gon* and *gonna* (Velupillai, 2003). Different combinations of the three auxiliaries forms the TMA system in HCE. Examples are shown below:

(17)  
hi wok  
he walk  
‘He walked’

(18)  
hi bin wok  
he ANT walk  
‘He had walked’

(19)  
hi go wok  
he IRR wok  
‘He will/would walk’

(20)  
hi ste wok  
he NPUN walk  
‘He is/was walking’

(21)  
hi bin go ste wok  
he ANT IRR NPUN walk  
‘He would have been walking’

(Bickerton, 1983:66-67)

ISN does not make the same TMA distinctions as HCE or other plantation creoles. But both HCE and ISN express temporality through free morphemes, some of which originated as separate lexical items. For example, early generations of ISN signers were found to use lexical items such as NEXT, STOP, or CONTINUE to convey tense and aspect; it is also common to
use ordinal numbers or AFTERWARDS to convey sequential actions (Shepard-Kegl, 2013; Kocab, et al. 2016). ISN and other sign languages tend to express temporality through context: the setting is presented beforehand, and the rest of the conversation is expressed in the present tense, but is assumed to take place in that aforementioned setting (Baker & Pfau, 2016). TMA auxiliaries are found in the pre- and post-verbal position:

(22) IX:chest SICK PAST PRESENT GOOD
I sick PST PRES well
‘I was sick, but now I am well’

(23) LACK BUS HERE
FUT bus here
‘The bus is not here [but is coming]’

(24) IX:chest WORK FINISH
I work COMPL
‘I worked’

(25) FALL circularly-reduplicated
fall-ITER
‘[He] falls head-over-heels repeatedly’

Unlike HCE, ISN can also express mood and aspe ctual information through verbal inflection, which is accomplished by changes in the movement of the verb. Two events can also be expressed through the simultaneous use of both hands, with each hand conveying one event (Kocab, et al. 2016). One example of aspectual inflection is reduplication, which imparts iterative aspect (Senghas, 1997; Kegl, 2002):

HCE and ISN are quite different in terms of the morphological and syntactic structures used to express TMA distinctions, but there are similarities in the actual TMA distinctions themselves. The existence of PRESENT and FUTURE markers in ISN indicate the presence of an
anterior-posterior distinction because there is a way to distinguish past and non-past events. The existence of the lexical item MAYBE suggests the presence of an IRREALIS distinction because the word conveys uncertainty. Finally, the existence of a verb inflection to indicate the ITERATIVE suggests the existence of a punctual-nonpunctual distinction.

Complementation

HCE and other creoles mark sentential complements using different prepositions, depending on whether the complement depicts a realized or unrealized event. In HCE, go indicates a realized event, while fo (from English for) marks the following sentential complement as being unrealized or hypothetical (Bickerton, 1981). ISN has not been found to make this distinction between realized and unrealized complements.

(26) de wen go ap dea erli go plan
they ANT go up there early PREP plant
‘They went up there early to plant’

(27) mo beta a bin go hanalulu fo bai ma self
more better I ANT go Honolulu PREP buy myself
‘It [would have] been better if I [had] gone [to] Honolulu to buy [it] myself’
(Bickerton, 1981)

Relative clauses

HCE differs from most other creoles, as it does not have relative pronouns. Other creoles introduce relative clauses using pronouns when the main clause and the relative clause have the same subject. Bickerton (1981) suggests that the existence of relative pronouns is a recent innovation in the other creoles, citing instances of optional relative pronoun usage in more conservative dialects of Guyanese Creole and Seychelles Creole. HCE and other creoles do
follow the same pattern when the subject of the relative clause is the same as that of the main clause. When this occurs, the sentences undergo subject copying, where the pronoun that corresponds to the subject is placed before the relative clause. An example of subject copying in HCE are shown; note that the pronoun is glossed as PM, which stands for PHRASE MARKER.

\[(28)\] *sambadi dei gon ova dea dea dei gon hia nau

'somebody PM over there PM go here now

'Those who were over there are coming here now'

\[(29)\] *sambadi dei gon ova dea dea dei gon hia nau

'somebody PM over there PM go here now

(Bickerton, 1983)

Bickerton (1983) noted that the placement of the PHRASE MARKER after the relative clause is a manifestation of the A-over-A Principle described by Chomsky (1964), which states that if there is a rule that applies to a type of phrase (e.g., noun phrases), then it must apply to the higher, more inclusive node of that phrase type. As shown in the syntax trees in Figure 1, the PHRASE MARKER dei must be placed after the relative clause gon ova dea because it must branch off the node of the more inclusive noun phrase.

![Syntax Trees](image)

**Figure 1.** Structure (a) is grammatical because the PM branches off the node of the more inclusive NP; in doing so, the PM acts a post-clausal phrase marker. Similarly, Structure (b) is ungrammatical because the PM branches off a less inclusive NP.
ISN patterns with HCE in that relative clauses are also not introduced with relative pronouns. Instead, relative clauses are marked through context; for example, the tense of the verb in a relative clause may differ from that of the verb in the main clause. Most surprising is the realization of the A-over-A Principle in ISN: Lexical items can be repeated after another sign or phrase to express simultaneous events. Unlike HCE, this reduplication occurs for both verbs and nouns in ISN. For example, in the sentence CAT ROLL DESCEND ROLL ‘A cat rolled down [a hill].’ the copying of ROLL after DESCEND indicates a motion in which the subject simultaneously rolls and descends. Another example of this is with the phrase CAT CLIMB CAT, shown in Figure 2:

![Diagram of Sentences](image)

**Figure 2.** In ISN, lexical items are often repeated after a sign or phrase for emphasis. Structure (a) CAT CLIMB CAT ‘The cat that climbed...’ is attested, but Structure (b) *CAT CAT CLIMB is not. According to the A-over-A principle, the PM must branch off the most inclusive NP.

**Negation**

Verb phrases in HCE are generally negated with *no*, but there are other negative auxiliaries used in more specific contexts. For example, *n w* (from English *never*) is an auxiliary that indicates the negated past; *n w* cannot be used for phrases with the copula and *no* must be used instead. There are also two distinct negative forms of the ability and permissive auxiliary *kan* (from
English *can*: *nokæn* is generally used for prohibition (PROHIB), while *kænot* (or *kæno*) is used for inability (INAB). *Nomo* is a negative existential. Finally, as with many other creoles, in negative sentences in HCE, nondefinite subjects, nondefinite VP constituents, and the verb must be negated (Bickerton, 1981).

(30) 
\[
\text{de} \quad \text{no} \quad \text{was} \quad \text{takin} \quad \text{hawa} \quad \text{n} \\
\text{they} \quad \text{NEG} \quad \text{COP.PST} \quad \text{talk.INTRA} \quad \text{Hawaiian}
\]
‘They were not talking Hawaiian’

(Velupillai 2003:55)

(31) 
\[
i \quad \text{va} \quad \text{sæ} \\
\text{she} \quad \text{NEG.PST} \quad \text{say}
\]
‘She didn’t say’

(Velupillai 2003:54)

(32) 
\[
a \quad \text{kæno} \quad \text{si} \quad \text{ju} \\
\text{I} \quad \text{INAB} \quad \text{see} \quad \text{you}
\]
‘I cannot see you’

(Velupillai 2003:117)

(33) 
\[
a\text{wa} \quad \text{grandma} \quad \text{a} \quad \text{tol} \quad \text{as} \quad \text{nokæn} \\
\text{our} \quad \text{grandmother} \quad \text{told} \quad \text{us} \quad \text{PROHIB}
\]
‘Our grandmothers told us that we were not allowed’

(Velupillai 2003:116)

(34) 
\[
\text{nowan} \quad \text{no} \quad \text{kæn} \quad \text{bit} \quad \text{diz} \quad \text{ga} \quad \text{z} \\
\text{nobody} \quad \text{NEG} \quad \text{can} \quad \text{beat} \quad \text{these} \quad \text{guys}
\]
‘No one can beat these guys’

(Bickerton 1981:66)

Negation in most of the sign languages that have been studied so far, including ISN, feature the use of some non-manual negation marker, such as a side-to-side headshake, in conjunction with a sentence-final manual negation marker (de Vos & Pfau, 2010; Roland & Bos, 2016). But there are also negative forms of some auxiliaries and verbs in ISN. For example, there is a phonological difference between the sign for the verb CONOCER ‘to be acquainted’ and NO-CONOCER ‘to not be acquainted,’ where the A-handshape of CONOCER is replaced with an O-handshape for NO-CONOCER. Other lexical items that mark negation in ISN include NOTHING, NEVER, and the general purpose NEG particle. A stark difference between ISN and
HCE is that in negative sentences containing a nondefinite subject and nondefinite VP constituents, only the verb must be marked for negation (Shepard-Kegl, 2013). Examples of negation in ISN are shown below:

(35) IX:chest NO SAD
I NEG sad
‘I am not sad’

(36) IX:chest EAT NOTHING
I eat nothing
‘I haven’t eaten anything’

(37) IX:chest NEVER CAR
I never car
‘I have never driven a car’

(38) SELL ICE NO.THERE
sell ice NEG.EXIST
‘There is no ice to sell’

(Shepard-Kegl 2013)

ISN and HCE are similar in that both languages negate sentences by simply using a negative auxiliary, without changing the word order of the sentences, using auxiliary verbs (such as do in English), or inflection. Additionally, both ISN and HCE generally place the NEGATIVE particle before verbs, though there are some exceptions (e.g. Example 36). Both languages also have negative forms of some auxiliaries or full verbs, but the use of these negative forms is by no means the default construction in either language. The two languages differ greatly in their treatment of nondefinite subjects and verb constituents in negative sentences: HCE requires these to be negated, while ISN does not.

Existential and Possessive
Many creoles mark existential (EXIST) clauses and the possessive (POSS) with the same lexical item. The following example shows HCE *get* used as an existential marker and a possessive marker:

(39) \begin{tabular}{llllll}
get & wan & wahini & shi & get & wan & data \\
EXIST & ART.INDEF & woman & PM & POSS & ART.INDEF & daughter \\
\end{tabular}

‘There is a woman who has a daughter’

(Bickerton, 1981:64)

On the contrary, ISN does not fully follow this pattern. The existential is marked via deixis, while possession is expressed using the verb HAVE. While HAVE and the existential are not exactly the same, they do have some phonological similarities: HAVE is articulated by forming the L-handshape on the dominant hand and making contact between the thumb and the chest, while the deictic handshape is simply an extended index finger. Interestingly, there are two possible ways to negate existential clauses: There is the aforementioned NO.THERE sign, which involves moving both arms, forming the B-handshape, across the signing space such that their paths cross. But there is also a loanword from Spanish that is articulated as NO HAVE, but meaning ‘there is not…’. The observations from HCE and other spoken creoles would suggest that the marking of the existential and possessive using the same lexical item may have arisen via realization of the Bioprogram; but the same construction in ISN arose due to language contact with Spanish.

**Copula**

The copulas in HCE exhibit a tense distinction, with some person/number distinction: There is free variation between *iz* (*am* in the first person singular) and zero-marking for the present tense, while *wæ* is obligatorily used for the past and *gonabi* (from English *going to be*) is used for the
future. In HCE the locative copula and the nonpunctual aspect auxiliary have the same form: \( ste \sim st \). Adjectives are underlyingly verbs in many creoles, including HCE, and thus do not require a copula. On the contrary, ISN and many other sign languages do not have a copula, thus following the pattern exhibited for the present tense in HCE (Shepard-Kegl, 2013; Baker & Pfau, 2016). This similarity between the two languages suggests that zero copula may be a parameter that originates from the Bioprogram. The existence of copulas for the past and future tense in HCE may be the result of superstrate influence from English.

(40) \( \begin{align*}
\text{was} & \quad \text{wan} & \quad \text{smaol bilin} \\
\text{COP.PST} & \quad \text{ART.INDEF} & \quad \text{small building}
\end{align*} \) ‘It was a small building’

(41) \( \begin{align*}
\text{ju} & \quad \text{gonabi} & \quad \text{r o smud} \\
you & \quad \text{COP.FUT} & \quad \text{real smooth}
\end{align*} \) ‘You will be real smooth’

(42) \( \begin{align*}
\text{ai} & \quad \text{mæd} & \quad \text{wid} & \quad \text{h} \\
I & \quad \text{mad} & \quad \text{with} & \quad \text{her}
\end{align*} \) ‘I am mad with her’

(43) \( \begin{align*}
\text{IX:chest} & \quad \text{READY} \\
\text{I} & \quad \text{ready}
\end{align*} \) ‘I am ready’

Questions

Yes-no questions in HCE have the same syntactic structure as their declarative forms. Wh-questions are formed by placing the question word to the beginning of the sentence, without the use of an additional auxiliary.

(44) \( \begin{align*}
\text{æn} & \quad \text{hiz} & \quad \text{ra} \\
\text{and} & \quad \text{he-COP} & \quad \text{right}
\end{align*} \) ‘And he’s right?’
Sign languages in general form yes-no questions through a process similar to that observed in HCE and other spoken creoles. In most sign languages, there is no difference in word order between an interrogative sentence and its declarative counterpart. Much like the use of intonation in spoken languages, yes-no questions are formed with some non-manual grammatical marker, such as a forward tilt of the body or eyebrow raising (Roland & Bos, 2016; Cecchetto, 2012).

Wh-questions in sign languages are often found with the structures OV+wh or SV+wh, where wh is a sentence-final manually articulated wh-word, though wh+[clause] structures are also found in ISN. Some sign languages, most notably ISN, also include a non-manual articulation, such as a nose wrinkle, to wh-questions (Kegl, 2002; Shepard-Kegl, 2013; Roland & Bos, 2016).

Examples of interrogatives in ISN are shown:

(46) **WHERE** URINATION
    ‘Where is the bathroom?’

(47) **TIME** WHAT
    ‘What time is it?’

(48) **MONEY** EXCHANGE **WHAT**
    ‘How much does it cost?’

(4) **Discussion**

In this work, Hawaiian Creole English and Nicaraguan Sign Language were compared in terms of the features that were outlined by Bickerton (1983) as the parameters common among creole languages, and potentially the linguistic parameters that are encoded in his hypothesized
Language Bioprogram. If an innate mechanism, such as the Bioprogram, were responsible for language acquisition and \textit{de novo} language formation in humans, then it can be supposed that HCE and ISN would be similar with respect to those features. Indeed, the findings from this work suggest that HCE and ISN are underlyingly similar in terms of those aforementioned language features, but there are some minor differences between the two: First, there are some morphosyntactic differences between tense-mood-aspect systems in HCE and ISN: while HCE indicates TMA distinctions through pre-verbal auxiliaries, ISN does so using both auxiliaries and verb inflection. Despite the morphosyntactic differences, both languages express similar TMA distinctions. Second, HCE and ISN differ in how noun phrases are distinguished by definiteness and specificity. Both languages mark definite NPs, but HCE accomplishes this through the use of a definite article, while ISN uses deictic expressions. HCE also further distinguishes indefinite NPs by specificity, but ISN does not do this. Third, while both languages exhibit verb serialization, HCE and other creoles distinguish between realized and unrealized complements using prepositions, while ISN does not make this distinction. Fourth, while HCE uses the same lexical item to express the \textsc{existential} and \textsc{possessive}, ISN does not. It should be noted that, under influence from Spanish, the negated \textsc{existential} can be expressed by signing \textsc{no have}, in a pattern that is similar to that found in HCE and other creoles.

The similarities between HCE and ISN suggest that there is a Language Bioprogram that favors the realization of certain forms in human language. But assuming that such as a Bioprogram does exist, the question of how to explain the differences between HCE and ISN then arises. The observed differences between HCE and ISN may be due to modality-specific effects. Because HCE is a spoken language, it is articulated using the vocal cords and perceived
auditorily; similarly, because ISN is a sign language, it is articulated using the hands and face and perceived visually (MacSweeney, et al., 2008). MRI studies have shown that the use of language through either modality is associated with an increase in activity in certain regions in the left hemisphere of the brain. But because sign languages additionally involve the movement of the hands and arms, there is also an increase in right hemisphere activity that is not observed for spoken language (Bellugi, et al., 1989; Hickok, et al., 1996). The Bioprogram is hypothesized to be an innate neurological mechanism, thus there may be regions in the brain that are responsible for the realization of the Bioprogram. But if spoken and sign languages activate different regions of the brain, it can be supposed that the realization of the Bioprogram would be different for the two modalities. This innate mechanism may be controlled by regions in the left hemisphere of the brain, but can be influenced by activity in the right hemisphere associated with sign language. This influence from the right hemisphere may explain some differences between HCE and ISN: the children who developed the two languages were utilizing different parts of their brain. For example, the use of movement and space by sign languages allows ISN to use inflection to express TMA distinctions; the lack of movement in the spoken modality may restrict creoles like HCE to the use of pre-verbal morphemes.

The structural differences between HCE and ISN may also be the result of environmental differences between the two language communities. The environment can affect the structure of neurons that make up the brain, and thus affect its functions (Tavosanis, 2011). First, social isolation has been found to have physical effects on brain physiology, which is then associate with changes in cognitive development (Cacioppo & Hawkley, 2009). The children who developed HCE were part of a larger community, while those who developed ISN were generally
ostracized because of the stigma surrounding deafness (Kegl, 2002). The social isolation experienced by the Nicaraguan children may have had an effect on the parts of the brain that are responsible for innate language ability and the realization of the Language Bioprogram. Because the children who developed HCE were not isolated from the community, social isolation may help explain the differences between HCE and ISN. Second, lack of sensory stimuli can also have physical effects on brain physiology. Certain regions of the brain are responsible for sensory perception; when these regions are not being stimulated, they may undergo a state of dormancy (Kenneally, et al., 1998). The change in brain function may have also affected the realization of the Bioprogram, thus explaining the differences between HCE and ISN.

Finally, the differences between HCE and ISN can also be attributed to language contact effects. When HCE was emerging around the turn of the 20th century, Hawaii was a multilingual society. Immigrants spoke in their native languages amongst themselves and with their children, while speaking Hawaiian Pidgin English with other people. HCE was not just in contact with HPE, but also with Japanese, Portuguese, Tagalog, etc. (Roberts, 2000). Furthermore, many of the children who are hypothesized to have developed HCE via the Bioprogram were attending school, and thus had extensive contact with English (McWhorler, 2006). Similarly, even early in its development, ISN also had contact with other languages, especially ASL. For example, the one-handed alphabet used in ISN is modeled from that used in ASL. The establishment of the Regional Resource Program for Deafness in Costa Rica by Gallaudet University, an American institution, also resulted in other indirect influence by ASL and Costa Rican Sign Language on the development of ISN. Finally, there is also some influence from Swedish Sign Language.
because of collaborative work between the Swedish Federation of the Deaf and the Nicaraguan Association of the Deaf (Delkamiller, 2013).
5 Conclusion

The emergence of Nicaraguan Sign Language (ISN) was hypothesized to be a realization of the Language Bioprogram, as evidenced by the typological similarities between ISN and Hawaiian Creole English (HCE). The differences between the two languages were then hypothesized to be the result of modality-specific effects, environmental and social effects, or language contact. An issue that arose in this work was that both ISN and HCE in their current states have been heavily influenced by Indo-European languages (e.g., English, Spanish, etc.) and Western culture. Both languages, for example, are spoken in the immediate sphere of influence of the United States. Thus, it is difficult to parse out typological similarities that may be the result of the realization of the Bioprogram, and those that are the result of common environmental, social, and linguistic influences. A topic for future research may be a study of a spoken creole (e.g., Nubi Arabic) or a sign language (e.g., Al-Sayyid Bedouin Sign Language) that exhibits little historical or current influence from Western European culture and language.
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