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Editorial

I am very pleased to have the opportunity to introduce the papers in the 27th edition of the ITB Journal.

In this issue, we have a paper from Irene Murtagh on *Computing the Lexicon Morphological-Phonological Interface for Irish Sign Language Sign Realisation*. This paper is concerned with determining the computational lexicon morphological-phonological interface of Irish Sign Language Sign (ISL) for sign realisation and it proposes set of computational phonological parameters for ISL. These parameters are determined with a view to developing a lexicon architecture that is capable of representing the linguistic phenomena consistent with Sign Language and ISL in particular.

The second paper, from Jone Bruno, discusses *A Third Number: Discussing Duals in Lithuanian Language*, and is concerned with the status of duals in Lithuanian. Modern Lithuanian has two grammatical numbers: singular and plural, nevertheless literature sources note the existence of the dual number residue in Lithuanian. This paper overviews the constructions of such phenomenon and presents results of a small research and it looks at the frequency of the usage of dual pronouns and demonstratives in the Lithuanian language. Data for the research was taken from the Corpus of Lithuanian Language compiled by Vytautas Magnus University, Kaunas, Lithuania.

The third paper from Conor Pyle examines *Directionals in Ngaanyatjarra*, a language spoken in Western Australia using a Role and Reference Grammar (RRG) account. The paper looks at directional morphemes within the suffixing subdivision of Australian languages, with both nominals and verbs having rich sets of inflectional and derivational suffixes. Despite this typological categorisation, there are a small number of directional prefixes.

I hope you enjoy reading these articles.

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Computing the Lexicon Morphological-Phonological Interface for Irish Sign Language Sign Realisation

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Abstract

The first modern linguistic analysis of a signed language was published in 1960 by William C. Stokoe, Jr., a professor of English at Gallaudet University, Washington DC, the only college for the deaf in the world. Nearly sixty years on, research in the area of sign language linguistics has established that signed languages are fully developed natural languages with their own syntax, morphology and phonology. The morphology and phonology of signed languages is concerned among with manual and non-manual features. These include handshapes, head, torso, eyebrow, eye, cheek, mouth, nose, chin and tongue movement and also movement of the shoulders. On application of various phonological rules these are used to represent the morphemes, phonemes, phonomorphemes and lexemes of Sign Language. This paper is concerned with determining the computational lexicon morphological-phonological interface of Irish Sign Language Sign (ISL) for sign realisation. We provide an outline of our proposed computational phonological parameters for ISL. These parameters are determined with a view to developing a lexicon architecture that is capable of representing the linguistic phenomena consistent with Sign Language and in particular to this research, ISL.

1 Introduction

Signs use visual imagery to convey ideas instead of single words. Stokoe (1960) described *signs* as being much more simultaneously organised than *words*. “Signs are not holistic units, but are made up of specific formational units: hand configuration, movement, and location.” Zenshan (2007) proposed that *signs* in sign language are situated at an equivalent level of organisation as words in spoken language and these units have psychological and cultural validity for their users. Following Brennan (1992), Leeson and Saeed (2012) identify *signs* in sign language as equivalent to *words* in spoken language in terms of grammatical role.

This paper describes and proposes computational phonological parameters necessary to represent ISL linguistically and in computational terms. We refer to Pustejovsky (1991) with regard to capturing lexical meaning using four levels of lexical representation. We propose an additional lexical representation level with regard to Pustejovsky's model in order to fully represent lexical meaning for Sign Language. We use Role and Reference Grammar (RRG) as the underlying theory of grammar for the development of our linguistic framework.

2 Motivation

In 2015 ISL is still not recognised by the Irish government and has no official status within Irish legislation. Deaf communities have their own culture, with their own values and their own language. This makes them a minority group, both culturally and linguistically. One consequence of this is that no linguistically motivated computational framework has ever been developed to describe the architecture of ISL. This type of framework has the potential to alleviate the communication barrier for members of the deaf community in computational terms by way of development of a 3D humanoid character capable of ISL synthesis. The use of signing avatar technology would provide members of the Deaf community access to important information in relation to education, employment and a myriad of other resources that are not currently available to members of the deaf community in Ireland (Murtagh, 2011a).

3 Three-Dimensional Humanoid Modelling for ISL Realisation

In terms of modality, ISL is communicated as a gestural-visual language as opposed to spoken language, which is communicated within an oral-auditory capacity. Due to the visual gestural nature of ISL, and the fact that ISL has no written or aural form, in order to communicate a SL utterance we must implement a humanoid model within three-dimensional (3D) space. Also in order to define a linguistically motivated computational model we must be able to refer to the various articulators (hands, fingers etc.) as these are what we use to articulate the various phonemes, morphemes and lexemes of an utterance. Murtagh (2011c) describes the development of a humanoid avatar for Sign Language realisation. The initial stage of avatar development involved the development of a skeleton referred to as an *armature*. The armature behaves in a similar fashion to the human skeleton. The bones of the armature are connected resulting in a controllable, intuitively movable character rig. We refer to various components within the joint hierarchy of this 3D humanoid model in our research into the morphological-phonological interface of ISL. Figure 1 below provides an overview of this hierarchy.

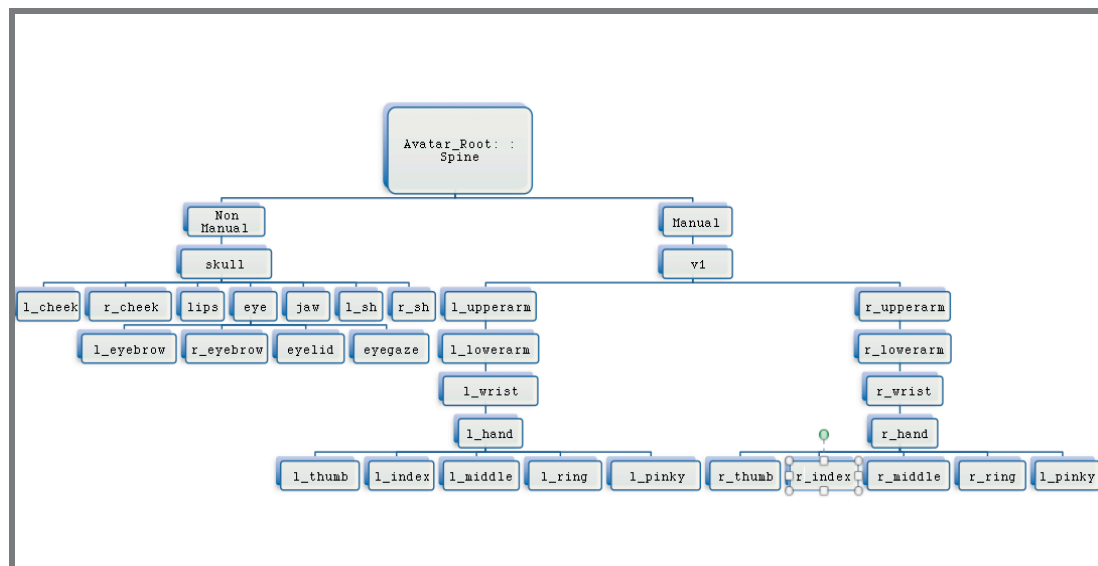


Figure 1: Overview of Avatar Joint Hierarchy (Murtagh, 2011c)

Once the armature was developed using the joint hierarchy illustrated in figure 1, a mesh for the avatar was attached, which resulted in an intuitively movable character rig. Figure 2, 3 and 4 below show examples of the armature, the mesh that is applied to the armature and the resulting avatar rig, from Murtagh (2011c).

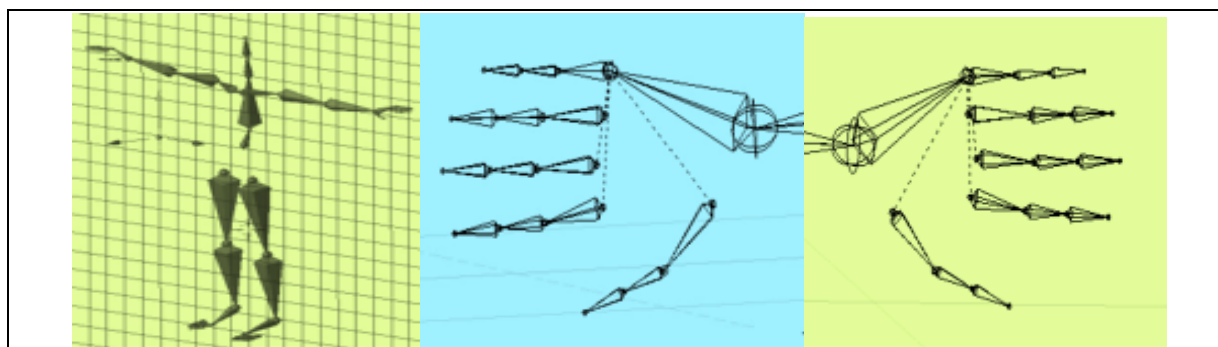


Figure 2: The Blender avatar rig and the armature of the left and the right hand respectively (Murtagh, 2011c)



Figure 3: Various orientations and views of the avatar right hand mesh (Murtagh, 2011c)

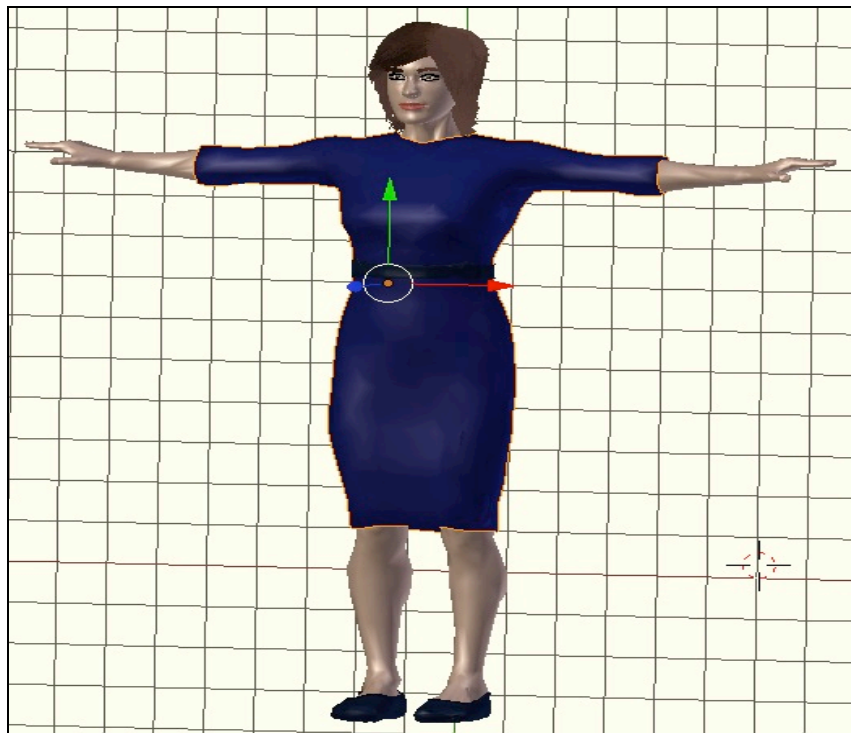


Figure 4: The 3D Humanoid Model (Murtagh, 2011c)

4 The Morphology of Irish Sign Language

4.1 Phonemes and Morphemes

Taub (2001) identified that there is an important difference between *signs* and *words* with regard to iconicity, where signs perform better at iconically depicting the concepts that they denote. Johnston and Schembri (1999) propose the term *phonomorpheme* as a descriptor for the dual nature of iconic signs. This term allows for the fact that iconic signs, contrary to the traditional linguistic division of phonemes and morphemes, can function simultaneously as both phonemes and morphemes. Meir (2012) also identifies that phonemes may be meaning-bearing and not meaningless within Sign Language.

4.2 Locus

A locus in Sign Language refers to a location in space in which a specific entity has been established (Liddell, 1990). The signer can establish an entity by articulating a lexical sign at a specific location in space. A signer can also produce a sign and then direct eyegaze or point to a location in space (Leeson and Saeed, 2012). Once established, an entity can be referred

to later in the discourse. Liddell (1990) describes how locus can also be situated on the signers body, in which case the location on the body that the locus is situated has been found to have phonological significance. Liddell refers to this as having an articulatory function. Locus may also refer to a particular place within 3D space. The signing space can be described as a stage on which entities are located. Signers use classifier predicates to represent real world entities and entities are located in relation to each other as they are in the real world (Leeson and Saeed, 2012). Sutton-Spence and Woll (1999) refer to this a topographical space. Leeson and Saeed (2012) describe how “entities can also be assigned a locus on the fingertips, with each fingertip then being activated as a locus that is co-referential with that entity”.

4.3 Verb Classification

Within the field of spoken languages, much research has been carried out within the domain of verb categorisation and classification. Levin (1993) provides a comprehensive classification of over 3000 verbs from spoken English based on properties shared meaning and behavior. Levin takes the view that the meaning of a verb affects its syntactic behavior and provides us with numerous verb classes by distinguishing verbs with similar syntactic behavior.

Verb classification within Sign Language is traditionally described according to Paddens tripartite classification of verbs based on American Sign Language (ASL) (Padden, 1988). Padden proposes that Sign Language verbs fall into one of three categories: *plain* verbs, *spatial* verbs and *agreement* verbs. The verb class can be differentiated between depending on the arguments that they encode.

4.3.1 Agreement

Agreement verbs, the class that denotes transfer, are said to encode the syntactic role of the arguments, as well as their person and number features, by the direction of the movement of the hands and the orientation of the palms. Agreement verb affixes show agreement with person or location.

4.3.2 Spatial

Padden (1988) describes spatial verbs as a class of verbs denoting motion and location in space. Spatial verbs encode the locations of locative arguments, the source and the goal based on the direction of movement of the hands. The shape of the path movement the hands are tracing is said to often depict the shape of the path that an object traverses in space.

4.3.3 Plain

According to Padden (1988), plain verbs, which constitute the default semantic class within ASL. Plain verbs do not encode any grammatical features of their arguments. They do not give morphological information of person and number by movement and do not show agreement with either subject or object. Plain verbs are uninflected and do not take agreement affixes.

4.3.4 Verb Classification for ISL

Figure 5, taken from Leeson and Saeed (2012) illustrates the morphological verb classes in ISL. Agreement verbs are further divided into those that show person agreement with subject/actor or object/undergoer and those whose affixes are controlled by locations (locative agreement).

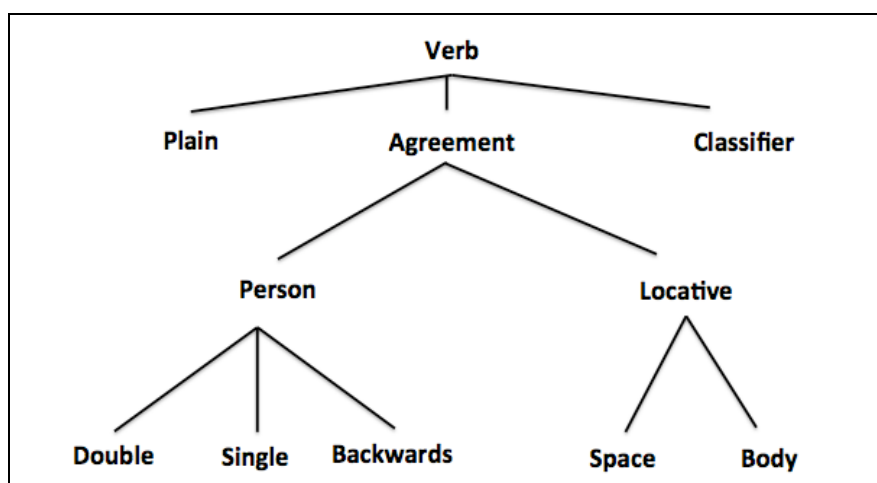


Figure 5: ISL Morphological Verb Classes (Leeson and Saeed, 2012)

4.4 Classifier Predicates

Classifier predicates or depicting handshapes are observed in almost all sign languages studied to date and form a well-researched topic in sign language linguistics” (Zwitserslood, 2012). Zwitserslood describes classifiers as “generally considered to be morphemes with a non-specific meaning, which are expressed by particular configurations of the manual articulator (or: hands) and which represent entities by denoting salient characteristics”. Leeson and Saeed (2012) define classifiers as “a set of handshapes (sometimes with movement components) that provide information about motion, location, handling and the visual-geometric description of entities in a signed language”. Leeson and Saeed refer to McDonnell (1996) who incorporates the six categories of classifier handshapes identified by Brennan (1994) to develop four broader categories of classifier predicates used in ISL. These are defined in table 1.

**Table 1: Four categories of classifier predicates in ISL (McDonnell, 1996)
(from Leeson and Saeed, 2012)**

Name	Description
Whole entity-CL stems	Includes discussion of hand configurations that refer to semantic size and shape, and instrumental categories.
Extension-CL stems	Includes reference to tracing size and shape configurations.
Handle entity-CL stems	Includes reference to handling and touch categories.
Body-CL stems	Where the signers body functions in a way that is similar to the way that handshape functions in certain two-handed configurations.

4.5 Noun plurals

ISL signs are inflected for grammatical information in similar ways to spoken language and while plural in English nouns is often marked by suffixation of a bound morpheme, for example –s in singular/plural pairs like girl/girls, in other languages plurals are marked by partial or full reduplication. Leeson and Saeed (2012) provide an example of noun pluralisation in ISL demonstrating the sign for HOUSE, which has been repeated three times HOUSE+++. This communicates the meaning ‘houses’.

4.6 Number

In ISL, person agreement verbs show a distinction between single and plural arguments in ISL. Leeson and Saeed (2012) also identify a general or non-specific plural, which is communicated through the articulation of a “smooth horizontal concave arc placed before the offset of the verb”. This plural may also be formed by a two handed sign in which each hand replicates the same form. Leeson and Saeed also identify an “exhaustive plural”, where the action is allocated to each member of a group by a series of short convex arcs. An example of an ISL sentence to illustrate an exhaustive plural would be: ‘I gave one to each of them’.

Leeson and Saeed also identify repetitions that modify the verb with regard to “attributive aspect”. In this case the repetition modifies the verb, but the focus is not “on the individuation of the plural argument”. Leeson and Saeed describe how this form occurs with a distributive sense, for example: ‘They all met each other (distributive)’.

4.7 Tense and Aspect

Leeson and Saeed (2012) describe aspect as an important inflectional category in ISL. Although tense is not marked morphologically on verbs in ISL, aspect allows speakers to relate situations in time with the view of being complete or incomplete. Leeson and Saeed describe how ISL shows similarities in findings with regard to aspectual morphology in ASL, which were identified by Klima and Bellugi (1979). Similar to ASL, ISL utilises modifications to the movement parameter to articulate aspectual marking. However, reduplication is particularly significant with regard to aspectual marking within ISL. Different verb types correspond to different dynamic situations. Leeson and Saeed describe an aspectually modified variant of the ISL punctual verb KNOCK. In this case iterative or repetitive aspect interacting with the verb produces a different interpretation.

Typically, within ISL, the verb KNOCK would have two repetitions associated with it. In the case identified by Leeson and Saeed, four repetitions signifies an aspectually modified variant of the verb, which implies that the knocking occurred repeatedly and with urgency. The movement parameter involves a straight line from close to the signer to the locus associated with the object (in this case a door). Leeson and Saeed also identify this “straight-line movement motif” repeated in other punctual verbs, for example HEART-BEATING +++++ (with multiple reiterations of the sign). Leeson and Saeed (2012) also identify the imperfective aspectual modification of durational verbs in ISL. In the case of the verb CRY, the inflection is articulated by a repeated circular movement. The meaning communicated is of the extended duration of the event.

4.8 Compounds

Sequential compounding in ISL occurs when signs are articulated one after the other in sequence. The compound formation involves the use of free morphemes and the meaning of the compound is generally distinct from the meaning of the phrase. Leeson and Saeed (2012) use the sign OLD_MOTHER in ISL, which means grandmother and not old mother to demonstrate this. They report that within ISL compound signs (which are usually made up of two free morphemes) usually involve a location change, and sometimes a change of handshape will also occur. The transition process between the ISL elements in the compound is smoother than the usual transition between separate signs. It is also noted that the duration of a compound sign is quicker than that of the production of individual morphemes.

4.9 Manner

The articulation of a sign representing a verb or an adjective may be modulated to provide further information regarding manner, intensity and also size. Adjectives may be modulated to provide information regarding scale. Leeson and Saeed (2012) identify that temporary states expressed by ISL verbs can also be modified, where movement of the verb is lengthened to convey the meaning of being for example “very” hungry or “very” tired.

5 The Phonetics and Phonology of Irish Sign Language

The visual gestural realisation of a word in Sign Language may involve the simultaneous and parallel expression of a varied number of manual and non-manual features. The phonology of Sign Languages is concerned with manual and non-manual features. Manual Features (MF) include handshapes across the dominant and non-dominant hand in simultaneous signed constructions. Non-Manual Features (NMF) include movement and tilt of head and shoulders, movement of eyes, eyelids, eyebrows, tongue, mouth shape and also blowing of cheeks. These are the morphemes, phonemes, phonomorphemes and lexemes of Sign Language.

5.1 The Handshapes of ISL

Murtagh (2011c) discusses the work of Ó Baoill and Matthews (2000) and describes how signs are formed within ISL by applying a set of phonological rules to a combination of handshapes and also how “identification of these handshapes and permissible combinations (noting that alteration of a single aspect provides the potential for expansion to the lexicon) provides us with an understanding of the building blocks of the formation of signs”. Figure 5 below, taken from Ó Baoill and Matthews, 2000, provides a subset of these the 66 different handshapes that are utilised within ISL in the formation of signed vocabulary.



Figure 6: A subset of the handshapes of ISL (Ó Baoill and Matthews, 2000)

5.2 The Signing Space

Ó Baoill and Matthews, 2000, describe the signing space as the space within which all signs must be articulated. The signing space usually extends from the waist outwards and includes the shoulders and the face. To ensure grammatical clarity, the signing space can be subdivided for meaning. Morphemes are articulated at particular points or *loci* in relation to the

signer for pronominal and anaphoric reference. Neutral space is the space immediately in front of the signer and close to the signer's body. It encompasses the area from the head to the waist and extends the width of the signer's body. Neutral space is the space that is used when producing the citation form of an item and generally does not act as a referent for particular or special meaning.

5.3 The Signs of ISL

As described in Murtagh, 2011, the signs of ISL can be divided into eight different categories according to the manner and mode of production. List 1 following illustrates these:

- (1).
 - a) One-handed signs, including body or near body contact during articulation.
 - b) One-handed signs, where the sign is articulated in free space without any body contact.
 - c) Two-handed signs having identical shape, where the hands touch during the articulation of the sign in space.
 - d) Two-handed signs having identical shape, where the hands move in symmetry but without any contact taking place during the articulation of the sign in space.
 - e) Two-handed signs having identical shape, where the hands perform a similar action and come in contact with the body.
 - f) Two-handed signs having identical shape, where the hands are in contact during articulation, however, using one dominant articulator and one passive articulator.
 - g) Two-handed signs showing a different shape, each hand having an active articulator and having equal importance.
 - h) Two-handed signs showing a different shape, where the dominant hand (depending on whether the signer is left-handed or right-handed) is the active articulator and the other hand is the subordinate or passive articulator.

5.4 Non-Manual Features

As discussed in Murtagh (2011a) NMF consist of various facial expressions such as movement of the head, torso, eyebrow, eye, cheek, mouth, nose, chin and tongue and also movement of the shoulders. While NMF are normally accompanied by a signed lexical item, they can be used to communicate meaning independent to manual accompaniment. The following list identified by Ó Baoill and Matthews, 2000, provides an overview of all the relevant functions provided by ISL NMF.

- (2).
 - a) To show the degrees of emotion
 - b) To denote intensification or modulation
 - c) To distinguish declarative or interrogative sentences
 - d) To denote negation
 - e) To define topic or comment structures
 - f) To indicate conditional clauses
 - g) To show sarcasm

5.5 Handshape in ISL

Murtagh (2011a) discusses William Stokoe, (1960) and his identification of the various parameters which are relevant for the analysis of sign language. He suggested that the articulation of a sign encompassed three different parameters. A designator, which was used to refer to the specific combination of hand configuration. A tabulation, used to refer to the

location of the hands, and a signation used to refer to the movement of the hands. Stokoe referred to these parameters as *cheremes*, the signed equivalent of phonemes.

Later research refers to the parameters of sign language as *handshape*, *location* and *movement*, (Sutton-Spence & Woll 1999, Valli & Lucas, 1995). Battison, (1974) claimed that a fourth parameter is necessary in order to be able to fully transcribe signs. This fourth parameter referred to as orientation denotes the orientation of the hands and fingers during the articulation of the sign.

The HamNoSys inventory of handshapes from the university of Hamburg, has been adopted internationally by many phonologists, however, Thorvaldsdottir (2010) identifies an issue that arises with the use of this international database of handshapes to represent ISL, is that it doesn't necessarily capture the range of ISL-specific handshapes that arise. Another issue with the use of an international inventory of handshapes is that there are phonetic variants within ISL that are not represented in this international database of handshapes.

6 ISL Computational Phonological Parameters

Taking into consideration the various information pertaining to the morphology and phonology of ISL we propose the following computational phonological parameters with regard to the development of a lexicon architecture capable of accommodating the various information pertinent to ISL. We define various x,y,z co-ordinates within 3D space, where x represents a value for the horizontal axis, y represents a value for the vertical axis and z represents a value for the axis that moves towards you or away from you.

6.1 Manual Feature Computational Phonological Parameters

The following sections describe the computational phonological parameters for ISL manual features (MF).

6.1.1 Handshape

We have identified the 66 handshapes of ISL proposed by O'Baoill and Matthews (2002).

With regard to architecture of our lexicon we now define in computational terms the various articulators used to create various hand configurations for ISL communication. We define these articulators once, referring to the hand, but it is important to note that the theory applies to both the left and the right hand. The handshape parameter refers to parameters that allow various configurations of the hand within 3D space. This must include four separate x,y,z co-ordinates, each representing an Inverse Kinematic (IK) driver for the four fingers(f1, f2, f3, f4) and also parameters that accommodate the configuration for the thumb(x,y,z).

We must consider that the thumb can rotate 360 degrees around a central axis and it can also move along a line in an arc shape towards the palm of the hand or towards an overlap of a closed fist. The thumb can also align itself along in an arc shape where it is spread along the arc or sitting parallel to the index finger. While the thumb is in this position the fingers may be open or in a fist shape.

It is assumed that the thumb has been developed and constrained within 3D space to reflect similar capabilities to a normal human hand thumb movement. A default resting handshape will be defined to represent the default resting handshape in 3D space.

Table 2 provides the proposed computational phonological parameters for hand configuration. Figure 7 illustrates the various x, y, z co-ordinates referred to in table 2 above, where (x, y, z) refers to the IK driver situated on the tip of the armature fingers and thumb.

Table 2: Hand configuration computational phonological parameters of ISL

Digit	Parameter	Description
Little finger	$f4Shape(x, y, z)$	IK driver location for configuration of the little finger.
Ring finger	$f3Shape(x, y, z)$	IK driver location for configuration of the ring finger.
Middle finger	$f2Shape(x, y, z)$	IK driver location for configuration of the middle finger.
Index finger	$f1Shape(x, y, z)$	IK driver location for configuration of the index finger.
Thumb	$tShapeR(x, y, z)$ $hShapeClosed(f1, f2, f3, f4)$ $hShapeOpen(f1, f2, f3, f4)$	IK driver location for configuration of the thumb with regard to rotation. The hand may be open or in a fist shape.
Thumb	$tShapeA(x, y, z)$ $hShapeClosed(f1, f2, f3, f4)$ $hShapeOpen(f1, f2, f3, f4)$	IK driver location for configuration of the thumb with regard to movement along arc towards hand. The hand may be open or in a fist shape.
Thumb	$tShapeP(x, y, z)$ $hShapeClosed(f1, f2, f3, f4)$ $hShapeOpen(f1, f2, f3, f4)$	IK driver location for configuration of the thumb with regard to movement along arc from a spread position to parallel with the index finger. The hand may be open or in a fist shape.

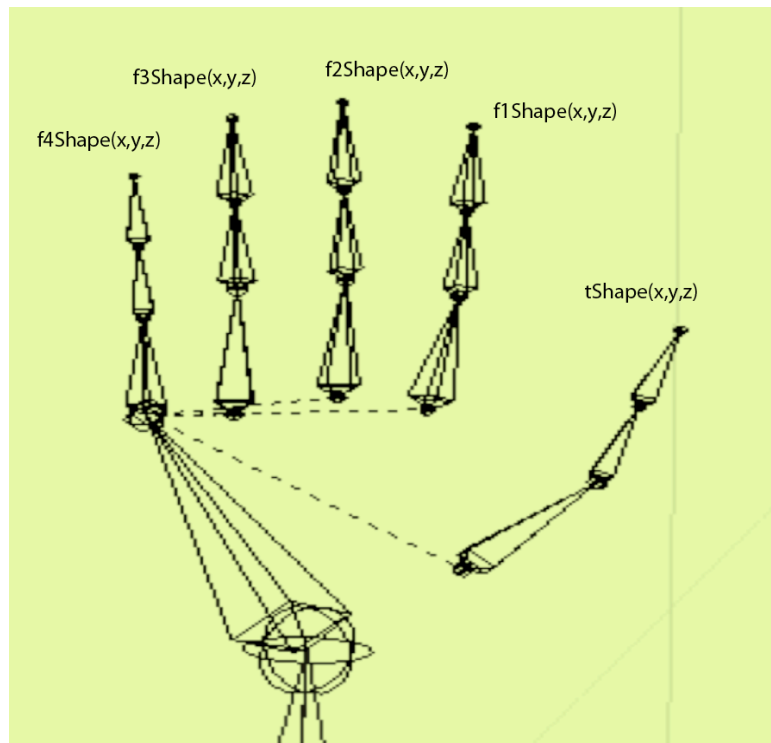


Figure 7: 3D-humanoid hand armature and the associated computational parameters for our lexicon architecture

6.1.2 Orientation

This parameter refers to the orientation of the palm of the hand. Due to human skeletal constraints, the palm orientation parameter also accounts for the orientation of the wrist and the forearm as these are children nodes with regard to the orientation of the palm and are therefore constrained to reflect the same orientation as the palm of the hand. The orientation parameter allows us to rotate the palm of the hand, the wrist and the forearm around any of the x, y or z axis within 3D space. We set out by defining a default resting position of our palms in 3D space $p_{(x,y,z)}$. This position sees the elbows tucked in by our sides and forearms pointing forward along the z-axis with the palms of the left hand and the right hand facing one another. Based on this initial position and due to human skeletal constraints, the palm, wrist and forearm can rotate from this position anywhere from zero to 90 degrees in a clockwise direction. And also from this default position anywhere from zero to 90 degrees in an anti-clockwise direction around the z-axis. Depending on the positioning of the forearm parameter $f1...f8$, which are defined in section 6.1.4, the rotation of the palm, wrist and forearm can rotate about any of the x, y or z axis from +1 degree to +90 degrees or from -1 degree to -90 degrees from our initial orientation $p_{(x,y,z)}$. The axis that we will rotate around is calculated based on the positioning of the forearm.

6.1.3 Orientation

This parameter refers to the hand movement or rotation of the hand in relation to the wrist. When the wrist rotates from the default resting position the hand can pivot on the wrist joint upwards to an angle of 80 degrees and it can also pivot from the default resting position downwards to an angle of 80 degrees. The wrist can also pivot from the default resting position to the left and to the right 20 degrees respectively. These movement constraints will be applied to reflect human skeletal movement. Parameters for the wrist movement can be defined based on the following figure where $w_i(x,y,z)$ represents our default resting position for the wrist and $w1(x,y,z)$, $w2(x,y,z)$, $w3(x,y,z)$, $w4(x,y,z)$ represent values for possible wrist movements along four different paths. Figure 7 provides an illustration of the orientation computational parameters.

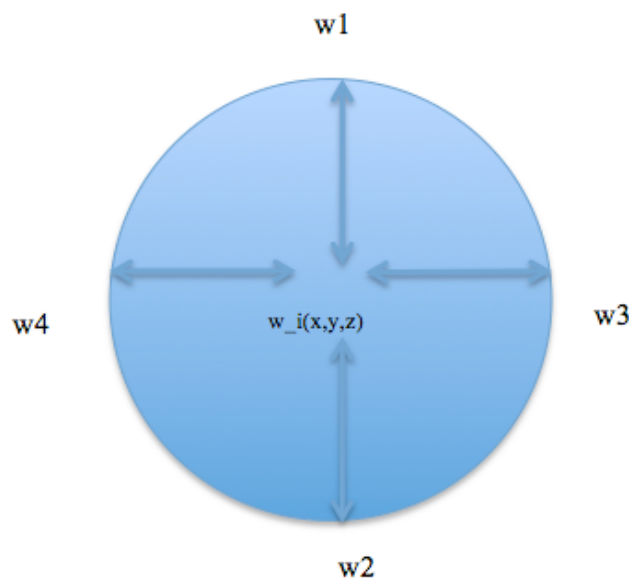


Figure 8: Hand movement parameters from initial position $w_i(x,y,z)$ to human skeletal constraint $w1....w4 (x,y,z)$ in relation to the wrist joint.

6.1.4 Forearm

This parameter refers to the movement of the forearm in relation to the elbow joint. We refer to the initial position of our forearm as our initial point $f_i(x,y,z)$, which will be set to a given parameter for both the left and right forearm. This will initially be set to a value that represents the forearm in its default resting position. This parameter will be over-written as each event within an utterance is realised within our framework, in which case the $f1....f8$ parameter will become the initial parameter and new values for $f1....f8$ will be set depending on the next MF event to be realised.

We propose that in relation to the elbow, the forearm, which includes the wrist, hand and fingers as children nodes and are therefore bound to the forearm, can move in 8 possible directions within our signing space in order to articulate a manual sign. These eight forearm movement parameters can be mapped to the 8 parameters outlined in the following figure, where the points $f1....f8$ define a line of movement in 3D space starting with the forearm in an initial position $f_i(x,y,z)$ and then moving in the direction of our chosen parameter $f1....f8$. The forearm movement can stop at any location along any of the eight parameters $f1....f8$. Forearm movement is constrained to terminate at the endpoint of the parameter $f1....f8$, which is the human skeletal constraint on forearm movement applied to the avatar.

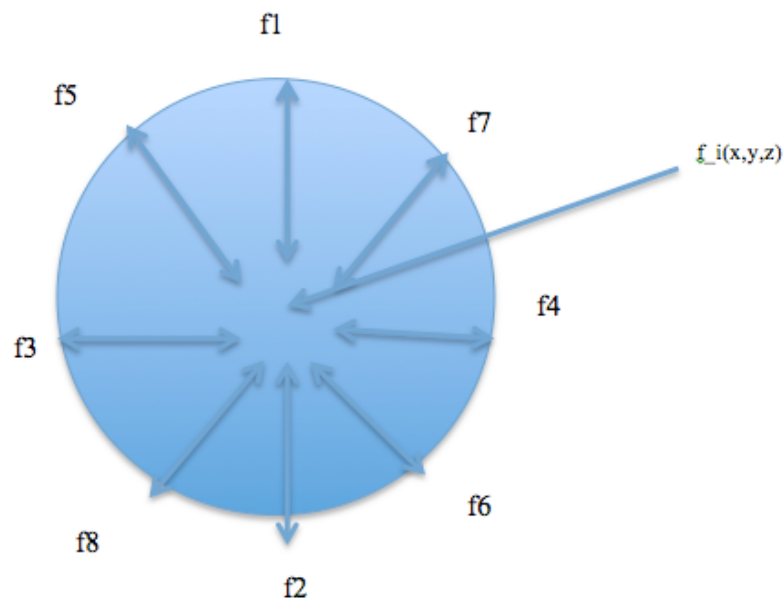


Figure 9: Forearm movement parameters from initial position $f_i(x,y,z)$ to human skeletal constraint $f1....f8(x,y,z)$ in relation to the elbow joint.

Similar to the forearm parameter in relation to the elbow joint, the upper arm parameter refers to the movement of the upper arm in relation to the shoulder joint. We refer to the default resting position of our upper arm as our zero point $(0,0,0)$ and from here we propose that the upper arm which includes the elbow, the forearm, the wrist, the hand and the fingers as children nodes can move in eight possible directions within our signing space in order to articulate a manual sign. These eight upper arm movement parameters can be mapped to any of eight parameters outlined in figure 10.

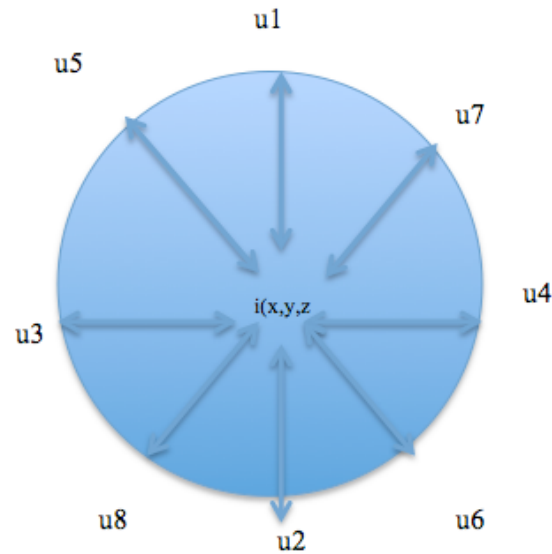


Figure 10: Upper arm movement parameters from initial position $u_i(x,y,z)$ to human skeletal constraint $u1....u8 (x,y,z)$ in relation to the shoulder.

6.1.5 Location

The location or tab at which a sign is realised within 3D space is significant with regard to the syntax and semantics of the articulation in ISL also. One example of this for ISL would be for body anchored minimal pairs “MY” and “STUPID”, where the handshape used is the same and the feature that changes meaning is the location feature. “MY” has the signer’s chest as a tab, whereas “STUPID” has the forehead as a tab. Our framework will take into account four different body anchored spatial locations: the head, the arms, the trunk and the hands. We also define spatial area around of the signer’s body. For the purpose of computational modelling, we have divided the body anchored tabs into a separate category to the spatial signing space tabs. Each of the locations or tabs can be further divided into individual subcategories. The following figure illustrates our proposed hierarchical division for the first two levels.

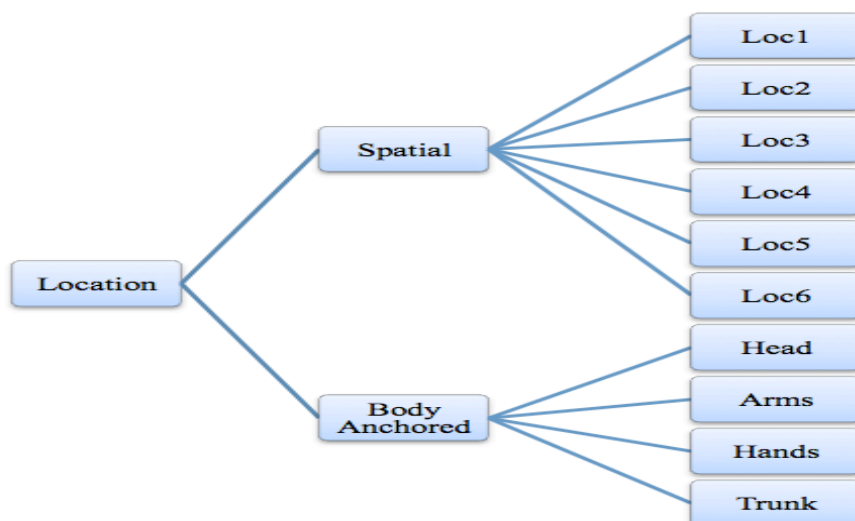


Figure 11: Location or tab parameter sub-categories

Due to the fact that within ISL an entity may be assigned a locus on the fingertips, with each fingertip then being activated as a locus that is co-referential with that entity, we must also consider these and assign the fingers of the hands as a subcategory of the hand tab category.

Table 3 illustrates the ISL body anchored location categories to include our comprehensive listing of subcategories.

For computational ease of modeling we have divided our spatial locations within the signing space into three tiers. The upper tier refers to above eye level, the mid tier refers to the level of neutral space in front of the signer at mid torso level and the lower space refers to the tier below torso level. The diagram following illustrates our computational parameters for spatial location with regard to our ISL Lexicon architecture.

6.1.6 Event Duration

The duration that it takes to articulate ISL MF phonological parameters and also the point at which these phonological parameters are articulated relative to the overall timeline of an articulation is critical to the communication process. This is also similar and true for ISL NMF phonological parameters. It is proposed that a parameter, henceforth termed event duration will be utilised in our linguistically motivated computational framework. Event duration will act as a meta-data repository pertaining to timing or temporal information. The event duration parameter will be utilised as an attribute within our framework in conjunction with every phonological parameter, both MF and NMF. It will represent the duration or time taken for any given MF or NMF phonological parameter to be realised.

The visual gestural realisation of an ISL MF and NMF phonological parameter is considered to be an event within our computational framework. The realisation of each event has a specific duration bound to it. This can be referred to as an event duration. This temporal parameter will play a central role within our framework in relation to the amount of specified time allowed for the various MF and NMF phonological parameter events to articulate various information in relation to an ISL utterance.

Table 3: Hand configuration computational phonological parameters of ISL

Tab	Subcategory
head	hair, topHead, backHead, leftTemple, rightTemple, leftEar, rightEar, leftCheek, rightCheek, nose, chin, forehead, mouth, neck
arm	rightShoulder, leftShoulder, rightUpper, leftUpper, rightElbow, leftElbow, rightLower, leftLower, rightWristTop, leftWristTop, rightWristPalm, leftWristPalm, rightWristRightSide, RightWristLeftSide, LeftWristRightSide, LeftWristLeftSide
hand	rightBack, leftBack, rightPalm, leftPalm, rightIndexup, leftIndexUp, Lf1(x,y,z), Lf2(x,y,z), Lf3(x,y,z), Lf4(x,y,z), Lt(x,y,z), Rf1(x,y,z), Rf2(x,y,z), Rf3(x,y,z), Rf4(x,y,z), Rt(x,y,z)
trunk	chestCentre, chestHeart, tummy

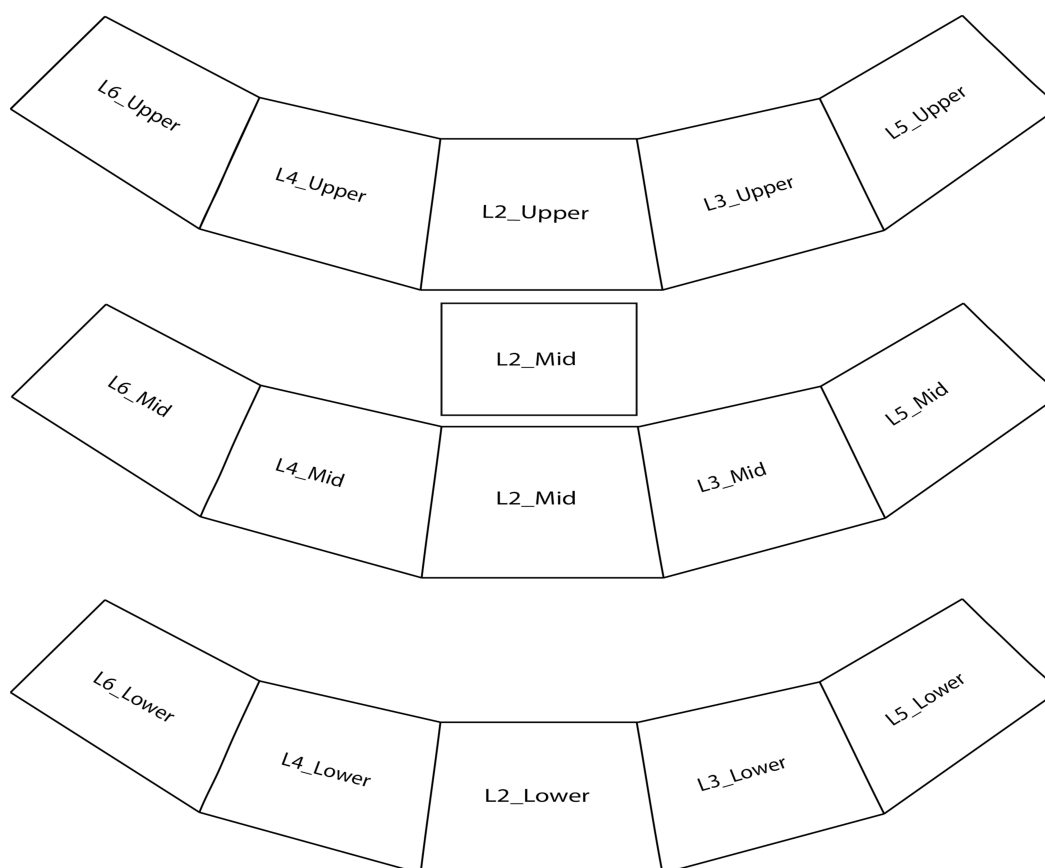


Figure 12: Computational parameters for spatial location with regard to our ISL Lexicon architecture

6.1.7 Timeline

A second temporal parameter, which must also be considered at this stage, is a *timeline* parameter. Not to be confused with the event duration parameter, which defines the time taken to realise any given MF or NMF phonological parameter within an utterance, the *timeline* parameter refers to a linear timeline representing the time taken from the moment an ISL utterance begins until the moment an entire utterance or articulation is completed or terminates. An utterance refers in this case to an ISL lexeme, phrase or sentence that communicates something meaningful.

The timeline parameter will play a central role within our computational framework as it is responsible for the ordering or sequence in which each phonological parameter event will be realised. The timeline parameter will assign specific temporal information to every phonological parameter defining at which point along the overall timeline any given phonological parameter or event may be realised. This parameter will allow us to synchronise the order in which each parameter will be articulated and also allow for the concurrent articulation of parameters when this is necessary.

Due to the visual gestural modality of ISL within 3D space, the event duration and timeline parameters are central components within our computational framework, providing essential temporal information that is relevant and bound to every phonological parameter. These parameters will enable the realisation of a credible, plausible and comprehensible ISL utterance articulated in 3D space.

6.2 Non-Manual Feature Computational Phonological Parameters

The NMF phonological parameters for our computational lexicon architecture are illustrated in table 4 below. It is anticipated that the NMF computational phonological parameters will be held in a repository within our framework architecture and represented as shape keys. These shape keys containing transformations of our 3D humanoid model mesh to reflect the NMF phonological parameter may be triggered when an event occurs within an utterance that requires any of the NMF illustrated in table 4 to be articulated.

7 Lexical Meaning for ISL

Pustejovsky (1995) defines the Generative Lexicon (GL) as a theory of linguistic semantics which focuses on the distributed nature of compositionality in natural language. According to Aristotle, there are four basic factors or causes by which an object can be described (Kronlid, 2003). These are outlined in table 5.

Prior to GL theory, lexical decomposition theories assumed a fixed set of primitives with regard to a word and then operated within this set in an exhaustive fashion to capture the meaning of all words within a language. Lexical ambiguity was accounted for by adding more than one word entry into the lexicon. Pustejovsky proposed that “rather than assuming a fixed set of primitives, let us assume a fixed number of generative devices that can be seen as constructing semantic expressions” (Pustejovsky, 1991).

Pustejovsky proposes that by assuming four levels of representation, as illustrated in table 6, we could best capture lexical meaning.

Pustejovsky defines qualia structures as the modes of explanation associated with a word or phrase. Qualia provide a description of the meaning of lexical items in terms of four roles. Table 7 provides an outline of these.

Table 4: Computational parameters for ISL NMF

ISL NMF Phonological Parameter	ISL NMF Phoneme
Head	nod, shake, tilt_left, tilt_right, turn_left, turn_right, chin_chest, chin_l_shoulder, chin_r_shoulder
EyeBrow (left and right simultaneous)	neutral, frown, arch
EyeLids (left and right simultaneous)	neutral, wide, squint, blink, closed
EyeGaze(left and right simultaneous)	neutral, left, right, up, down, left_up, left_down, right_up, right_down, locus
Cheek (left and right simultaneous)	Suck_in, blow
Mouth	neutral, open_wide, closed_tight, smile_teeth, smile_teeth_wide, smile_closed, round_open, round_closed
*Tongue	in, out_pointed_1, out_pointed_2, out_pointed_3, out_round_1, out_round_2, out_round_3,
R_Shoulder	neutral, up, down
L_Shoulder	neutral, up, down

* With regard to the tongue phonological parameter, the values 1, 2 and 3 in relation to pointed and round define the percentage of the tongue which will protrude past the lips. 1 represents 10%, 2 represents 60 % and 3 represents 100% protrusion.

Table 5: The four basic factors by which an object can be described (Aristotle, Kronlid, 2003)

Cause	Description
<i>Material</i>	The material an object is made of.
<i>Agentive</i>	The source of movement, creation or change.
<i>Formal</i>	Its form or type.
<i>Final</i>	Its purpose, intention or aim.

Table 6: Lexical meaning: four levels of lexical representation (Pustejovsky, 1991)

Lexical Representation Level	Description
<i>Argument Structure</i>	The behaviour of a word as a function, with its arity specified. This is the predicate argument structure for a word, which indicates how it maps to syntactic expressions.
<i>Event Structure</i>	Identification of the particular event type (in the sense of Vendler (1967)) for a word or phrase: e.g. as state, process, or transition.
<i>Qualia Structure</i>	The essential attributes of an object as defined by the lexical item.
<i>Inheritance Structure</i>	How the word is globally related to other concepts in the lexicon.

Table 7: Qualia structure roles (Pustejovsky, 1991)

Role	Description
Constitutive	Describing physical properties of an object, i.e. its weight, material as well as parts and components.
Agentive	Describing factors involved in the bringing about of an object, i.e. its creator or the causal chain leading to its creation.
Formal	Describing the properties that distinguish an object in a larger domain, i.e. orientation, magnitude, shape and dimensionality.
Telic	Describing the purpose or function of an object.

It was initially suggested that in order to create a lexicon architecture, which is sufficiently rich and universal in nature to capture the linguistic phenomena persistent to ISL, the theory of qualia should be extended. On further investigation it is now proposed that rather than extending the theory of qualia, we must develop an entirely new level of representation for lexical meaning to capture these linguistic phenomena and truly represent and accommodate Sign Language at the lexical semantic level.

Computational phonological parameters have been defined here and it is proposed that these parameters and their respective subcategories be represented in a new level of lexical representation for Sign Language referred to as *Phonological Level*. Phonological level refers solely to the lexical meaning of signed languages and specifically to the level of lexical meaning for Sign Language in which the essential (computational) phonological parameters of an object as defined by the lexical item are captured.

Table 8 illustrates the four levels of lexical meaning proposed by Pustejovsky (1991) and an additional *phonological structure* level, which has been proposed in relation to our research.

Table 8: Lexical meaning - five levels of lexical representation for Sign Language (An extension of Pustejovsky, 1991).

Lexical Representation Level	Description
<i>Argument Structure</i>	The behaviour of a word as a function, with its arity specified. This is the predicate argument structure for a word, which indicates how it maps to syntactic expressions.
<i>Event Structure</i>	Identification of the particular event type (in the sense of Vendler (1967)) for a word or phrase: e.g. as state, process, or transition.
<i>Qualia Structure</i>	The essential attributes of an object as defined by the lexical item.
<i>Inheritance Structure</i>	How the word is globally related to other concepts in the lexicon.
<i>Phonological Structure</i>	The essential (computational) phonological parameters of an object as defined by the lexical item.

8 Discussion and Conclusion

Within this research we have identified and defined the morphology and phonology of ISL. We have considered the morphological-phonological interface and we have identified and defined the various computational phonological parameters necessary to create a lexicon architecture that is sufficiently rich and universal in nature to capture the linguistic phenomena persistent to ISL. In order to adequately represent a grammatically coherent and credible Sign Language utterance in computational terms, we must consider the behaviour of these MF and NMF phonological parameters in relation to temporal information. We have proposed that *event duration* and *timeline* parameters will play a central role within our computational framework as these parameters will be responsible for the management of the ordering or sequence in which each phonological parameter event will be realised.

It is anticipated that these parameters will enable the realisation of a credible, plausible and comprehensible ISL utterance articulated in 3D space. We have also proposed parameters for handshape, orientation, hand movement, forearm, upper arm and location. The location parameter has been subdivided into spatial and body anchored parameters and each of these subcategories have been rigorously defined. We have also defined parameters that are necessary to accommodate information pertinent to NMF.

Further to this we have proposed that with regard to GL theory (Pustejovsky, 1991), that we must extend the levels of representation for lexical meaning specific to signed languages. We propose that we add a fifth level: *Phonological Structure*. This new level representing the phonological structure will be utilised to accommodate information pertinent to Sign Language that must be captured to truly represent the lexical meaning of signs.

Further investigation and consideration must be given to the development of our linguistically motivated computational framework architecture. Questions relating to where the various 66 handshapes of ISL will reside within the architecture are currently being researched. On analysis of these handshapes we have identified that 24 out of the 66 handshapes carry grammatical meaning. 42 of these handshapes carry no grammatical meaning without

applying some other phonological rule to the handshape. It is proposed at this point that the various phonemes and morphemes will be stored in separate inventories within our framework.

The next and final stage of this research will be the investigation and the description of the linking system from the lexicon to include our extended lexical representation level into spatial visual syntax for ISL nouns and verbs. We will also investigate the ISL sentence and operator representation within our proposed lexicon architecture.

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A Third Number: Discussing Duals in Lithuanian Language

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Abstract

Modern Lithuanian has two grammatical numbers: singular and plural, nevertheless literature sources note the existence of the dual number residue in Lithuanian. This phenomenon is prominent in Austronesian languages as stated by Schwartz (1989:237-238) and there are different types of duals. However, in European languages this phenomenon is not as widely spread. This paper overviews the constructions of such phenomenon and presents results of a small research which looked at the frequency of the usage of dual pronouns and demonstratives in the Lithuanian language. Data for the research was taken from the Corpus of Lithuanian Language compiled by Vytautas Magnus University, Kaunas, Lithuania which is accessible online. The main aim is to discuss the place of duals in Lithuanian language and to establish whether it is still frequently used by the Lithuanian language speakers.

1. Introduction

Every culture understands the world in different ways and it is safe to say that one of the ways to transfer such information is through language. The existence of syntactic, phonetic and morphological patterns that exist through different languages has been widely discussed and through such discussions, the different perspectives of the existent world were revealed. This paper is set to reveal the complex understanding of the Lithuanian culture through an extraordinary feature of dual number, or as Ambrazas (2006) states the residue of it.

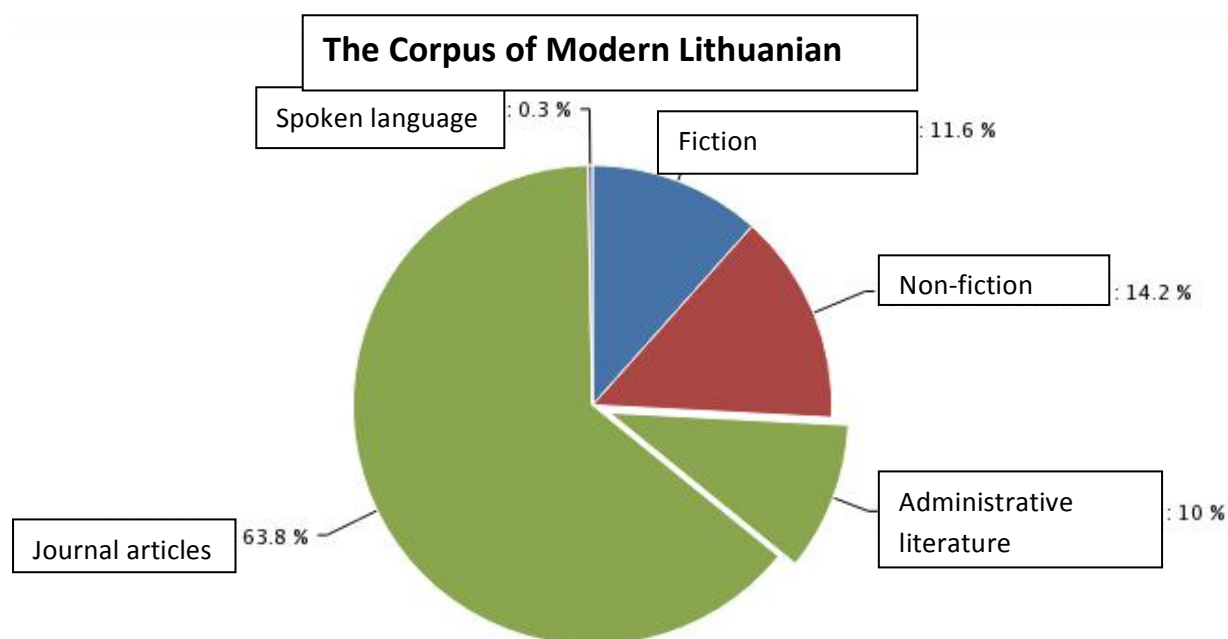
What is the category of number and what are duals? What type of number system does Lithuanian language have? Are duals considered a part of the grammatical class? If not, what are the functions of duals? These are just some of the questions that this paper addresses. Moreover, an empirical research was completed in order to establish the frequency of the dual usage, to observe which duals are preferred by the speakers and which are less used.

2. Framework, Methodology and Data

This research adapts quantitative and qualitative methodology. The data is extracted from Corpus of Lithuanian Language (CLL) which was compiled by the Vytautas Magnus University, Kaunas, Lithuania. It is accessible online through [vdu.lt](http://tekstynas.vdu.lt)¹. It is a database of journal articles, administrative literature, fiction, non-fiction and a small amount of spoken language. This corpus is not annotated and consists of approximately 102 million tokens and is the biggest corpus of the Lithuanian language. Nevertheless, the tools of this corpus are not elaborate. Figure 1 indicates the distribution of literature that this corpus is composed of.

Words that carry dual number were chosen and were searched using the tools of the corpus. The examples were extracted and compared. Also the frequency of the word occurrence was noted and the numbers compared. The next section briefly overviews the class of number in order to fully understand the phenomenon.

¹ <http://tekstynas.vdu.lt/tekstynas/>



Statistiniai duomenys

Figure 1: The distribution of The Corpus of Lithuanian Language.

3. The Category of Number

This chapter discusses the grammatical category of number. Miller (1993:12-13) points out that numerating items is an abstract and arbitrary depending on the cultural understanding and the enumerating system, however, it occurs in all of the languages unexceptionally. It seems to be apparent that the category of number is simple, nevertheless, Corbett (2012:7) marks that number is a morpho-syntactic category and is not as clear as it appears. This means that languages mark it differently and there are various systems of number. To clarify, the category of number does not discuss the numerals like 1, 2, and 3; it rather takes scope over the ways that language encodes the opposition of one, two, three or more referents in the clause. As it is further outlined, this class is multi-layered and more complex.

Pavey (2010:191) explains that in most languages there are distinctions between singular and plural, some languages have dual in addition to traditional binary opposition and only a few have trial number which refers to the three referents. It is clear that the class of number encodes the perception of what the culture groups together as an entity: single person/ item, two people/ items, three as a group marking the importance of all, or distinguishes just the opposition between 'one' and 'more than one', or all of the above. Bhat (2004:91) states that the agreement of number is more complex than it seems in the cases of languages which have specific differentiation of 'inclusive' and 'exclusive' numbers, nevertheless, in languages with the 'singular' and 'plural' distinction, the agreement always corresponds between the noun or the pronoun and the entity it refers to. It needs to be clarified that this paper acknowledges the existence of number systems that enumerate the events in the predication. However, this paper is set out to analyse only the nominal constructions.

There are several levels that the class of number takes scope over. Pavey (2010:191) states that grammatical number on the noun phrase is a core level operator and therefore modifies the entire meaning of the phrase. This means the agreement in number has to be

carried not only by the noun or pronoun, but also by the entire phrase constituents. Labutis (2002:30) states that all adjectival words in Lithuanian do not carry an inherent number, however, when used in a phrase it has to agree with the nominal of the phrase in gender and number and most often in case. Number, also is reflected in the syntactic level. Bhat (2004:16) states that usually arguments agree with the predicate by number and person and are expressed by the noun phrase or the corresponding pronoun. This agreement also depends on the number system of the language and it is reflected on all of the items of the noun/pronoun phrase.

In many languages the number is marked inflectionally, as stated by Miller (1993: 11) and rarely derivational if marked on the nouns, however, there are a few exceptions. Pavey (2010:192), gives an example of Mangghuer language from Mongolic branch, China where there are no specific markers on the noun phrase elements if the numeral is used in the clause, however, if the numeral is not used, then the plural marker is used meaning 'some' or 'a few' of the referents. In any event, all number systems in the nominal constructions enumerate the referents that are being discussed in the act of speech. These referents can be noted in the construction by different means: noun, noun + modifiers, demonstratives, pronouns etc.

Givon (2001: 55, 57-59) states that nouns are concrete entities and therefore the pronouns that refer to the same nouns are considered to be referring to the same concrete entities. Furthermore, it is also noted that the noun dependants of the noun phrase in most cases need to agree with the head noun in number (Givon, 2001:57-58). The class of nouns does not pose many issues, on the contrary to the class of pronouns. Bhat (2004:2) notes that the category of pronouns takes scope over much more than personal pronouns and the division is not clear. Pronouns also are considered to 'stand for' nouns in the sentence which is also questioned by Bhat (2004:2) and Lyons (1968) suggesting that they refer to the entire noun phrase in most of the cases. Furthermore, Bhat (2004:2-4) suggests classifying pronouns into two types: personal pronouns (mainly first and second) and other pronouns like demonstratives, interrogatives, identifiers, relatives, correlatives etc, and refer to such as general pronouns, explaining that classical categorization does not fully describe the morpho-syntactic and mainly semantic functions of the class of pronouns.

It was also suggested by Bhat (2004:15) that third person pronoun could be classified together with the remote demonstrative as it refers to the non-participant of the speech in the speech act and therefore does not carry same characteristics as a first and second pronoun. This paper acknowledges the existence of different classification and distinction between first and second person pronouns and their different characteristic from the rest of the items in the pronoun category, however, the main scope of the paper is not connected to the pronoun classification and all types of pronouns will be considered falling under the general class of pronouns.

Pavey (2010:191-192) notes that singular traditionally is an unmarked category in languages, however, there are languages that have different type of classification like in South-Central Papuan, Papua New Guinea, where the dual is the unmarked category while all other have specific suffixes. As mentioned earlier, Austronesian languages have vast number of types of duals, on the other hand, Indo-European languages have very little examples of existing dual. Corbett (2012:28-29) gives an example of the Slovene, a South Slavonic language, where dual number is optional and depends on the speakers wish to use it, therefore the existence of duals in Lithuanian poses such interest. Givon (2001: 64) proposes that the dual form could be treated as the initial stage of the evolution into plural and notes that such

residues can still be confirmed by Hebrew ‘*im*’ which occurs in most of the words which encode the meaning of two as seen in the Example (1) adapted from Givon (2001: 64):

(1) a.	<i>yad</i> /hand/	<i>yad-ayim</i> /hands/
b.	<i>regel</i> /foot/	<i>ragl-ayim</i> /feet/

Adapted from Givon (2001: 64)

In Uto-Aztec language the dual is formed by adding a dual suffix, nonetheless, in combination with other suffixes it marks plural, but the amount of nouns used in dual is considerably small and restricted to animacy (Givon, 2001:64). This shifts the discussion from the general class of numbers to the Lithuanian number system which is discussed in the next section.

4. Lithuanian Duals

Givon (2001: 63) explains that number classification is usually divided into two domains: singular and plural, where singular is considered to be an unmarked form of the nominal and the marked form is the plural or dual. There are other types of numeral systems in the world and for example, as stated by Schwartz (1989:238), there are three singular dual numbers in Yapese which include dual, inclusive dual and exclusive dual. However, in standard Lithuanian grammars there are only two grammatical numbers: singular and plural. Dual in Lithuanian is not considered to be a grammatical category and is mentioned only as a possibility to derive pronouns with the meaning of ‘two’. Karaciejūtė (2012:50) notes that Lithuanian differentiates between singular and plural grammatical numbers, which is confirmed by Ambrazas (2006:101-102). Nevertheless, Ambrazas mentions the existence of the dual number in certain pronouns, mainly personal pronouns and some demonstratives like *mudu* ‘the two of us’, *juodu* ‘the two of them (masculine)’, *jiedvi* ‘the two of them’ (feminine), *anuodu* ‘the two of those (masculine)’, *aniedvi* ‘the two of them (feminine)’ etc. (Ambrazas, 2006:184-185). Moreover, both pronouns *abu* masculine and *abi* feminine have the dual semantic meaning encoded without the dual number markings (ibid.).

(2)		Derived from NOM	Derived from ACC
1 PL	<i>Mes</i> We	<i>Mudu</i> To of us	
2PL	<i>Jūs</i> You	<i>Judu</i> Two of You	
3PL	<i>Jie / Jos</i> Tey _M / they _F	<i>Jiedu / Jiedvi</i> Two of them	<i>Juodu</i>
3PL	<i>Šie</i> These _M / These _F	<i>Šiedu / Šiedvi</i> Two of these	
3PL	<i>Tie / Tos</i> Those _M / Those _F	<i>Tiedu / tiedvi</i> Two of those	<i>Tuodu</i>
3PL	<i>Anie/ Anos</i> Those _M / Those _F	<i>Aniedu / aniedvi</i> Two of those	<i>Anuodu</i>

Adjectives *abudu* and *abidvi* are derived from the previously noted *abu*, and *abi* adding the dual suffix *-du*; *-dvi* meaning ‘two’. These suffixes as seen from the example (2)

are used to form other dual pronoun and demonstratives. As can be seen from the examples, the forms of dual are derivational and therefore considered to be somewhat productive. It also needs to be noted that Lithuanian also distinguishes between the proximity of the items in the act of speech when using demonstratives *tie / tos*, *anie/ anos* ‘those’. *Tie / tos* are the items that are in closer proximity of the speaker than the ones that are being referred to by the demonstratives *anie/ anos*.

Paulauskienė (2006a: 73), supported by Ambrazas (2006:102), states, that the residue of dual in the modern Lithuanian is enough of evidence to state that there was a more complicated number system which included the distinction between one, two and more than two. Also, it is discussed by Paulauskienė (2006b) the issues of the first grammar books which were written about Lithuanian Language and refers mostly to Klein who lived and published Lithuanian grammars in 17th century (republished in 1950’s). The dual number is also featuring in Klein’s discussions as seen in the example (3):

(3)	CASE	SINGULAR	DUAL	
			M	F
	NOM	<i>Aš</i> ‘I’	<i>Mudu & wedu</i>	<i>Mudwi</i>
	GEN	<i>Manęs</i> ‘me’	<i>Mudu & wedu</i>	<i>Mudwi</i>
	ACC	<i>Manę</i> ‘me’	<i>Mudu & wedu</i>	<i>Mudwi</i>
	DAT	<i>Man</i> ‘for me’	<i>Mum dwiem</i>	<i>Mum dwiem</i>

Adapted from Paulauskienė (2006b:52)

Paulauskienė (2006b:52) notes that the forms are irregularly inflected as case inflection for the singular is more elaborate than the case markings in dual. Furthermore, Paulauskienė (2006b:52-53) points out that there are several things that are not discussed by Klein but evident from the examples; for instance, the existence of the synthetic form derived using *du / dvi* meaning ‘two’ and the a lexical form of *wedu* which is entirely lost in modern Lithuanian. From this example it is seen that the first pronoun in plural has 4 cases, but the dual pronouns are inflected only in the two cases where NOM GEN and ACC have the same word forms with the DAT carrying a different inflectional suffix.

The question arises then, how did dual number disappear from a language? Aikhenvald (2003:244) states that most of the Indo-European languages have lost the grammatical dual through the process of grammaticalization. Peterson (1995:48-49) quoted in Aikhenvald (2003:245) explains that the process of dual grammaticalization in Lithuanian has changed the classification of plural gender and therefor there are no gender differentiation in first person plural as seem in the example (4) adapted from Aikhenvald. This theory seems plausible in regards to the gender distinction, however, the examples are not accurate as the second person plural in Lithuanian is *jūs* and the dual forms also pose some issues. If to look closer to the example (2) it has two types of dual: derived from NOM and from ACC and the number of actual duals are not accounted correctly in Aikhenvald (2003) as well.

(4)	SG	DU	PL
1M	Aš	Mudu	Mes
1F	Aš	Mudvi	Mes
2M	Tu	Judu	Jū
2F	Tu	Judvi	Jū
3M	Jis	Juodu	Jie
3F	Ji	Juodvi	Jos

Adapted from Aikhenvald (2003)

Corbett (2012:25-26) notes that the Tundra Nenets from Uralic language family distinguish singular, dual and plural and the verb obligatory agrees in number with the noun phrases. However, the speaker has a choice to use plural or dual agreement on the verb itself and both are grammatically correct, still, if the subject is used in plural, a dual marker on the verb is unacceptable. In Lithuanian, if the argument is used in the dual, the verb carries plural as there are no dual markings as seen from the Example (5):

- (5) *Buv-o* *aštunt-a* *ryt-o,* *veikiausiai* *aniedu*
 AUX.3.SG.PST eight-SG.F.NOM. morning-SG.M.GEN. most likely **them two**
lik-o *kaimel-yje.*
 stay-3.PL.PST. village-SG.M.LOC.
 /It was eight in the morning, most likely the two of them stayed in the village/.
- Adapted from CMLL.

In this sentence the verb carries the third person plural marker in the past tense while the argument – the doer of the action – is expressed through the demonstrative *aniedu* in dual.

As mentioned above, Ambrazas (2006), Balkevicius (1989), Paulauskiene (2006) and many others state that Lithuanian number is the binary opposition between singular and plural. Roduner and Čížik (2006:67), on the other hand, enumerate three numbers in Lithuanian: singular, plural and dual, noting that dual is used only with several personal pronouns and some demonstratives. Roduner and Čížik (2006:74) propose to add Lithuanian dual to be a part of the number system as it seems to have inflectional properties. As seen from the examples in Example (6), the dual in Lithuanian mostly is used with the first and second pronouns.

This is also evident that there is masculine and feminine distinction in the suffixes. Roduner and Čížik (2006:74) same as Karaciejūtė (2012:49) note that Lithuanian suffixes carry more than one meaning and therefore number is marked together with gender and case by one suffix. In the case of dual, the case is usually NOM as there are no more inflectional variants left from Old Lithuanian. Ambrazas (2006:102) explains that in a few of the dialects the dual number is still retained, however, it is used only in nominative and accusative cases and are at all times used with the numeral *du* and *dvi* ‘two’ or the adjective *abu*, *abi*, *abudu*, *abidvi* meaning ‘both’.

(6) Singular	Plural	Dual
<i>Aš ėjau gatvė.</i> /I was walking down the street/	<i>Mes ėjome gatvė.</i> /We were walking down the street/	<i>Mudu ėjome gatvė.</i> /Two of us were walking down the street/
<i>Tu ėjai gatvė.</i> /You were walking down the street/	<i>Jūs ėjote gatvė.</i> / You were walking down the street/	<i>Judu ėjote gatvė.</i> /Two of you were walking down the street/
<i>Jis ėjo gatvė.</i> /He was walking down the street/	<i>Jie ėjo gatvė.</i> /They were walking down the street/	<i>Juodu ėjo gatvė.</i> /Two of them were walking down the street/

Adapted from Roduner and Čižik (2006:74)

Karaciejūtė (2012) conducted a research by collecting real speech samples from the Varėna sub-dialect speakers in the East Aukštaitija, Lithuania. One of the examples which is presented in the Example (7) reveals the strategy where the speaker uses a dual number agreement on the argument realised as a noun phrase. The noun phrase includes the numeral *du* meaning ‘two’ and the noun *laiškai*, as it appears, the dual number:

(7)	<i>Paskui išvažiav-o, tai po to, tada dar du laišk-u</i>
Later	leave-3.SG.PST, so after that then more two letter-DU
<i>atraš-ė</i>	<i>t-as staršin-a mums.</i>
write-3.SG.PST	that-SG.M.NOM. officer- SG.M.NOM we-PL.DAT.
/Later he left, so after that, then that officer wrote two letters to us./	

Adapted from Karaciejūtė (2012:50).

Such examples show that the dual number is productive and it is used not only on the pronouns and demonstratives, but also on the noun phrases in the non-agent position. Nevertheless, the number of the examples was very limited and so low, that Karaciejūtė (2012) made a conclusion that the dual number in the sub-dialect is used just for highlighting a specific argument in the context of the speech act.

Aikhenvald (2003:247) explains that in most languages the classification of nouns and agreement in number most often is closely connected to other types of noun classification. For example, animate nouns and human noun classes carry the category of number in Australian Anindilyakwa language (Leeding 1996) only human nouns in North Arawak, Palikur Language (Aikhenvald & Green 1998). Roduner and Čižik (2006:71) explains that most research of languages with dual number show similar patterns. It was explained that the animacy hierarchy plays a major role in assigning number to the nominal and pronouns as personal pronouns were dominant in assigning dual (Roduner and Čižik, 2006:71). As suggested by (Givon, 2001:64), animacy is one of the criteria for the languages to have dual number. Roduner and Čižik (2006:73) point out that the rules of such hierarchy does not allow the existence of dual if there is no plural and there cannot be trial if there is no plural and dual (more on the animacy hierarchy see Corbett 2002; Dixon 1979, Corbett 2000). As seen from Karaciejūtė’s (2012) research Lithuanian duals are not restricted strictly to animate entities and Roduner and Čižik (2006:76) also points out that the dual number can be used on any noun phrases, therefore, the animacy theory can be questioned. Demonstratives can refer to any type of referent that can be human, non-human and inanimate so in the case of Lithuanian language animacy theory should be rejected.

5. Research

Corbett (2012:29) points out that if the language uses the dual for specific purposes and it is not obligatory for special class of nouns, the main reason for the existence of dual, as discussed in relation to Slovene, is to highlight the information of the two of the discussed items. Such suggestion by Corbett (2012) explains the existence of the dual pronouns in Lithuanian. This research was inspired by few factors:

- 1) The claims by most linguists that the dual number is extinct and only the residue remains in Lithuanian.
- 2) The existence of productive dual constructions in Austronesian languages while very few Indo-European languages have such number classification.

It is also mentioned that there is a reduction in the usage of the opposition between the ‘two’ and ‘more than two’ referents moving closer to the binary distinction of ‘single’ and ‘more than one’ items (Ambrazas, 2006:i85). The curiosity about the productivity was raised by claims that only the residue of the dual number is left in the Lithuanian language, while clearly it is still used in a daily life (observation is mine). Moreover, Karaciejūtė (2012:49) raises the question whether dual is a semantic or grammatical category as it clearly carries the characteristics of both: it carries the meaning of ‘two’ and it is morphologically marked on the nominal, however, it is syntactically non-obligatory. Roduner and Čížik (2006:75-78) discuss the tendency of declining in the usage of the Lithuanian dual as it has become optional with pronouns and unusable with nouns. This claim, as seen from Karaciejūtė’s (2012) research, can be discarded as the dual number is not productively, but still used in some of the dialects in Lithuania. It is also noted that the main function of the dual in Lithuanian is to mark the close relationship between the two referents and the importance of such depends solely on the speaker (Roduner and Čížik, 2006:75-78).

To clarify the frequency of usage and the productivity of the dual in Lithuanian, such dual constructions of such pronouns were chosen for research in the corpus: *mes* ‘we’, *jūs* ‘you_{PL}’, *jie* ‘they’, *šie* ‘these’, *tie* ‘those’, *anie* ‘those’, *mudu abudu* ‘two of us together’, *kuriuodu* ‘which the two of them’. As most of the pronouns in Lithuanian form the masculine and feminine forms, both types of dual forms were administered through the corpus. It needs to be noted that the pronoun *jūs* ‘you_{PL}’ does not have a feminine distinction therefore the space in the table is left blank. The constructions were searched in the corpus and from 140,921,288 tokens such results were extracted which are presented in the Table (1):

Table (1): The frequency of the dual pronouns in CLL.

	<i>MES</i> /WE/	<i>JŪS</i> /YOU _{PL} /	<i>JIE</i> /THEY/	<i>ŠIE</i> /THESE/	<i>TIE</i> /THESE/	<i>ANIE</i> /THOSE/
Masculine Dual:	<i>MUDU</i> 5571	<i>JUDU</i> 841	<i>JIEDU</i> 3661	<i>ŠIEDU</i> 263	<i>TIEDU</i> 287	<i>ANIEDU</i> 50
Feminine Dual:			<i>JOS</i> /THEY/	<i>ŠIOS</i> /THESE/	<i>TOS</i> /THESE/	<i>ANOS</i> /THOSE/
	<i>MUDVI</i> 1296		<i>JIEDVI</i> 186	<i>ŠIEDVI</i> 29	<i>TIEDVI</i> 16	<i>ANIEDVI</i> 2

It can be seen from the Table (1) that the usage of the duals on the pronouns is very high. The most frequent pronoun that was used in dual was of the first person plural *mudu* of

5571, while the second most frequent was not of the second but of the third person masculine *jiedu* which was 3661. As it was already mentioned, the personal pronouns were used more than demonstratives the most frequent being *tiedu* 287 and least frequent *aniedvi*. It needs to be mentioned that the amount of duals in feminine were used considerably less. Moreover, Karaciejūtė (2012:50) states that the feminine dual is a rarity in the East Aukštaitija as well. According to Holvoet and Semėnienė (2006:106) and Paulauskienė (2006a:72), masculine gender assignment carries a function of marking mixed group referents. i.e. if the group consists of feminine and masculine animate arguments, masculine is used to refer to such group. In her research Bruno (2012) states that in Lithuanian, masculine gender assignment to the loan words of English was used as the neutral gender as there is no formal neutral gender in Lithuanian. As this research only used qualitative analysis, it cannot draw clear conclusions what type of referents were discussed. A more thorough qualitative research is needed to draw the conclusion whether feminine gender duals are declining.

The main function of the first and second personal pronoun, as stated by Bhat (2004) is to mark the speaker and the interlocutor of the act of speech and therefore the indefiniteness of both is considered to be a common characteristic. The rest of the pronouns on the other hand carry the characteristic of the definiteness as they refer to the specific entities (ibid.). Balkevičius (1963:22) states that in Lithuanian language the functions of the first and second personal pronouns correspond to the ones discussed by Bhat (2004), stating that the first personal pronoun is used by the speaker, the second personal pronoun is used to note the interlocutor of the speech act. This explains the high number of duals that were used in the first personal pronoun, however, the second personal pronoun in plural is less used than the third PP.

The research also searched for the frequency of the *mudu abudu* ‘two of us together’ usage. Such construction is presented in the Example (8):

- (8) *Tau tek-s nešio-tis mudu abudu šird-yje.*
 You_{SG.DAT.} have-2.SG.FUT. carry-INF.REF. **we**_{DU.} **two together** heart-SG.F.LOC.
 /You will have to carry us together in the heart/.

Adapted from CMLL

Mudu abudu carries a double marking of dual from morphological and semantic perspectives. Morphologically both words in the phrase are constructed using the suffix *-du* and the semantic meaning both are dual. The languages usually do not prefer the excessive marking for semantic meaning. The explanation two this phenomenon of over specification can be grounded on the speakers wish to shift the focus from the actor of the predicate to the direct argument. The second reason for such construction possibly lies in the agreement of the dual number in the phrase level of *mudu abudu*, however this claim needs to be analysed in more detail which is not the main focus of this paper.

The construction with *kurioudu* was found only 4 times and one of such examples is illustrated in the Example (9):

- (9) [...] *mano tėv-as paėm-ė du pinig-u, kurioudu*
 [...] my father-SG.M.NOM. take-3.SG.PST. **two** **money-DU.M.** **which two of them**
t-as pon-as met-ė ant stal-o [...].
 that-SG.M.NOM. lord-SG.M.NOM. throw-3.SG.PST. on table-SG.M.GEN. [...]
 /[...] my father took the two coins , which two of them the lord threw on the table
 [...]/.

Adapted from CMLL

This example incorporates the classical example of Old Lithuanian type of usage of dual number not only on the pronoun but also on the nominal phrase *du pinigu* ‘two coins’. The money is transcribed in countable equivalent of ‘coins’ as in Lithuanian *pinigas* ‘money_{SN}’ can occur in plural meaning ‘money’ and in singular meaning ‘one’ either ‘a coin’ or ‘a note’.

Corbett (2012:49) suggests classifying the features of languages into morpho-semantic and morpho-syntactic. The former describes the features that carry semantic meaning and are coded morphologically but does not carry any significant importance in syntax, where the latter defines features that are of syntactic importance and is distributed accordingly across the constituents of the clause (ibid.). Following such description, dual number in Lithuanian falls under the morpho-semantic feature as it does not participate in agreement and carries the meaning of two. On the other hand, clauses having dual argument have to be marked by plural as dual carries the semantic meaning of more than one, therefore it partially participates in syntactic marking. Similarly, the same phenomenon is noted by Corbett (2012:50) in Maltese, where the opposition between the singular and the plural is morpho-syntactic and dual number is used only optionally marked by plural agreement markers and is considered to be morpho-semantic.

In the Example (9) the dual number does not reach further than the phrase level as the predicate agrees with the agent *mano tėvas* ‘my father’ in number and person. Such findings obviously show the productivity of dual which reaches further than the pronouns in some dialects as seen from the dialect of Varėna in the findings of Karaciejūtė (2012:52) and the findings of this research. The findings of this research agree with the findings of Roduner and Čižik (2006:80) who explain that the productivity of the dual in Lithuanian defines the dual as part of the number class rather than the residue. Dual on the other hand as seen from the description is not considered to be a grammatical number in Lithuanian language. Therefore, the agreement in dual is carried only on the constituents of the noun phrase that the speaker chooses to use. Furthermore, dual is used not only on the animate or noun phrases referring to humans as seen in the Example (7) and Example (9).

5. Conclusion and further research indications

Nolan (2012:22) states that operators like number are effective on the level of CORE of the phrase, in the case of Lithuanian - the level of the noun or pronoun phrase. As it was established that the dual number in Lithuanian is not a grammatical category, or at least does not fully fall under such classification, dual pronouns in such case is stored in lexicon as a separate entry. This, however, does not explain how Lithuanian dual number can be derived using, for example, the questions words like *kurie* ‘which’ into *kuriedu* ‘which two.’ This research indicated that the dual is still productive and was used quite frequently in Lithuanian language. It occurs on the most plural pronouns including demonstratives.

In Role and Reference Grammar, as noted by Nolan (2012), qualia theory is incorporated to explain a various qualitative features in the clause. Qualia theory, which was developed by Pustejovsky (1995) and adapted in the framework of Role and Reference Grammar (see Van Valin and LaPolla 1997:184-186) states that the qualitative features of the noun phrase add to the composition of the predicate and the clause. As the noun phrase can be substituted by the pronoun phrase and the pronoun phrase can be marked by dual number which carries the meaning of two, it is safe to state that the dual number itself adds to the

predication of the sentence. However, this suggestion needs to be analysed using RRG theoretical framework which is not covered by the main scopes of this paper.

Abbreviations

1 first person	GEN. genitive case
2 second person	INF. infinitive case
3 third person	LOC. locative case M. masculine
ACC. accusative case	NOM. nominative case
DAT. dative case	PST. past tense
DU. dual	PL. plural
F. feminine	PP. personal pronoun
FUT. Future tense	REF. reflexive marker
	SG. singular

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Directionals in Ngaanyatjarra

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Abstract

This paper looks at directional morphemes in Ngaanyatjarra, a language spoken in Western Australia. This is part of the suffixing subdivision of Australian languages with both nominals and verbs having rich sets of inflectional and derivational suffixes. Despite this typological categorisation, there are a small number of directional prefixes. Using a Role and Reference Grammar (RRG) account, we look at directional elements, both prefixes and local peripheral case marking suffixes. RRG posits two types of directional operator, at the nucleus and the core. We find that the prefixes are nuclear operators describing the direction of the verb itself; while the case endings are core operators indicating movement of the predicate's arguments.

1 Introduction

Ngaanyatjarra is a dialect of Australia's Western Desert language group which covers a large territory in Western Australia, South Australia and the Northern Territory. This group also contains the closely related dialects of Pitjantjatjara and Yankunytjatjara. It is part of the Pama-Nyungan family containing most languages outside the Top End of Australia. As in most Australian languages, there are two inflecting classes, nominals and verbs (Blake 1987: 3). Adjectives pattern like nouns and they are together grouped as nominals. Typologically Ngaanyatjarra has an ergative-absolutive nominal and nominative-accusative pronominal case system. Nominals may have predicative function so sentences frequently lack verbs, and ellipsis of arguments is common, with reference retrievable by context. Marking is on the dependent; there is no marking for person, gender or number on the verb. Pama-Nyungan languages are classified as suffixing languages in the great prefixing-suffixing division of Australian languages. However as we see in this paper there are a small number of prefixes that indicate the direction of a movement verb.

2 Role and Reference Grammar

RRG is a functional theory of grammar that has a constituent, operator and focus syntactic projections, and lexical decomposition for semantic representation. Noun and verb are posited as universally valid categories, based on reference (nouns); and predication (verbs) (Van Valin & LaPolla 1997: 28). A clause has a nucleus containing the predicate, a core containing the nucleus and arguments and a periphery containing non argument adjunct modifiers of the core. The syntactic and semantic representations are joined by a linking algorithm. As well as referring items and predicators, clauses may contain operators that act to modify the nucleus, core or clause. Operators are a closed class of grammatical categories (Pavey 2010: 62). The constituent and operator projections are summarised in figure 1 based on Nolan (2012: 9).

Parts of a sentence indicating direction may be nuclear or core operators. Nuclear directionals refer to the direction of the action or the event; core directionals refer to the direction of the participants (Aubrey 2014) such as the action moving away or towards the speaker (Pavey 2010: 70-75).

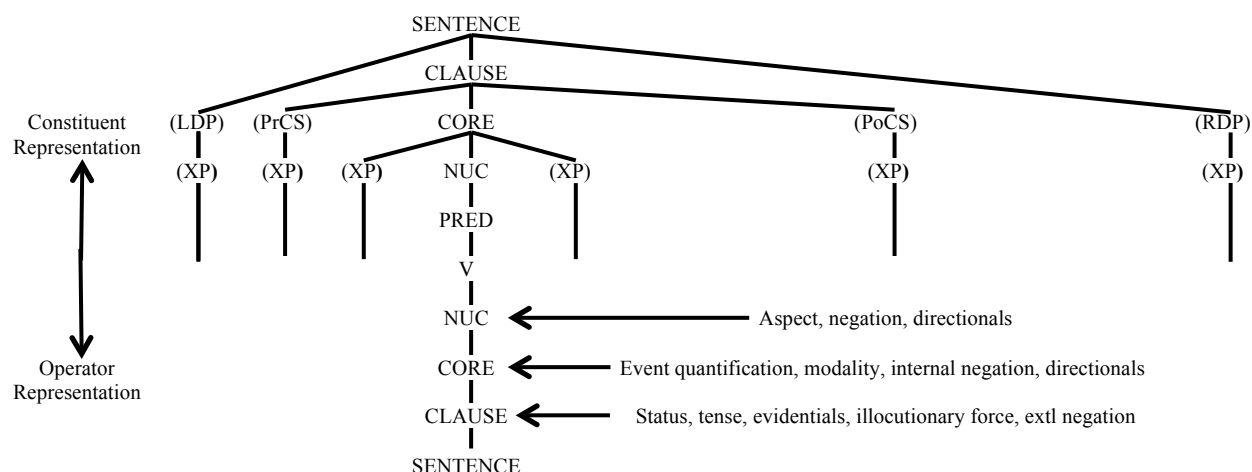


Figure 2: Constituent and operator projections

3 Direction

There is a distinction between direction seen as relative to the person like ‘left’ or ‘right’ versus fixed cardinal items such as river banks, ‘north’, ‘south’, ‘landward’ or ‘seaward’ (Pavey 2010: 324-325). For example the Australian language Guugu Yimithirr would describe a location as ‘east of the tree’ rather than ‘in front of’ or ‘behind’ it as English does (Pavey 2010: 324-325, 335).

Morphosyntactically direction can be shown by agglutinative morphemes such as *-u-* ‘motion away from’ in Chinookan (Silverstein 1976) or by prepositions such as *sur* ‘on’ or *vers* ‘toward’ in French (Rowlett 2007: 42).

Alternatively directionality can be part of the lexicon, for example in the English words *push/pull* where direction is not marked with an operator (Pavey 2010: 71). These lexical items may belong to different word classes. Locatives and directionals are one of seven subclasses of nominal in Warlpiri (Hale 1983). There is a set of eight directional motion verbs in the Papua New Guinea language Urim (Wood 2012: 80-81). These are described as being semi transitive, with two arguments: a core argument S (theme) and an oblique L (location) which is a locative object. Serial verb constructions may include a verb that specifies the direction in which the action occurs (Pavey 2010: 240-241). Adverbs may occur also that express direction and location (Payne 2006: 118). In this Ngaanyatjarra example from Obata & Kral (2005: 69) the direction of the action is done with respect to the agent, the one pushing.

- (1) *Walypala ngaa-lu yurltu yurntu-ra*
 White.man DEM-ERG car.ABS push-PRES
 ‘This white man is pushing a car.’

4 Australian cases

Australian languages typically have five or six distinct case inflections but up to a dozen different functions so there is overlap and sharing of structures in case function (Dixon 2011: 293-294). These cases may be grouped into core and peripheral. The core ones are case markings on the required nominal arguments of a predicate. The peripheral cases may be local, describing the location or movement of the action, or syntactic, adding further information such as the indirect object or goal. These functions represent the RRG elements

in the layered structure of the clause; containing the core with the arguments and the periphery with non-arguments.

Local peripheral functions provide information about the setting of the event but they are not strictly necessary in the clause so appear in the periphery (Dixon 2011: 295-297):

- Verbs of rest with locative (in at, on).
- Verbs of motion with allative (to, towards) and ablative (from).

The locative describes the location of the event or situation. Verbs of motion ('go', 'run') take complements with allative or ablative while verbs of rest ('sit', 'put', 'leave') take complements with locative case. The locative covers a wider spectrum and can be used for any type of verb so is the most unmarked of the local functions. The order of markedness can be summarised:

(2) Locative (unmarked) > allative > ablative (marked)

In Western Desert, the locative is used in other cases (Dixon 2011: 309) such as allative, ablative and instrumental. Table 1 summarises the main case forms: the alternative form in absolutive common noun *-pa* is where the nominal root ends in a consonant. The alternative forms for ergative, locative and absolutive common nouns are for nasals where there is place of articulation assimilation. Dixon (2011: 209) describes this as a homorganic stop plus vowel.

Table 1: Ngaanyatjarra cases

		Common	Proper
Core	Absolutive (S, O)	-Ø/- <i>pa</i>	- <i>nya/-nga</i>
	Ergative (A)	- <i>lu/-tju/-tu</i>	- <i>lu/-tju/-tu</i>
Local Peripheral	Locative	- <i>ngka/-tja/-ta/-pangka</i>	- <i>la/-tja/-ta</i>
	Allative	PURP + <i>-tu</i>	LOC + PURP+ <i>-tu</i>
	Ablative	- <i>nguru</i>	LOC + <i>-nguru</i>
	Perlative	- <i>wana/-wanu</i>	- <i>wana/-wanu</i>
Syntactic Peripheral	Purposive	- <i>ku</i>	
	Instrumental	LOC	
	Genitive	PURP	

In Ngaanyatjarra, case marking is on the final word of a noun phrase rather than on individual components (Glass & Hackett 2003: 8). Thus in this example from Glass & Hackett (1979: 107) the locative case marker *-ngka* occurs in phrase final position.

- (3) *kutjupa kapi-ngka*
 other water-LOC
 'at another water hole'

5 Suffixes

These are the local peripheral case endings in Ngaanyatjarra shown in table 1. We look at the different cases in this section, and distinguish between descriptions of where an event takes place versus the direction in which it occurs.

5.1 Locative

The basic locative case ending is *-la* with placenames and *-ngka* otherwise (Glass & Hackett (1979: 10). In both places there is place of articulation assimilation if the root ends with a consonant. Both *Papanyarrkalta* and *kapingka* have locative marking in (4) suggesting they are in separate phrases: at the waterhole at Papanyarrkal. The locative can encode ‘at, in, into, on, under’ (Glass & Hackett 2003: 232).

- (4) *Ma-wirrtja-rnu nya-ngu papa kurluny-pa pupa-rra-warni-nytja*
 away-hasten-PST see-PST dog little-ABS crouch-SER-scatter-NOML
Papanyarrkal-ta kapi-ngka
 [place name]-LOC water-LOC
 ‘He hurried away and saw lots of little dogs crouching there at the water-hole Papanyarrkal.’

5.2 Ablative

The ablative case ending is *-nguru*. This indicates ‘movement from’ with intransitive verbs. Other meanings can be implied too, such as ‘because of, after, on, side’ (Glass & Hackett 2003: 240). For names, the locative *-la* is inserted prior to the ablative ending. This example from Glass & Hackett (2003: 240) shows the dog’s movement in relation to the shelter. *Papa* ‘dog’ is absolutive as it is the only core argument, in S function.

- (5) *Papa wuurlarra-lku wiltja-nguru*
 Dog.ABS jump-FUT shelter-ABL
 ‘A dog might jump down from a shelter.’

This example from Glass & Hackett (1979: 131) shows that there does not have to be movement; looking is done from a tree. We see future and continuous future being used in the conditional sense.

- (6) *Ka=ya kutjupatjarra kutipitja-ku yimiya-ku nyina-ma nyina-ku nya-ku*
 and.DS=3plNOM others go-FUT emu-PURP sit-FUT.CONT sit-FUT look-FUT
warta-nguru nya-ku pitja-yinkunyangka tati-lku katu ngara-ma
 tree-ABL look-FUT come-where climb-FUT above wait-FUT.CONT
ngara-ku - ngara-ku
 wait-FUT - wait-FUT
 ‘And others would go for emus. They would climb a tree where the emus come (for water) and sit and wait.’

Glass & Hackett (1979: 85) shows the locative and ablative for a name: *-la-nguru*. Again the subject sees from a place, without movement.

- (7) *Mantji-ra-lpi wirrtja-rnu tati-ra-lpi nya-ngu Pukara-la-nguru tati-ra-lpi*
 Get-SER-having hasten-PST climb-SER-having see-PST Pukara-LOC-ABL climb-SER-having
nya-ngu waru kampa-rra
 see-PST fire burn-SER
 ‘Having got the hitting-stick he came and climbed up, and from a place called *Pukara* saw a fire burning.’

Glass (2006: 45) illustrates this difference with movement verbs: (8) with a common noun and (9) with a placename; there is place of articulation assimilation with locative *-ta* rather than *-la* in (8).

- (8) *Tjilku pirni=ya tali-nguru pitja-ngu*
 Child PL=3plNOM sandhill-ABL come-PST
 ‘The children came from the sandhills.’
- (9) *Minyma pirni=ya Wanarn-ta-nguru pitja-ngu*
 Woman PL=3plNOM Wanarn-LOC-ABL come-PST
 ‘The women came from Wanarn.’

A different ending indicates ‘out of/away from’, *-tja* in the example (10) from Glass (2006: 46), and here used with the locative. This parallels Crystal’s (2008: 164) distinction between the elative ‘from inside’ from the ablative ‘from outside’.

- (10) *Kuka waru-ngka-tja mantji-rnu*
 Meat.ABS fire-LOC-ABL get-PST
 ‘(He) got meat out of the fire.’

With names the locative can be used with the ‘out of/away from’ ending *-martatji*. In this example the direction of movement of the theme is described.

- (11) *Tjulya-rnu Kaye-la-martatji*
 Grab-PST Kaye-LOC-ABL
 ‘She grabbed (it) from Kaye.’

These different forms are used based on emphasis (Glass 2006: 102). So (12) is a general enquiry; (13) asks for the name of the place you have come from. Example (14) enquires as to the person’s origin or home country, so there is no verb *pitjangu*; the predicate is the non-verbal *ngurra ngananyamartatji*.

- (12) *Wanytja-nguru=n pitja-ngu?*
 Where-ABL=2sgNOM come-PST
 ‘Where have you come from?’
- (13) *Ngurra ngana-la-nguru=n pitja-ngu?*
 Place name-LOC-ABL=2sgNOM come-PST
 ‘What place have you come from?’
- (14) *Ngurra ngana-nya-martatji=n nyuntu-lu?*
 Place name-ABS-ABL=2sgNOM 2sg-NOM
 ‘What place do you come from?’

5.3 Allative

The allative case ending *-kutu* indicates ‘movement towards’, which includes the purposive *-ku* (Dixon 2010: 302). In this example (Glass & Hackett 2003: 105) the direction of movement is towards home *ngurrakutu*:

- (15) *Tjinguru=pula wati minyma-lu mapitja-ku karru kartanypu-ngkula mapitja-ku*
 Maybe=3duNOM man woman-ERG go-FUT creek.bed cross-SER go-FUT
ngurra-kutu
 home-ALL
 ‘A man and woman might go along and after crossing over a creek, go on home.’

This example from Glass (2006: 45) also demonstrates the destination occurring clause finally. In this the word order differs from a typical ablative marked nominal.

- (16) *Minyma pirni=ya ya-nu ngurra-kutu*
 Woman PL=3pINOM go-PST home-ALL
 'The women went home'

As with the ablative, for names the locative *-la* is suffixed prior to the allative ending.

- (17) *Wati pirni=ya ya-nu Mantamaru-la-kutu*
 Men PL-3pINOM go-PST Mantamaru-LOC-ALL
 'The men went to Mantamaru'

Glass & Hackett (1979: 131) show the marking is on the noun phrase, *pirti nyarra kutju* in this case is marked phrase finally with *-kutu*.

- (18) *ka-ya watipitja-ma ka-ya mularrrpartu*
 and.DS-3pINOM go.across-CONT.FUT and.DS-3pINOM truly
Watipitja-yinama pirti nyarra kutju-kutu kapi pirti purlka-ku
 Go.across-CONT.FUT hole there one-ALL water hole big-PURP
 'And they would all go across to the one big water-hole.'

Glass & Hackett (2003: 51) illustrates that the allative does not have to involve movement 'towards'. The direction of sitting is shown here, towards the sun.

- (19) *Tjirntu-kutu=rna=yi nyinaa-ma ka=rni kampa-ma*
 sun-ALL=1sgNOM=OPT sit-CONT.IMP and.DS=1sgACC burn-CONT.IMP
 '(Put the tray there). Then I can sit towards the sunshine and it will warm me.'

5.4 Perlative

The perlative suffixes are *-wana*, or *-wanu* denoting 'along, through, by way of, around'. This is shown in the following from Glass (2006: 84).

- (20) *Ka=litju mawirrtja-rnu tali parnta-wana*
 And.DS=1pINOM hurry-PST sandhill base-PERL
 'And we went quickly along the base of the sandhill.'

Glass & Hackett (1979: 6) show the perlative with the locative and ergative on a placename: *Pangkupirri-la-wana-lu*. As the phrase has the ergative case ending it is adverbial. Adverbs of time have no case marking in the related dialect Pitjantjatjara whereas those of frequency or manner are ergative in transitive sentences (Bowe 1990: 8). The example in (21) is an adverb of manner indicating Ngaanyatjarra agrees with this.

- (21) *matjulya-ra wana-rnu=ya wana-rnu puru*
 catch-SER follow-PST=3pINOM follow-PST again
watitjulya-ra wana-rnu ngalya-wana-rnu Pangkupirri-la-wana-lu
 catch-SER follow-PST towards-follow-PST Pangkupirri-LOC-PERL-ERG
wati-wana-yirnu Giles-tja ngaatja-ya wati-wana-rnu
 across-follow-PST Giles-LOC here-3pINOM across-follow-PST
 'And trying to catch him they followed all around. They followed by way of Pangkupirri and across this side of Giles they followed.'

6 Prefixes

While part of the suffixing group, Ngaanyatjarra has a small number of verbal prefixes, that relate to the direction of the action (Glass 2006: 88): *kuti* ‘away’; *ma* ‘away’; *murru* ‘in a backwards direction’; *ngalya* ‘towards’; *parra* ‘around’; *wati* ‘across’. Directional prefixes in the neighbouring Western Desert dialect Yankunytjatjara do not occur only with verbs of motion and describe orientation of action or direction of motion with respect to speaker or another implied reference point (Goddard 1983: 121). We look for evidence of this in Ngaanyatjarra.

6.1 *Ma* ‘away’

With *pitja* ‘come’ *ma-* derives *mapitja* ‘go’ as shown in this from Glass & Hackett (2003: 132).

- (22) *Ka-rna ma-pitja-ngu warntu mantji-rnu pitja-ngu tati-rnu*
And.DS=1sgNOM away-come-PST blanket.bundle get-PST come-PST climb-PST
‘So I went and got my bundle of blankets and came and climbed (in the car)’.

Glass (2006: 89) shows how *ma-* also means ‘completely’, extending the concept metaphorically.

- (23) *Ma-munga-rri-ngu*
Completely-night-INCH-PST
‘It became completely dark.’

6.2 *Ngalya* ‘towards’

Glass & Hackett (1979: 40) show *ngalya-* indicating the direction of movement of *katurri* ‘get up’:

- (24) *palunyalu puru ma-pupati-ngu ngala-ngu palunyalu ngalya-katurri-nyangka*
and again away-crouch-PST eat-PST and towards-get.up-ANT.DS
mantji-rnu kungka-mirntany-tju mulyatarrka kata yatu-rnu mirrparn-tu
get-PST girl-that-ERG nose.bone head hit-PST angry-ERG
yirliltu-tjirratja-lu
honey.ant-on.account.of-ERG
‘And again she crouched away, and when she turned to them and got up, the girl angrily hit her mother on the head, on her nose, because she wanted honey ants.’

6.3 *Parra* ‘around’

This imperative example is from Glass & Hackett (2003: 298). *Parra-* is prefixed to *wirrtja* to indicate the direction of movement.

- (25) *Parra-wirrtja-la nya-wa ngara-yi*
Around-hurry-IMP see-IMP sit-OPT
‘Go around quickly and see if (she’s) standing there’

This example is from Glass & Hackett (1979: 40) shows the prefix on the first of a series of actions, and only operating on that verb, suggesting these are core junctures.

- (26) *Minyma parra-wirrtja-rnu pupati-ngu pupa-ngu yapu-rri-ngu*
woman.ABS around-hurry.PST crouch.down-PST crouch-PST rock-INCH-PST
‘That woman hurried around, crouched down and became rock.’

parrapitjaku is also lexicalised to mean ‘arrive’ (Glass 2006: 88).

- (27) *Pitjayi-rnu parrapitja-ngu kapi purlkanya-kutu*
 Come.along-PST arrive-PST water big-ALL
 ‘He came along and arrived at the big waterhole’

Glass & Hackett (1979: 9) shows this with ‘sit’, indicating the verb doesn’t have to be action. This agrees with Goddard (1983: 121) on Yankunytjatjara. The form is duplicated *parra-parra-nyinangu*.

- (28) *Waru tjuwarntu pupa-rra tirtu purli yapu purlka-nya nyina-rra-warni-ya*
 fire without.fire crouch-PRES still rock rock big-ABS sit-PRES-scatter-3pINOM
pirni-nya parra-parra-nyina-ngu ngururtju-nu
 many-ABS around-around-sit-PST surround-PST
 ‘Crouching around with no fire, those rocks are still there. Having sat around surrounding the water-hole, those big rocks are lying all around there.’

6.4 *Wati* ‘across’

In this example from Glass & Hackett (2003: 505) *wati-* is prefixed to the matrix verb *kukurraarnu* and followed by the subordinate same subject intensive clause *pungkukitja*.

- (29) *Mirrarnarra-rnu wati-kukurraa-rnu pu-ngkukitja*
 Scream-PST across-run-PST hit-INT
 ‘(She) screamed and ran across to hit (someone)’

In the example (30) from Glass & Hackett (1979: 44) *wati* and *parra* appear on consecutive verbs showing the dynamic action of moving across and around.

- (30) *Ma-wana-rnu wati-wana-rnu=ya parra-yangatju-nu*
 Away-follow-PST across-follow-PST=3pINOM around-close.in-PST
puru purtu nya-ngu ngurra-kutju parturtu kutjulpirtu ruwangkatja kuti-pitja-ngu
 again in.vain see-PST camp-only.one however before previously away-come-PST
 ‘They followed, closed in and again looked in vain; there was only the camp. They had gone before that.’

The prefix can occur with the imperative (Glass 2006: 88). Here *watipitja* is lexicalised as a warning.

- (31) *Wati-pitja! Mutuka pala murrukati-ku!*
 Across-come.IMP car.ABS there reverse-FUT
 ‘Get out of the way! A car is going to reverse there!’

6.5 *Kuti* ‘away’

Kuti- ‘away’ only occurs with *katiku* ‘take’ and *pitjaku* ‘come’ (Glass & Hackett 2003: 104-105). This limitation is reflected in the apparent lexicalisation of the prefix-verb combinations.

- (32) *Palunyatjanu-lu-pula ngurra-ku kuti-kati-ngu kutjupatjarra-nya*
 Then-ERG=3duNOM camp-PURP away-take-PST rest-ABS
 ‘Then they carried (the rest of the meat) to the camp.’

- (33) *Ngurra-ku=ya kuti-tja-ngu pirriya purlka-ngka*
 Home-PURP=3pINOM away-go-PST wind big-INSTR
 ‘They all went home because of a big wind.’

6.6 *Murru* ‘backwards’

mur:ru- ‘in a backwards direction’ is a directional prefix in the related Western Desert dialect Mantjiltjara (Marsh 1976: 111). We see this in the Ngaanyatjarra verb *murrukatiku* ‘reverse’ (Glass & Hackett 2003: 190). In (34) it is combined with *ngalya*.

- (34) *Ngalya-murru-kati*
 Towards-backwards-take.IMP
 ‘move back here’
- (35) *Mutuka pala murru-kati-ku.*
 Car DEM.ABS reverse-take-FUT
 ‘The car is going to reverse.’

Murru-murrurriku ‘move downhill’ (Glass & Hackett 2003: 191) is derived from reduplication and the inchoative suffix *-rri*; an example is shown in (36).

- (36) *Wiya-la kuli-la murru-murrurri-ngu*
 Oh-we.and.you listen-IMP move.downhill-PST
 ‘Oh, we’re going downhill’

7 Scope of directional affixes

Case suffixes are core directional operators indicating movement of the argument. The text from (5) is shown in figure 2. The ablative case marker *-nguru* shows the direction of movement of *papa* ‘dog’ with respect to *wiltja* ‘shelter’. *Wuurlarra* ‘jump’ is an intransitive verb; *papa* is the S argument with *wiltja* in the periphery.

The prefixes append directly to the verb and are nuclear rather than core directional operators, indicating the direction of the verb itself. As Pavey (2010: 71) notes, core operators can also appear as verbal affixes so this is not necessarily a criterion of scope. The constituent projection of (35) is shown in figure 3. The prefix *murru* acts as a nuclear operator.

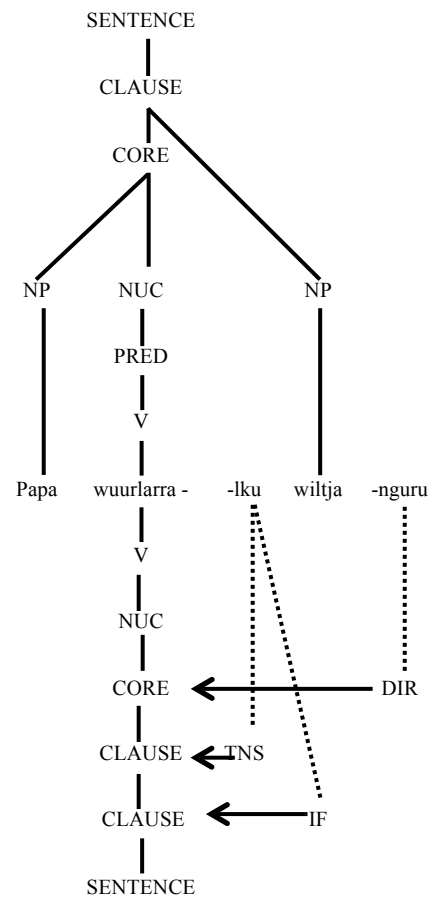


Figure 3: Case ending core operator

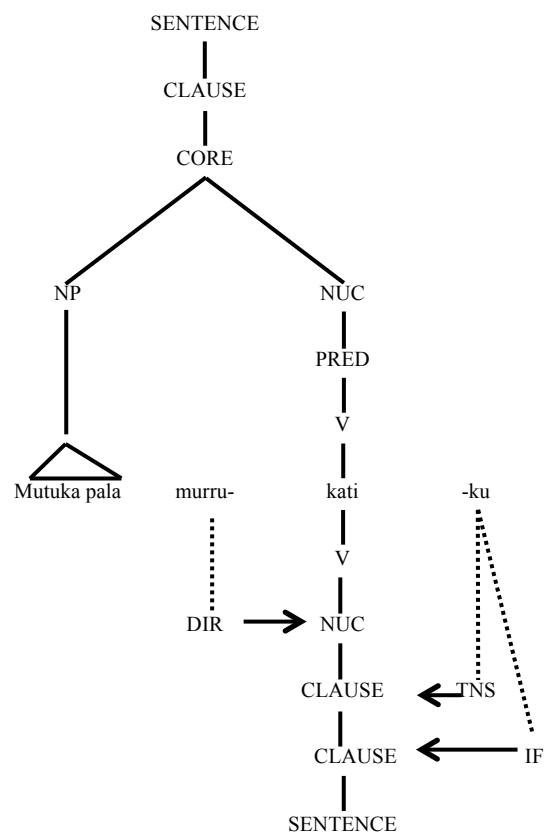


Figure 4: Nuclear directional operator

In situations where there are two adjacent verbs the directional prefix governs depending on the nexus and juncture between the elements. In this Ngaanyatjarra example from Glass & Hackett (2003: 505) there is core level juncture. Each verb has its own tense marking. *Ma* only operates on *pitjangu*. In other words he went first and then saw.

- (37) *Ma-pitja-ngu nya-ngu*
 Away-come-PST see-PST
 ‘(He) went and saw.’

By contrast in this example from Goddard (1983: 100-104) in the related Western Desert dialect Yankunytjatjara there is a non periphrastic tight verb serialisation which is nuclear level juncture. The directional attaches to the verb complex and governs both nuclei, so the nexus is cosubordinate.

- (38) *kaa paluru ngalya-kuli-ra kulpa-ra ngalya-kuli-ra kulpa-ra*
 and.DS 3sgNOM this.way-hear-SER return-SER this.way-hear-SER return-SER
 ‘And he was (over) hearing while returning, hearing while returning’

8 Cardinal directions

Kakarrara ‘east’, *kayili* ‘north’, *yapurra* ‘west’ and *yurlparirra* ‘south’ are described as spatial adverbs in Ngaanyatjarra (Glass & Hackett 2003: 25, 66, 557: 588). In this from Glass & Hackett 2003: 557) *yapurra* is in the ablative case. It is noteworthy that *pirriya purlka* ‘big wind’ gets the ‘name’ absolutive case ending *-nya*, suggesting animacy.

- (39) *Ka pirriya purlka-nya yapurra-nguru wangka-rranytja*
 And.DS wind big-ABS west-ABL blow-PST.CONT
 ‘But a strong wind was blowing from the west.’

Glass & Hackett (1979: 43) show flexible word order with the spatial adverb being in clause final position.

- (40) *Ka-pula kurrirarra pitja-yintja kayili-nguru*
 And.DS-2du man.and.wife come-PST.CONT north-ABL
 ‘A man and his wife were coming from the north.’

In (41) the ablative is used with iterations of a stationary verb *nyinangu* ‘sat’ and cardinal location to indicate the location lived in (Glass & Hackett 1979: 81).

- (41) *Ka nyina-ngu-nyina-ngu kakarrara-nguru nyina-ngu*
 And.DS sit-PST-sit-PST east-ABL sit-PST
wati yirna purlka-nya nyina-rranytja
 man old very-ABS sit-PST.CONT
 ‘And in the east lived a very old man.’

Spatial qualifiers in the Western Desert dialect Yankunytjatjara do not count as verbs or nominals as they do not take the full range of inflections (Goddard 1983: 18-19). In the non-Western Desert language Diyari spoken in South Australia, spatial locationals are a closed subset of nominals that inflect for ablative and allative only (Austin 2011: 41); locative is the

root. These Ngaanyatjarra spatial adverbs appear nominal like as they receive local peripheral endings so this agrees with Austin's analysis.

9 Lexical locatives

Adverbs describe the location of the event with respect to a participant. These examples are from Obata & Kral (2005: 121). In (42) the spatial adverb *kurranyu* 'in front' occurs with the participant in the locative, *wartangka*. In (43) the adverb *marlarrku* gets the ablative case marking. In (44) *katu* describes a location.

- (42) *Minyma ngaa-nya warta-ngka kurranyu ngara-la*
 Woman DEM-ABS tree-LOC in.front stand-PRES
 'This woman is standing in front of a tree.'
- (43) *Minyma ngaa-lu marlarrku-nguru ngara-la nyaku-la*
 Woman DEM-ERG from.behind-ABL stand-PRES see-PRES
 'This woman is standing looking from behind (the tree).'
- (44) *Miipurr-pa pirni-ya katu ngara-la*
 Coconut-ABS many-3plNOM above stand-PRES
 'There are many bush coconuts up high (in the tree).'

The spatial adverb *ngururra* 'in between' is shown in (45) from Glass & Hackett (2003: 240). The enclitic pronoun =*latju* attaches to the first phrase, indicating *willpa Kaminala ngururra* is a locational adjunct.

- (45) *Will-pa Kamina-la ngururra=latju tjiku-rnu kapi*
 Well-ABS Kamina-LOC in.between=1plNOM drink-PST water.ABS
 'We drank water from the well between Kamina (and here).'

Glass & Hackett (2003: 470) show spatial adverbs meaning 'left' and 'right'. *Wakunguru* 'right side' is derived from *waku* 'strong right arm' with the ablative.

- (46) *Ka ngaa-nya pirti lawu tjawa-lku wanti-ku pirrmalpa tjampu-nguru.*
 And.DS DEM-ABS hole hollow.ABS dig-FUT stop-FUT trap.ABS left-ABL
Palunyalu waku-nguru kupulu witurpu-ngku.
 Then right-ABL club.ABS hold-FUT
 'A hollow is dug on the left side of the trap. Then on the right side you sit and hold a club.'

10 Discussion

Ngaanyatjarra is part of the Australian language suffixing subdivision and has a rich set of local peripheral case endings. Cardinal directions and other spatial adverbs behave like nominals and receive a limited set of case endings. In addition there are a number of verbal prefixes that indicate the direction of the action itself.

In the RRG analysis, directionals may be nuclear or core operators. There is a tendency for nuclear operators to be closer to the verb (Pavey 2010: 77-78). We see the verbal prefixes in Ngaanyatjarra as nuclear operators while the case marking on nominals operates on the core. Nuclear directionals indicate the direction of movement itself while core directionals indicate movement with reference to the participants or spatial adverbs. The third type, spatial adverbs act as non-arguments, adjuncts outside the core. Cardinal directions do not appear to be used; rather adverbs like left, right and behind are used to indicate relative location.

Case endings are on the phrase rather than individual nominal. The prefixes in many cases only occur with a limited set of verbs and lexicalisation is evident. This is similar to noun-

verb compounds in Ngaanyatjarra where the noun provides semantic narrowing to the compound. While one criterion of wordhood in Western Desert languages is that stress is on the first syllable, the prefixes are exceptions. In the closely related dialect of Yankunytjatjara, the directional prefixes are separate phonological words as they both receive primary stress (Goddard 1983: 14). This is reflected in the Pitjantjatjara example (47) from Sheppard (1975: 1) where *wati* ‘across’ is not written orthographically as a prefix.

- (47) *Ka wati wirtjapaka-nu malu watja-ra,*
 and.DS across run-PST roo.ABS tell-SER
"Awari, awarinatju, malari-ngu=na."
 oh.dear oh.dear fall.behind.PST=1sgNOM
 ‘Suddenly a kangaroo hopped past (her), saying, "Oh dear, oh deary me, I'm late."’

This does not appear to be the case in Ngaanyatjarra orthographically though is a function of the separate phonological wordhood of the prefixes. While most of the prefixes have no separate dictionary entry, *ngalya* ‘towards’ is also a lexical item meaning ‘face’ (Glass & Hackett 2003: 209). The prefixes appear to be on a spectrum from independent wordhood to compounding. The languages have only recently been given written forms, and separately-Pitjantjatjara since the early 1940s (Goddard 1993: 1) and Ngaanyatjarra from the 1950s (Glass 2006: 7), and thus differences in the form the prefixes take may occur.

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Abbreviations

ABL Ablative	INT Intent
ABS Absolutive	LOC Locative NOM Nominative
ACC Accusative	NOML Nominalised
ALL Allative	OPT Optative
ANT Anterior	PERL Perlative
COND Conditional	PST Past
CONT Continuous	PURP Purposive
DEM Demonstrative	SER Serial participle
DS Different Subject	
ERG Ergative	Pronouns
FUT Future	1, 2, 3 first, second and third person
IMP Imperative	sg singular
INCH Inchoative	du dual
INSTR Instrumental	pl plural

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