Fall 12-18-2016

A COGNITIVE APPROACH TO PHONOLOGY: EVIDENCE FROM SIGNED LANGUAGES

Corrine Occhino
University of New Mexico

Corrine Occhino

Candidate

Department of Linguistics

Department

This dissertation is approved, and it is acceptable in quality and form for publication:

Approved by the Dissertation Committee:

Sherman Wilcox, Chairperson

Joan Bybee

Jill Morford

Phyllis Wilcox

Teenie Matlock

A COGNITIVE APPROACH TO PHONOLOGY:
EVIDENCE FROM SIGNED LANGUAGES

by

CORRINE OCCHINO

B.A., Linguistics, University of Wisconsin-Milwaukee, 2004
M.A., Linguistics, University of Wisconsin-Milwaukee 2006

DISSERTATION

Submitted in Partial Fulfillment of the
Requirements for the Degree of

Doctor of Philosophy
Linguistics

The University of New Mexico
Albuquerque, New Mexico

December, 2016

DEDICATION

For Ruth Occhino, I think of you every day.

ACKNOWLEDGMENTS

To my advisor, Sherman Wilcox, thank you for throwing me into the deep end of the Cognitive Grammar pool. It was surely through this baptism by fire that I came to understand and appreciate the utility of cognitive approaches to language. Thank you for loudly disagreeing with me about Langackarian diagrams, in coffee shops, and obliging me to hold my own in theoretical debates. I am a better scholar for it. Phyllis Wilcox, it was your course on metaphor and metonymy in signed languages that started me thinking about the issues that later became my dissertation. Your insight into the interaction of form and meaning in signed languages inspired me to develop a model of phonology which captures the complexity of these relationships in ASL, and by extension showed me the untapped richness of spoken language phonology as well. You and Sherman have been my Albuquerque parents, thank you for welcoming me into your lives with open arms.

To Jill Morford, thank you for showing me the 'ins and outs' of being an academic. Your professional, and personal guidance have helped me to strike a balance which I think many in our profession sorely lack. You lead by example, and are a role model for me in so many ways. Thank you for being the ultimate advocate. To Joan Bybee, our conversations about the intersections of signed and spoken language analysis have been instrumental in shaping the way in which I think about phonology/morphology. During my graduate career, "the blue book" was a bible, in that no matter the question that arose, that book would always point me in the right direction. Thank you for holding me to high standards and challenging me to explain myself in a clear and concise manner. To Teenie Matlock, getting to know has been one of the highlights of writing my dissertation. I was so pleased to find out that in addition to your inspiring research on cognitive semantics, you are also such a wonderful person.

To my colleagues, Benjamin Anible, Ryan Lepic, and Logan Sutton, thank you for listening, arguing, and diagramming "all the things" with me. I can't imagine how intellectually stunted my graduate career would have been without your challenges and support. Keiko Beers, Susan Brumbaugh, Shelece Easterday, Brittany Fallon, and Laura Hirrel, thank you for being the fierce feminists that you are. Thank you for lifting me up. You will probably never know what your friendships have meant to me.

To my parents, Maureen and Lance, without whom I would not be the woman I am today, thank you for encouraging me to splash in puddles and make 'stews' out of leaves, berries and twigs from the backyard. You fostered a curious mind and a love of learning that will no doubt lead me on countless more adventures. To my siblings, Corbin, Molly, Megan, and Morgan, I am cosmically lucky to have you in my life. It amazes me every day how different we all are, and yet how each one of you contribute something amazing to the world in your own way. From the frozen tundra to the semi-arid desert, you have supported me every step of the way. Thank you for believing in me.

To the unnamed entities who have impacted my life in various ways over the years, the road has been long and winding, thank you for helping me find my way. For your continued guidance, love, and patience I am eternally grateful.

A Cognitive Approach to Phonology: Evidence from Signed Languages

by

Corrine Occhino

BA, UNIVERSITY OF WISCONSIN - MILWAUKEE, 2004

MA, UNIVERSITY OF WISCONSIN - MILWAUKEE, 2006

PHD, UNIVERSITY OF NEW MEXICO, 2016

ABSTRACT

This dissertation uses corpus data from ASL and Libras (Brazilian Sign Language), to investigate the distribution of a series of static and dynamic handshapes across the two languages. While traditional phonological frameworks argue handshape distribution to be a facet of well-formedness constraints and articulatory ease (Brentari, 1998), the data analyzed here suggests that the majority of handshapes cluster around schematic form-meaning mappings. Furthermore, these schematic mappings are shown to be motivated by both language-internal and language-external construals of formal articulatory properties and embodied experiential gestalts. Usage-based approaches to phonology (Bybee, 2001) and cognitively oriented constructional approaches (Langacker, 1987) have recognized that phonology is not modular. Instead, phonology is expected to interact with all levels of grammar, including semantic association. In this dissertation I begin to develop a cognitive model of phonology which views phonological content as similar in kind to other constructional units of language. I argue that, because formal

units of linguistic structure emerge from the extraction of commonalities across usage events, phonological form is not immune from an accumulation of semantic associations. Finally, I demonstrate that appealing to such approaches allows one to account for both idiosyncratic, unconventionalized mappings seen in creative language use, as well as motivation in highly conventionalized form-meaning associations.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

Chapter 1

1 Introduction

In signed languages, the articulatory parameter of handshape is understood to be a meaningless, contrastive phonological unit within the core lexicon; however, in classifier usage and in the adoption of foreign vocabulary, handshape often behaves as a morpheme. As a result, multiple divisions within the lexicons of signed languages have been proposed to account for the variable behavior of handshape across signs. This dissertation uses corpus data from ASL and Libras (Brazilian Sign Language), to investigate the distribution of a series of static and dynamic handshapes across the two languages. While traditional phonological frameworks argue handshape distribution to be a facet of well-formedness constraints and articulatory ease (Brentari, 1998), the data analyzed here suggests that the majority of handshapes cluster around schematic form-meaning mappings. Furthermore, these schematic mappings are shown to be motivated by both language-internal and language-external construals of formal articulatory properties and embodied experiential gestalts.

Usage-based approaches to phonology (Bybee, 2001) and cognitively oriented constructional approaches (Langacker, 1987) have recognized that phonology is not modular. Instead, phonology is expected to interact with all levels of grammar, including semantic association. In this dissertation I begin to develop a cognitive model of phonology which views phonological content as similar in kind to other constructional units of language. I argue that, because formal units of linguistic structure emerge from the extraction of commonalities across usage events, phonological form is not immune from an accumulation of semantic associations. Finally, I demonstrate that such approaches allow for motivation in both unconventionalized mappings (creative language use), as well highly conventionalized form-meaning associations.

1.1 Arbitrariness vs. Iconicity

From the outset of signed language research, motivated form-meaning pairings have been a source of contention. Arbitrariness traditionally has been assumed to be the driving force behind form-meaning pairings in spoken languages, as the vast majority of words in spoken languages do not seem to evoke anything about their referent with their phonological shape. It is only when a given linguistic community conventionally agrees to use a sequence of sounds to represent a given object that a meaning is associated with a form.[1] Before the turn of the last century, research on signed languages primarily de-emphasized the prevalence of 'iconicity' and focused instead on arbitrariness (Frishberg, 1975; Klima & Bellugi, 1979; Sandler, 1989; Stokoe, 1960).[2]

Despite a body of emerging evidence which points to iconicity as a relevant factor in language processing (Baus, Carreiras, & Emmorey, 2013; R. L. Thompson, 2011; R. L. Thompson, Vinson, & Vigliocco, 2009; R. Thompson, Vinson, & Vigliocco, 2010), linguists have not been able to account for motivation in signed language lexicons, let alone its prevalence. [3] The reason for this theoretical blind spot is two-fold, primarily, it has grown out of the need for signed language linguists to prove that signed languages were real languages, subject to the same types of internal organization as spoken language. The way signed language linguists accomplished this was to show that the types of theoretical constructs found in spoken language, also existed in signed languages (S. Fischer & Gough, 1978; Friedman, 1977; Frishberg, 1975; Lane, Boyes Braem, & Bellugi, 1976). So it was by mere coincidence that signed language linguistics was born into a field of dominant generative paradigms. This lead to the secondary reason for the lack of attention to iconic motivation; a general adherence to formal

[1] We will return to this notion of arbitrariness in spoken language phonology in the final chapter of the dissertation.
[2] Notable exceptions to the anti-iconicity trend include the following: Armstrong, Stokoe, & Wilcox, 1995; Gee & Kegl, 1982; Mandel, 1977; Pizzuto, Cameracanna, Corazza, & Volterra, 1995; Poizner, Bellugi, & Tweney, 1981.
[3] For an Optimality Theory account of iconicity as a well-formedness constraint see (Eccarius & Brentari, 2010).

theories of linguistics which emphasize I(NTERNAL)-language and the universal structure(s) that underlie surface representations (Chomsky, 1986), without the appeal to language external influences. Consequently, theories of signed language phonology have been designed to privilege only a subset of relevant linguistic phenomena: (a) the ability to capture all contrastive features, (b) descriptions which lack redundancy, (c) modularity of the phonological system, and (d) derivational rules or constraints which generate surface forms. Such theories were not designed to account for other comparable, if not more important, phenomena: (a) variation across surface forms, (b) observable motivations of signs or their features, or (c) the influence of language external content, and domain general processes on the organization of the system. These latter concerns, which are not part of the generative program, lie at the heart of usage-based approaches to language.

1.2 Motivating a New Approach

The problem, which motivates this dissertation, is that while traditional theories of signed language phonology suggest that phonemes in the signed language lexicon are necessarily arbitrary, those same parameters, be it handshape, movement, location, etc. are considered morphological in other parts of the lexicon, such as classifier constructions (Brentari & Padden, 2001). This is further complicated by issues such as variation in diachronic change. When does a parameter 'become' a phoneme if it begins its life as a morpheme?[4] If frequency plays a role in language change, then the status of any given phoneme/morpheme is mediated by the constructions in which it occurs. This means that such transitions from morpheme to phoneme do not happen at the same rate across all signs which contain a given handshape. Some constructions may show evidence of more advanced stages of lexicalization or

[4] For a version of this question, "When does a system become phonological?" see Brentari, Coppola, Mazzoni, & Goldin-Meadow, 2012; Brentari et al., 2012.

grammaticalization, while other constructions might lag behind (Bybee, 2010; Goldberg, 2006).

Instead of viewing phonological parameters as meaningless building-blocks which belong to a universal set of formal units, I suggest that handshape (and by extension other phonological parameters) as a formal unit in signed languages is emergent, arising from individual experience and exposure to multiple usage events. If we view phonological content as emergent, we should expect large degrees of variation among different handshapes and different handshape-change patterns. That is to say, a usage-based approach both predicts and explains the variable status of formal parameters as more or less meaningful. I hypothesize that handshapes emerge as form is schematized with meaningful associations from semantically rich usage-events. Moreover, I hypothesize that higher the number of constructions and the higher the frequency of a given handshape, the weaker the semantic associations for that handshape. Conversely, the fewer number of constructions, and the lower the frequency of a given handshape, the stronger the semantic associations for that handshape. I postulate that handshape as an articulatory unit exists on a continuum of form-meaning mappings ranging from near one-to-one mappings to many-to-one mappings. The former are more 'phonological' while the later are more 'morphological.'

The theoretical framework proposed in this dissertation helps to explain this phoneme-morpheme continuum on which elements vary in terms of their schematicity or specificity. The more form-meaning mappings ascribed to a single parameter the more likely the user is to extract higher level schemas. Higher level schemas of form and meaning promote perceived phonological status. On the other hand, when fewer form-meaning mapping are associated with a handshape, this encourages lower level schemas, which adds to the perception that the given formal unit has morphological status. These two extremes are representative of two ends of a continuum, but of course, the majority of tokens exist somewhere between these extremes. Therefore, the perceived differences between morphological and phonological categorizations of the same parameter are merely differences in the schematicity of form-meaning mappings.

1.3 Basic Premises of a Usage-based Model

Early cognitive pioneers have already proposed linguistic theories capable of explaining the presence of motivated form-meaning mappings in morphosyntax (Bybee, 1985; Givón, 1985; Haiman, 1980, 1983, 1985, Langacker, 1987, 1991). In fact, the interaction of form and meaning is both characteristic of, and central to, usage-based frameworks which evoke domain general cognitive processes to explain how embodied conceptual schemas make available meaningful scaffolding for linguistic representation. Usage-based, cognitive approaches provide us with a framework in which language motivation is both anticipated and natural; however, application of these principles to phonological material has remained less developed, though both Bybee and Langacker discuss the interaction of semantics with phonetic form (Bybee, 2001; Langacker, 2008). The reason is likely two-fold – primarily, the Structuralist belief that phonemes are necessarily meaningless units, has been passed down largely unquestioned.[5] Secondly, spoken languages have not provided linguists with enough data to push back compellingly against such assumptions. While motivations do occur in phonology, the frequency with which they occur has allowed this data to be relegated to the periphery or considered extra-linguistic.[6]

By proposing a new cognitive phonology, I intend to outline an approach which is fully usage-based, largely modeled on Bybee (2001) but that more centrally incorporates concepts of embodied cognition and explores the human ability to construe the articulators, and by extension

[5] Notable early exceptions include Bolinger (1965b) and Wescott (1971), while later challenges include Blevins (2012) and Ladd (2012).

[6] A third possibility may be that motivation, at the level of phonology, may arise through diagrammatic and imagistic motivations which has not been well described or differentiated in either signed or spoken language investigations of phonological iconicity.

form construals of articulations themselves, which allows for mapping of language internal and language external patterns to individual features, phones, syllables, and other ‘meaningless’ linguistic units. But first, in order to develop a cognitive theory of phonology that will allow us to account for such motivated mappings, we must orient ourselves in an approach that provides the tools necessary for such an undertaking. The scaffolding for such an approach can be erected from basic principles which cognitive/usage-based linguists hold to be true. Here, I briefly sketch a condensed version of three basic hypotheses of usage-based models (Bybee, 2001, pp. 6–8), which will be central to the implementation of cognitive phonology. Importantly, these three principles are related to one another and interact in various ways.

1. **Lexical units are emergent**. ‘Units’ such as segment, phoneme, syllable, or morpheme, arise from the schematization of real usage-events. In this sense, schemas are abstracted from experience through categorization of like form and like meaning in a given context. By definition, schemas are fuzzy categories consisting of more or less prototypical members surrounded by variants which share formal or semantic properties to various degrees with the central prototypes.

2. **Linguistic and Cognitive processes are not separate**. The same cognitive processes are at work in both linguistic and non-linguistic domains. Therefore, it is likely that the way our brain represents linguistic material is no different from how the brain represents other non-linguistic material. Thus categorization and schematization of experiences, objects, et cetera, is the same categorization process which language is subject to. Schemas in the usage-based approach necessarily comprise all instantiations of that schema, organized by their degree of similarity as compared to other members of that category. Therefore, the process of schematization does not eliminate individual tokens

of usage which instantiate the schema, as the abstraction of commonalities across events does not denote the discarding of redundant material. On the contrary, it is precisely this redundant material which strengthens the prototypes of a given schema.

3. **Language use affects language structure**. In Bybee's words, "Experience affects representation," (Bybee 2001:6). This is arguably the most important contribution of usage-based approaches to phonology. The idea that frequency, repetition, immediacy, saliency and other general perceptual factors impact our mental representations of these structures, has reverberating repercussions. Linguistic structures are dynamic. Thus as more linguistic content is encountered, our representations constantly update and fluctuate to accommodate more and more usage-events.

The aforementioned hypotheses of the usage-based model stand in opposition to those principles by which generative theory has operated. Where generative grammarians posit the existence of Universal Grammar (UG), which is innate and dictates all possible outcomes of phonological (or grammatical) structure, usage-based linguists view phonological 'categories' as *emergent* and thus are discovered through, and built-up from language use. Where generative grammarians view grammar and lexicon as two separate modules which function within a rule/list paradigm, usage-based approaches posit that lexicon and grammar are fully integrated into a single system. This usage-based view of grammar involves constructional schemas that are abstracted from and continually reinforced by all previously experienced usage-events. Where generative grammarians posit a separate language module, independent and unique from other cognitive processes, usage-based approaches propose a single set of cognitive mechanisms which operate over both linguistic and non-linguistic stimuli. This ability to compare, analogize, and generalize across any two pieces of data, concepts, or elements is a domain-general ability; it is not specific to linguistic capabilities.

At the center of these principles lies a question which drives much of linguistic analysis: how do humans categorize linguistic stimuli? As noted, usage-based paradigms tend to differ from generative approaches, in regards to categorization, in that language external experiences influence the systematicity of a language, as well as language internal categorization. In other words, domain general processes contribute to our schematization and thus the emergence of linguistic structure, while language use itself changes the topography of linguistic organization through frequency, and construal of form and meaning mappings.

Humans are bombarded with stimuli which we must evaluate to determine how it relates to other pieces of information which we have already experienced. Children are capable of abstracting commonalities between the fluffy four-legged creature that lives in their house, with the fluffy-four legged creature that lives next-door, and understand they are of the same kind. Perhaps these creatures are labeled *dogs*, or *kutyák*, or *chiens*, but the arbitrariness of the sign is inconsequential, what is important is that humans possess a general ability to observe characteristics of any two pieces of data and compare and identify common properties. We use this general cognitive property to build an understanding of how things relate to one another.

When applied to language, this process accounts for the way that linguistic structures emerge as learners are exposed to usage-events. Language users chunk data into meaningful pieces and store these experiences with highly detailed information regarding the context in which something occurred, the frequency with which it occurs, and the likelihood it will occur in the same manner again. For example, hearing babies at only two-days old have been found to discriminate between patterns in prosodic cues, such as rhythm and intonation (Ramus, 2002), and distinguish between their mother's voice or other women's voices (Cooper & Aslin, 1989;

de Casper & Fifer, 1980). This suggests that hearing babies, are already forming abstractions while still in the womb, predisposing them to prefer certain voices and prosodic patterns. From such events, learners schematize patterns and commonalities across both form and meaning dimensions of the signal. Schematizations result in exemplar clouds, or schemas, depending on which usage-based model one follows, containing information about all of the usage events which have been tagged as relating to that pattern. Such a view is quite different from the notion of a ‘rule’ or a ‘constraint’. In the usage-based approach, once an abstraction is made, all of the content that contributed to the formation of the schema remains in memory and becomes part of the representation itself. Because we do not discard the predictable content after generalizations are made, our generalizations are built up from rich, maximally detailed usage-events. Over time, exposure to multiple usage-events allows users to extract patterns. In this way, language structure is emergent from linguistic data.

In fact, the storage of these instantiations of linguistic structure from usage-events lies at the heart of prototype theory (Rosch, 1978). Exemplar clouds are not merely randomly distributed collections of every token of every form ever encountered; to the contrary, they are naturally, and systematically organized according to the probabilistic statistical information as more frequent exemplars are strengthened (K. Johnson, 1997; Pierrehumbert, 2001). This natural tabulation allows for the development of stronger representations for more central members. Similarly, complex overlapping schemas are expected; the emergence model does not operate on a model of categorization based on classical categories. These fuzzy categories vary in their strength of representation, semantic information, and categorical affiliation.

This idea of *language as emergent structure* (Beckner et al., 2009; Bybee, 2001; Bybee & Hopper, 2001; P. Hopper, 1987) is key to understanding the framework of cognitive phonology: abstraction is a domain-general cognitive process which is at the root of the emergence of linguistic structure through the chunking and schematization of usage events. The preservation of predictable content allows for detailed comparisons to be made, and these generalizations, coupled with new usage events, affect the structure of language itself. As such, usage-based approaches provide us with a psychologically plausible set of assumptions which set the stage for cognitively realistic analyses of phonetic content: how we move from usage-events to categorization of usage-events, how we register frequency in form and meaning mappings, and how language use affects our representations.

In such a model, articulatory factors also play an obvious role in the organization and description of language structure. Usage-based models and models of Articulatory Phonology provide largely complimentary accounts of how routinization of motor programs, coordination of gestures, retiming of articulatory units are affected by frequency and language use.[7] Articulatory Phonology, as pioneered by Browman and Goldstein (1986), suggests that speech is a motor activity that constrains and shapes the organization of phonological systems. In this model, coordinated articulatory movements, or *gestures*, combine into complex motor routines in which multiple articulators are simultaneously and sequentially active. Stretches of coordinated articulatory gestures combine in larger or smaller chunks to achieve an articulatory goal. Gestures are considered the primary representations of linguistic units which includes articulatory motor routines, as well as perceptual information such as acoustic or visual properties.

While Articulatory Phonology was not designed to account for signed languages, the narrative of *articulation as gesture,* lends itself to application across modalities. By describing

[7] Advances since its advent have taken Articulatory Phonology away from some of its more important initial propositions. Nevertheless, the foundational work from the late 1980s (Browman & Goldstein, 1986, 1989) has proven very useful for understanding purely phonetic effects of language organization and change.

all linguistic motor routines as gestures which are subject to domain general pressures regarding the coordination, chunking, smoothing, and retiming of muscular movements, we gain explanatory power that allows for direct cross-modal comparisons. Only a handful of attempts have been made to extend this model across the modal divide (Easterday & Occhino-Kehoe, m.s.; Keane, 2014; S. Wilcox, 1988), but each of these studies has shown the promise of articulatory approaches in both their ability to describe phonological processes, and also in their ability to allow for more direct comparison between signed and spoken languages. Articulatory Phonology is well suited for describing spoken and signed languages because the domain general pressures relevant to vocal articulations are in many ways similar to the articulatory pressures exerted on manual-corporal systems. Thus legs learn to run, mouths learn to speak, and hands learn to sign, in similarly embodied ways.

Thus, usage-based and articulatory approaches to phonology regard the sensorimotor routine as central to the linguistic form. Phonetic content, which is neither necessarily contrastive nor attended to, has the potential to become part of the linguistic representation itself, through routinization, reduction, and/or assimilation. Thus, rather than discussing phonological processes in traditional terms of segmental 'insertion' or 'deletion', or one segment 'becoming' another segment, we can view these resulting synchronic states as simple matters of articulatory retiming or reduction of gestures (Browman & Goldstein, 1986, 1989, 1992). In this sense, a gestural score, like other motor routines, becomes streamlined as it becomes more routinized, and as a result, the articulatory gestures come closer together. This entrainment of musculo-skeletal activity is not unlike what takes place for professional athletes. By practicing a given sequence of movement, the repetition and training leads to the creation of a new motor routine, which is processed as a single unit (Bybee, 2006, p. 715). In this same sense, our neuro-motor routines become entrenched and through repeated use can reduce or re-time to achieve maximal articulatory efficiency. In summary, Articulatory Phonology and usage-based phonology are binocular lenses through which to view many relevant phonological phenomena, capable of describing both the articulatory gesture of a given usage-event while providing the tools needed to explain the storage, processing, and representation of those gestural events. While articulatory approaches are concerned with describing the dynamic nature of gestures and how they change within a given context, usage-based phonology is concerned with deriving schematic content from individual usage events, while considering the implications of storing such gestures in full articulatory, semantic, and pragmatic detail.

1.4 Goals, Hypotheses, and Methods

Taken together, these basic premises of usage-based models of phonology lend themselves to certain predictions and testable hypotheses. This dissertation comprises two main goals: to develop a model of phonology that accounts for both arbitrariness and motivation based on the aforementioned premises of usage-based approaches, and to apply the tools made available by this approach to investigate the nature of handshape distribution in the lexicons of American Sign Language (ASL) and Brazilian Sign Language (Língua Brasileira de Sinais, or Libras). The first goal involves the integration of several theoretical frameworks, primarily relying on usage-based phonology, cognitive grammar, and construction grammar approaches to language analysis. By committedly adhering to the principles of usage-based, cognitive approaches, I show how a phonological model naturally arises which forecasts iconic, motivated and arbitrary form-meaning mappings. The second goal entails applying the proposed theoretical model to the analysis and distribution, of both static and dynamic handshapes in ASL and Libras, as it relates to frequency of occurrence in the lexicon and constructional patterns in which these handshapes occur.

Using the Morford and MacFarlane corpus of ASL (2003), the ASL Handshape Dictionary (Tennant & Gluszak Brown, 1998), and a database of Libras signs (Xavier, 2006), I investigate the distribution of four static handshapes, and four patterns of handshape change as they occur in ASL and Libras. I extract all tokens of the selected static and dynamic handshapes from ASL and Libras data to investigate their distributional properties. Handshapes are then coded by the author and ASL and Libras consultants as to whether the parameter contributes meaning to the sign. Tokens of handshape which are coded as ‘contribute meaning’ are then extracted and coded for the type of semantic information contributed by the handshape. These signs are then grouped according to semantic labels.

Analyses of these static and dynamic handshapes in ASL and Libras suggest that meaning is certainly involved in the structure and distribution of phonological parameters across the lexicon of signed languages. The influence of both language-internal (analogical) patterning and language-external (iconic) patterning are both widespread. This realization may be problematic for theories in which form and meaning are necessarily modular; however, these results are neither problematic nor surprising when interpreted within the framework of cognitive phonology proposed here.

1.5 Outline of Chapters

This dissertation begins with an introduction to the development of phonological theories of signed language phonology (Chapter 2). I discuss the birth of signed language phonology in Section 2.2. where I describe Stokoe’s pioneering approach to the analysis of the formal properties of ASL. Section 2.3 presents criticisms of Stokoe’s simultaneous bundling of phonological features and introduces the inception of segmental models which emphasized sequential structure of signs. This section ends with an introduction to the Prosodic Model of signed language phonology (Brentari, 1998), which has dominated the field of signed language phonology for nearly twenty years. Brentari presents a model which focuses on the hierarchical structuring of features, separating those features which persist throughout the sign with a single specification, and those which are specified more than once, and thus exhibit change within the articulation of a sign.

Section 2.4 reviews in depth, current theoretical explanations for structural properties of phonological parameters, including recognized rules and constraints, emphasizing problematic cases in which theoretical predictions do not adequately describe real usage-events. In Section 2.5, I highlight what I perceive to be problematic outcomes of generative approaches to phonological analysis in signed languages, by underscoring ways in which current models do not line-up with usage-based approaches, which account for many cognitive phenomena borne-out by current research. This includes the following preconditions: linguistic knowledge is procedural (Bybee, 2001, 2010), language usage effects language structure (Bybee & Hopper, 2001; Pierrehumbert, 2001), language is a dynamic system (Beckner et al., 2009; Elman, 1995), domain-general processes are active in language emergence and structure (Bybee, 2006; P. Hopper, 1987; MacWhinney, 2005), and that language is embodied (B. Bergen & Chang, 2005; Fowler, 2010; R.W. Gibbs, 2012).

Finally, in Section 2.6 I highlight new research which has recently emerged, offering alternatives to the current models, including work on articulatory approaches to signed language phonology (Mauk & Tyrone, 2012; Tyrone & Mauk, 2012), construction based approaches to signed language morphology (Lepic, 2015, 2016), and theories which look at form and meaning of signed language features as they relate to ‘kinematics’ (Malaia & Wilbur, 2012; Malaia, Wilbur, & Milkovic, 2013).

In Chapter 3, I outline the advent of cognitive phonology by reviewing previous efforts at outlining the tenets of such an approach (H. G. van der Hulst, 2003; Kaye, 1989; Kristiansen, 2006; Lakoff, 1993a; Välimaa-Blum, 2005). Following this discussion, I propose a non-modular model of cognitive phonology, in which phonological content, like other linguistic units, is emergent but also symbolic. Cognitive phonology, as it is proposed here, is not divorced from other grammatical structures; but interacts, influences, and is influenced by them. I suggest that phonemes, segments, syllables and the like, are extracted from usage-events which are experienced as situated and embodied, rich with social, pragmatic, and linguistic meaning. The result is that form, regardless of level of complexity, can and does retain meaningful associations as form and meaning are experienced together. Importantly, this model of cognitive phonology helps to resolve several issues relating to form-meaning mappings in phonological form in both spoken and signed languages, not the least of which is how do ‘meaningless phonemes’ evoke senses of meaning in the words they occur. In spoken language, sound symbolism is generally explained as existing outside of the regular phonological system, sometimes considered semi-morphemes and often considered ‘extra-grammatical’ (Mattiello, 2013, p. 206). In signed languages, the problem of ‘motivated phonemes’ is solved by creating artificial divisions in the lexicon to explain why sometimes handshape is phonological and sometimes handshape is morphological (Brentari & Padden, 2001).

Chapters 4 & 5 comprise the data chapters in which the proposed theory of cognitive phonology is applied in the analysis of phonological structures in two signed languages. I present corpus data from ASL and Libras, which are analyzed utilizing tenets of a cognitive approach to phonology. Chapter 4 focuses on the distribution and analysis of static handshapes, while chapter 5 focuses on sign-internal handshape changes, which I refer to throughout as dynamic handshape. Analyses of several articulatory patterns across ASL and Libras reveal regular and robust form-meaning mappings, associated with both phoneme and feature level components of form.

Finally, Chapter 6 contextualizes the findings of the previous data chapters and proposes future research applications of a cognitively oriented approach to phonological analysis. Topics discussed in this final chapter include issues of embodiment, simulation, cognitive semantics, and dynamic systems.

Chapter 2

2 Signed Language Phonology

This chapter reviews the emergence of signed language phonology within the larger field of signed language linguistics. In Section 2.2 I trace the development of the field from Stokoe's initial attempts at sublexical analysis of signs, through the development of several formal models of phonology (Section 2.3), terminating with the Prosodic Model of Phonology (Section 2.3.3), which stands as the currently accepted model for description and analysis signed language phonology. Section 2.4 reviews the formational properties of signs. Section 2.5 introduces challenges to current formal models of signed language phonology. I end the chapter with a brief look at emerging models of linguistic analysis which incorporate considerations of phonological form in their analyses (Section 2.6).

2.1 The Legitimization of Signed Languages

The study of the sublexical structure of ASL began in 1960 when William C. Stokoe first proposed that signs were made up of three smaller attributes: *tab*, *dez*, and *sig*, which correspond to location, handshape and movement (Stokoe, 1960). Based on the analogy with phonemes as units of sound, Stokoe coined the term *cheremes*, to refer to manual units. Before Stokoe's seminal analysis, signs were seen as holistic, unanalyzable units, much akin to pantomime and certainly not linguistic. Stokoe's analysis was the first attempt at deconstructing signs into something smaller than a non-compositional, unanalyzable gesture. Correspondingly, signed languages before this time were not considered real languages as they were too iconic, too expressive, and too much "of-the-body." Signed languages were considered by many "a collection of vague and loosely defined pictorial gestures," (Klima & Bellugi, 1979, p. 3).

From the outset, signed language linguists have had the burden of proving that languages of the visual modality were worthy of study, while at the same time documenting and theorizing about the language itself. Many prejudices had to be addressed before the linguistic community at large could accept that signed languages were indeed true human languages. This burden produced many unfortunate repercussions, not the least of which was necessarily denying the possibility that iconicity played any role in language structure and organization. In the early literature, iconicity was treated as a peculiarity of the modality. While iconicity was often noted, such notations were followed with explanatory statements assuring the accidental nature of such mappings in the visual modality, and declarations that the iconicity played no role in the structure of the language.

Instead, during this nascent period of signed language studies, linguists concentrated their attention primarily on structural similarities between spoken and signed languages. This strategy, no doubt a necessary step in the legitimization of the field, led many researchers to a tit for tat strategy of signed language analysis. It became a popular strategy to select an identified structure from spoken language (usually English) and then select data from signed language research that supported the existence of the selected structure in the signed language in question. Thus the assumption was, if spoken languages exhibit Structure-X, then signed languages must also exhibit a similar Structure-X. Nowhere is this more apparent than in the attempts at creating a comprehensive model of signed language phonology.

In this way, the trajectory of signed language phonology has followed the trajectory of spoken language phonology trends, generally with a lag of several years. Hence, when the generative phonology text *The Sound Patterns of English* was published in 1968 (Chomsky & Halle, 1997), signed language linguists influenced by this line of work, adapted and applied it to ASL (Liddell, 1984; Liddell & Johnson, 1989a). Work on the phonological structure of signed languages became largely focused on defining constituents and uncovering the underlying structures of signs.

Subsequently, as autosegmental approaches became popular after Goldsmith published his dissertation on Autosegmental Phonology (1976), Sandler adapted this model for signed languages, developing her Hand-Tier Model of signed language phonology (Sandler, 1986, 1989). Following this line of research, and the search for the universals of language, structures analogous to segments, feature geometries, syllables, moras, sonority hierarchies, and prosodic units, were assumed to be present in signed languages based on their existence in spoken language. Perhaps unsurprisingly, these phonological structures were searched for, and found, in signed languages (Brentari, 1998; H. van der Hulst, 1993; Liddell & Johnson, 1989a; Perlmutter, 1989; Sandler, 1989).

Once generative frameworks overtook the field, form and meaning were separated, considered separate modules, and therefore analyzing form without appealing to meaning became the norm. Focus on formal analysis, combined with strong convictions regarding *duality of patterning* and *arbitrariness* as a necessary condition of "real languages," led the majority of researchers during this period to divorce the analysis of form and function, with a few notable exceptions (S. Fischer & Gough, 1978; Friedman, 1977; Gee & Kegl, 1982; Mandel, 1977).

The lion's share of research during this time advanced the idea that though signed languages seemed iconic at first glance, iconicity was merely a modality effect which played no role in language processing. Language change was often touted as proof that iconicity eroded over time, being replaced by more phonologically structured units which did not preserve the iconic value of the original gesture. Phonological regularization processes were shown to tend toward symmetry, fluidity, locational displacement, and assimilation and these ease of articulation and ease of perception pressures, motivated language change away from iconic (transparent) forms. This eventually led to the idea that iconicity was inversely related to phonologicalization. Frishberg claimed that these regularization processes often eroded iconicity where it had previously been central to signed forms (Frishberg, 1975). The conclusion was that iconicity, though widely observed, did not play a role in the structure of signed languages. In essence, iconicity was treated as a result of language production in the visual modality. As the subversion of interest in iconicity became commonplace, linguists shifted their focus to developing models of signed language phonology which emphasized arbitrary formal structures. Interestingly, this has resulted in a lesser degree of descriptive documentation or corpus work on languages such as ASL. ASL remains one of several widely used signed languages which still does not have a comprehensive grammatical sketch nor does it have a widely available and well annotated digital corpus, despite the fact that these descriptive goals have already been achieved for several lesser studied signed languages.

In the following sections I briefly review the development of the field of signed language phonology covering dominant theoretical frameworks from its inception to present day. Beginning with Stokoe's pioneering analysis of ASL's formal properties (2.2), continuing with the progression of models positing simultaneous cheremic bundles, to sequential, segmental structures (2.3), and closing with a more detailed review of Prosodic Phonology (Brentari, 1998) (2.3.3). I then discuss the current understanding of several structural properties related to signed language phonology, and discuss topics of phonological parameters, and accepted rules and constraints (2.4). I highlight problematic cases where theoretical assumptions conflict with actual usage events. In Section 2.5 I address complications which have arisen because of proposals of underlying representations, model-internal faithfulness, and lack of attention to form-meaning constructions. Finally, in Section 2.6 I highlight several new models which have recently emerged as alternatives to the current models of signed language phonology.

2.2 Stokoe and the Simultaneity of Signs

Signed language linguistics has, from the beginning, both benefited and suffered from an application of spoken language models to signed language data. At the height of structuralist approaches to linguistics, Stokoe, the father of signed language linguistics, was greatly influenced by the dominant theoretical paradigm. Stokoe was the first to apply a model of analysis to the internal structure of ASL.[8] During his time as a professor at Gallaudet College, now Gallaudet University, Stokoe noticed that contrary to generally held beliefs, his students' signing had recurrent properties and structure that was not reminiscent of pantomime. After this realization, Stokoe set out to document the different functions of these internal aspects of signs and described the uses of individual hand configurations, movements, and locations.

In early models (Stokoe, 1960; Stokoe, Casterline, & Croneberg, 1965) phonemic status was based on the presence or absence of minimal pairs in which one of the major parameters was altered. Stokoe noticed that certain 'attributes' of a sign were able to be altered to create new signs with new meaning. For example, Stokoe noticed that signs such as MOTHER and FATHER have the same 5-handshape, and same movement articulation (a double tap) but what differentiates these signs is the place of articulation. The ASL sign MOTHER is articulated by tapping the extended thumb on the chin, while FATHER is articulated by tapping the extended thumb on the forehead. Thus rather than non-compositional holistic units, signs were structured from the building-blocks: *tabula*, *designator*, and *signation*, which he abbreviated as *tab*, *dez*, and *sig* respectively, and which correspond today to location, handshape and movement (Stokoe,

[8] The first modern dissertation on a signed language was completed in 1953 by Fr. Tervoort on "the manual communication system" of Dutch school children.

1960). Stokoe, Casterline and Croneberg (1965) documented a list of sign 'aspects' proposing that for ASL, there were a total of 24 movements, 19 handshapes, and 12 locations which could be combined and recombined to make new signs.

In addition to positing contrastive units, Stokoe also proposed allophonic variations of handshapes which he called "allochers" based on articulatory similarities seen in the sign's production, i.e., handshapes that were formed similarly but in which a change of the handshape did not create a minimal pair with another sign.[9] Thus, handshapes S, A, and T were posited to be variants of the same phoneme, as they are all articulated with a fist-like handshape (Figure 1). The articulatory variants pertain to the position and extension of the thumb in the A-handshape, and the insertion of the thumb between the index and middle fingers in the T-handshape.

Figure 1) Allophones of the A-Handshapes: A, S, T

Stokoe also stressed the uniqueness of the simultaneity of signed languages and argued that all three "aspects" — handshape, movement, and location — contributed equally to the formation of the sign. Moreover, he contended that these aspects were equivalent to segmental phonemic units in spoken language though the linearity of the speech stream seemed in some ways at odds with the simultaneous nature of signs.

Within a given sign, handshape, location, and movement were all capable of being

[9] "Allocher" was proposed by Stokoe based on the analogy with "allophone" in which variants of a chereme arose in different articulatory contexts as allophonic variants.

simultaneously deployed, while a voiceless bilabial stop could not be articulated simultaneously with a voiced alveolar fricative. Stokoe did suggest however, that despite these simultaneous structures, minimal pairs could still be found by varying just one parameter, while keeping the other parameters constant. In this way, MOTHER and FATHER, as we saw above, were considered minimal pairs, despite the fact that the parameters were not sequentially segmentable.

Stokoe was ahead of his time in many of his approaches to signed language analysis. He saw structure where few had observed structure before. With little linguistic training, he identified several structural patterns, and created labels and ways of organizing the data which still influence the description of signed languages today. Though it would take several decades, and one could argue that in many ways signed languages are still not measured as equals with their spoken language brethren, Stokoe's original description of what was to become ASL initiated the legitimization of the study of signed languages as real language.

Soon after Stokoe's preliminary analyses, others followed with similar emphasis or at least agreement on the uniqueness of simultaneity in signs (Battison, 1974, 1978; Friedman, 1977; Klima & Bellugi, 1979). Like Stokoe, other researchers in the early stages of signed language linguistics recognized that though there were some specifications for ordering, the high degree of simultaneity within sign structure required attention and analysis. For example Battison (1974), suggested the use of a single phonological matrix column to describe the bundle of simultaneous features of phonemes but noted some degree of sequentiality:

> Physical constraints of the articulator require that these primes are expressed simultaneously, and not linearly over time. In some cases, however, these tautosegmental units may have a linear arrangement just as the feature [+strident] pertains to the final part of the affricate [č], and not the initial part. There are signs, for instance, whose

articulation involves first contacting one part of the body, and then moving away from it, and there are others which require the opposite order of events. The movement in such signs in thus linearly (not simultaneously) expressed with respect to the rest of the articulation. (p. 4)

Similarly, Klima and Bellugi pointed out that though movements have a beginning and ending point by necessity, this is not reason in and of itself to specify sequential segments of the movement. For example, they state, "the ASL sign DECIDE does have an essential movement; that is, there is an essential temporal property – a change in position in space. But this in itself does not necessitate considering the movement anything other than a simple unitary downward motion. The handshape occurs simultaneously with the movement. In appearance, the sign is a continuous whole," (1979, pp. 38–39) (Figure 2).

Figure 2) ASL sign DECIDE (SLTD.tv, n.d.)

Therefore, while the sign DECIDE is specified as being two-handed, symmetrical, F-handshapes, articulated in neutral space with a movement beginning near shoulder height, the movement simply unfolds as a phonetic effect of the sign's other specifications. Under this analysis there is no need to specify that the movement parameter consists of a beginning and endpoint. As we shall see, the segmentation of movements and points of articulation on the movement path becomes central to the next wave of phonological models of signed language.

Formalization of phonological notation within these sequential models tended to rely on Stokoe Notation, a system of symbolic representation pioneered by Stokoe as a way to describe the simultaneous properties of the sign.[10] An example of this type of notation can been seen in the description of the sign KNOW, which specifies the B-handshape with a movement toward the signer and a final contact point at the side of the forehead, notated as follows: ${}^{\cap}\mathbf{B}_{\top}^{\times}$. In this notation, the union symbol represents the forehead, the B represents the handshape, the $_{\top}$ represents the movement toward the body, and the $^{\times}$ represents the contact with the forehead. Note that each individual symbol contributes equally in this simultaneous representation. One benefit of this single matrix system is that one can use this notation to easily compare minimal pairs which differ in only one segment as seen in Figure 3.

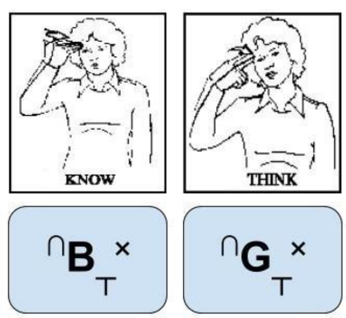

Figure 3) Minimal pairs using Stokoe Notation: THINK and KNOW (adapted from Klima & Bellugi, 1979)

It is important to emphasize that in this representation, the notation for upward movement, indicated by the ^ in Stokoe Notation, is not part of the phonemic representation.

[10] Stokoe's model of annotation is still used by some signed language researchers today and in many ways is still a very effective tool for capturing properties shared across signs

Consequently, in this model, the movement upward is considered to be an incidental phonetic effect caused by the necessary movement toward the body in order to make contact with the forehead. We will return to this issue in the Section 2.3.1, where the lack of such notation is shown to be problematic when signs are produced without contact with the forehead.

In an attempt to solve issues of underlying representations of signs with multiple surface forms, this method of description soon gave way to more segmental generative analyses, introducing both sequential segments in the vein of SPE and articulatory timing tiers, by way of Autosegmental Phonology. The issue of simultaneity however, continued to rear its head for years to come, leading linguists to invent increasingly complicated levels of hierarchical relationships and multiple phonological tiers in an attempt to better represent the proposed associations between different phonological pieces of the sign.

2.3 Sequentiality and the rise of Autosegmental models

While the first twenty years of signed language linguistics stressed the uniqueness of the simultaneous structure of signs, subsequent attempts to represent signed languages within a phonological paradigm downplayed the role of simultaneity and showed that like spoken languages, signs consist primarily of sequential structures (Liddell, 1984a; Liddell & Johnson, 1985; Sandler, 1989a; 1990; Brentari, 1998). This was likely due in part to a push in spoken language phonology which regarded similar issues as important, but was also driven by the underlying pressure for signed language linguists to push for legitimization of the field by keeping up with these current trends in linguistics.

2.3.1 Movement-Hold Models

Simultaneous models had been able to capture and describe several characteristics of signs which were seen as significantly different from spoken language structure. As such, some critics argued against moving away from simultaneous models which focused on primes and seemed to better represent the interwoven nature of handshape, movement, and location as they relate to the production of signs. When feature based models of signed language phonology began to emerge, Friedman warned, “Until it can be demonstrated that generalizations about variations in hand shapes, either historical or synchronic, can best be formulated in terms of recurring features — thereby giving the feature analysis explanatory value — I do not believe we need such an analysis,” (1977, p. 15). Nevertheless, the focus on simultaneity was soon abandoned for a more parsimonious structural comparison with spoken language structures. Feature based analyses soon became a popular analytical tool for the description of signed languages.

Liddell (1984) and later Liddell and Johnson (1989b) made significant claims about the sequentially of signed language parameters, in direct response to Stokoe’s simultaneous model. They argued that while there were some aspects of signs which seemed to privilege simultaneity, undeniable sequential structure existed by virtue of the movement parameter. After all, the movement in a sign must be specified for beginning and ending positions, as the movement parameter must originate at some specified point in space and ultimately culminate in the arrival at a different point in space. With the exception of a handful of signs which seemed to be amenable to metathesis, i.e. the movement parameter could begin or end at either point of origin, for the majority of signs the movement and location parameters were not interchangeable. This lead Liddell and Johnson to single out the parameters of movement and holds as the primary organizing principles of signs.

Their Movement-Hold model, which was in many ways the first hint of an autosegmental approach to signed languages, emphasizes the sequentiality of signs by segmenting the sign into pauses and movements. Importantly, the major difference between the simultaneous models and the Movement-Hold model was that handshape, movement, location, and orientation were interpreted as sets of features which defined a segment, rather than as phonemic primes in their own right. Consequently, within this model, segments and not individual primes were considered the defining characteristics of signs. This deviates from Stokoe and others previous models which considered the primes as the basic units of phonological description.

The types of issues these new sequential models sought to reform focused on issues of surface form variation and the ability to relate various surface forms to a basic underlying structure. Returning to our previous example of KNOW (p.25), recall that the citation form requires a contact with the side of the forehead, however an often produced variant of KNOW, in fast signing, does not make contact with the forehead. In this variation, the sign moves up and toward the body but stops short of contacting the head, instead, the hand pausing for a moment often at about the height of the eye, though still on the same vertical plane with the temple, before moving on to the next articulation. The variant without contact was thus observed to exhibit an obvious change in the structure of the sign.

Recall that in Stokoe's notation, no formal representation of upward movement was included in the base form. The upward movement was considered a phonetic side effect caused by movement toward the body to contact the forehead. In the contactless variant, the sign has a slight upward movement toward the side of the forehead from neutral space, but the movement does not culminate in a contact with the forehead. In this non-contact variant, only two of the three previously specified phonemic primes surface. It was claimed that there was no way to explain the upward trajectory of the sign if the contact was not realized in the surface structure. So, while the upward path of the movement had previously been described as a phonetic consequence of the movement toward the body to contact the forehead, in the non-contact version, this phonetic movement inward toward the body, becomes only the movement itself. According to Liddell, “If the specification of KNOW is ‘forehead, B handshape, contact’, but the contact is eliminated, no reason is apparent for the hand to move at all,” (1984, p. 380). For the contact and non-contact versions of THINK and KNOW, it is argued that the underlying forms are specified for contact, but that the surface forms, often produced in fast signing, lose their contact segment. The Movement-Hold model was developed specifically to solve these exact issues which were not well handled by the Stokoe model.

A similar criticism of simultaneous models arose from the phonological restructuring that occurs in what are traditionally called ‘compounds.’ So-called compounds arise from the frequent co-occurrence of two signs which later become fused into a single sign.[11] Klima and Bellugi (1979) conducted a survey of ASL compounds which found that rather than the compounded signs being equivalent in duration to the sum of the two original signs, the new compound’s duration was equivalent to a single sign duration. This led Liddell to suggest that there may be a restructuring of the sign concerning the timing of the movement and hold segments.[12] He suggested that signs contain underlying specifications which govern movement and hold segments. These underlying specifications in turn are restructured, based on well-formedness rules when signs are combined in compounds.

To return to our example THINK, Liddell (1984) compared the structure of THINK to the sign BELIEVE, historically considered a compounded form of the ASL signs THINK+MARRY in the sense of ‘commit to a thought.’ Because the supposed restructuring of signs occurs when they enter into compounds and become a single sign, the compounded version of THINK necessarily exhibits a different underlying structure from the uncompounded variant

[11] Signs such as BELIEVE have come under question as to whether or not they are truly compounds in a synchronic sense. For a rich discussion on the issue of compounding in signed languages see Lepic, 2015.
[12] Liddell investigated this by counting durations of signs using frame by frame video analysis.

as seen in Figure 4. In the THINK and BELIEVE examples, the suggested analysis proposes a loss of the initial approach-segment in THINK and a merger of the hold-segment in THINK with the initial hold-segment in MARRY. This is taken as evidence that surface forms are reconciled by a basic underlying structure and that the sequentiality of a sign is necessarily part of the specification, otherwise we cannot account for such surface variation.

	THINK			**MARRY**		
Segment	Approach	Hold		Hold	Approach	Hold
Handshape	1	1		C	C	C
Orientation	Fingertip-down	Fingertip-down		Palm-toward	Palm-toward	Palm-toward
Location	Forehead	Forehead		Basehand	Basehand	Basehand
Contact	-	+		-	-	+
NonManual	–	–		–	–	–
		BELIEVE				
		Hold			Approach	Hold
		1			C	C
		Fingertip-down; Palm-toward basehand			Palm-toward	Palm-toward
		Forehead			Basehand	Basehand
		+			-	+
		–			–	–

Figure 4) THINK+MARRY and BELIEVE: different sequential structures (adapted from Liddell 1984)

While the problems regarding the representation of compound signs and underlying structures of formal and informal sign variants were the driving forces behind the rise of the sequential models, several other perceived benefits were also gained in the movement away from simultaneous models. By proposing that signs were made up of alternating movement and hold segments, linguists were able to create parallels between these segments and spoken language vowels and consonants respectively. This provided linguists with the ability to debate preferred segmental structures, giving rise to the study of syllable structure, and morphological well-formedness in signed languages.

Thus for any given signed sequence containing three segments, while in theory six possible orderings are equally plausible, the ‘preferred’ order proposed by proponents of sequential theories seemed to be Hold-Movement-Hold. This proposal has been argued to underlie the reason why signs, which arise from compounding such as BELIEVE, reorganize their phonological segments as shown previously. In other words, signs are subject to morphophonological rules which allow or disallow certain sequences of segments. When two signs come together which violate these sequencing rules, a reorganization of the individual segments must take place in order to satisfy these constraints.

Once the initial analogies regarding equivalences between movements and vowels and hold and consonants began to propagate, it did not take long for several other structural similarities between signed and spoken language structures to be posited. For example, it was conjectured that syllables in signed languages consisted of a movement segment (Coulter, 1982). This analogy was due in part to the proposed correspondence between movement in signed languages and vowels in spoken languages as they relate to the peak of a sonority hierarchy. As it was shown that hold-movement-hold structure was the optimum morphophonological shape, it was opportunely mapped onto CVC syllable structure. Liddell suggested these parallels laid the groundwork for predicting and describing these movement-hold tendencies, “treating M segments as vocalic, and H segments as consonantal, we find that ASL words in citation form primarily occur in sequences analogous to VC, CVC, or VCVC….If we use sequential representations like those presented in this paper, it becomes possible to predict, for the majority of cases, not only the final syllable structure in terms of M's and H's but even which specific segments will be selected to make up the compound," (1984, p. 396).

Still other theories of the sign syllable suggested that each hand represented a consonant, while non-manual facial expressions constituted vowels based on the proposition, "Since it is possible for facial expression to occur alone in a surface syllable, we have chosen to refer to it as the core of the syllable," (Kegl & Wilbur, 1976, p. 377).

Despite the newfound ability to describe a number of sequential structures, several issues were identified with the early segmental models which precipitated the development of new ways of dealing with problematic data. Among the most pressing concerns were the problem of redundant representations, lack of broad generalizations, and the issue that handshape often behaves differently from the other parameters. With these new descriptive goals in mind, the field evolved to embrace autosegmental approaches to signed language phonology.

2.3.2 Autosegmental Models

Expanding on the propagation of segmental models of the early 1980s, signed language phonology models of the late 1980s and early 1990s sought to streamline the representation of sign parameters. Sequential models, it was argued, contained too many redundant specifications which were necessary to specify each segment's parameters. This was especially apparent in the notation of the handshape parameter, since the same handshape is often shared across several movement and hold segments. As we saw in Figure 4, a sign such as MARRY, which consists of two hold segments and one movement segment, must have handshape and orientation specified three times, once for each segment. Because formal representation in generative approaches to phonology values minimalism in description, this redundancy was considered unnecessary and perceived to show weaknesses in the ability of the segmental model to adequately deal with the complexity of the form.

Similarly, Padden and Perlmutter (1987) critiqued the Movement-Hold model for its treatment of alternating movement in signs. They argued that since the segmental model treated the dominant and non-dominant hand as having separate specifications for sign internal parameters, features were associated with either the ‘strong’ or ‘weak’ hand, but no parameters were shared across the hands. Padden and Perlmutter argued therefore that signs with alternating movement could not be adequately represented because, “alternating is a global property of the sign executed by the two hands together; neither hand in isolation can be said to be alternating. Given Liddell and Johnson’s basic assumptions, it is impossible to have a feature [Alternating], since all features are either features of the strong hand representation or of the weak; there is no way to represent global features of the two hands together,” (1987, p. 370).

Other major issues raised against purely segmental models concerned the handshape parameter specifically. The handshape parameter often transitions out of sync with the other segments. In other words, handshape transitions across segments not ‘on’ the segment. Additionally, sequential models struggled to adequately represent signs with sign-internal handshape change, or so-called micromovements. Such signs exhibit either a combination of path movement plus movement within the handshape, or the combination of a simple hold segment plus movement within the handshape. Within the sequential model, signs with sign-internal handshape change/movement were represented in such a way as to violate constraints on sequential structure creating an impermissible hold-hold structure.

As Sandler (1986, p. 9) demonstrated the ASL sign BUG (Figure 5) is represented as two hold segments, each of which is specified for a different handshape, 3 and bent-3 respectively, which is then repeated. However, two hold segments in sequence violate a well-formedness constraint, as sequences must alternate between movement and hold segments. Thus hold-hold sequences are disallowed in the underlying form in the sequential model, therefore signs such as BUG cannot be faithfully represented in this model.

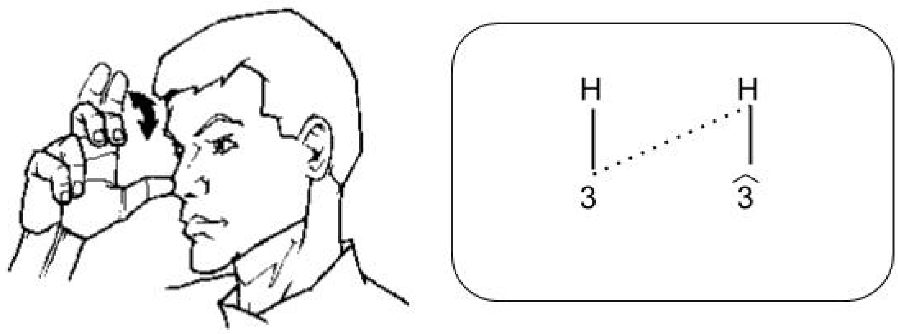

Figure 5: Segmental model of ASL BUG (adapted from Sandler 1986)

Finally, segmental models were criticized for failing to make broad generalizations concerning the organization of handshape, movement, and location as the primary contrastive parameters of a sign. In the Movement-Hold Model, movement was awarded segment status but handshape and location were relegated to specifications of an individual segment. In sequential representations where handshape change was represented by specifying the individual shape on each segment, there was no way to adequately restrict the subset of permissible handshape changes. Importantly, in any given signed language, handshape change is generally restricted to a small subset of the handshape inventory, meaning that there are direct relationships between the initial and final handshapes. All alternations in handshape change hinge on regularities of articulations such as flexing, wiggling, opening, closing various configurations. But some changes are not allowed; for example, transitions such as B-handshape to 5-handshape, which involves finger spreading, is not a permissible change. In sequential models, there no restrictions are placed on the permissible combinations, and they fail to capture the phonetic relationships shared by the initial and final handshapes.

To combat these perceived weaknesses, signed language linguists adapted popular autosegmental models from spoken language which had arisen primarily to deal with issues related to tone spreading. Signed language researchers applied the same principles to show that handshape, like tone and other non-segmental features, freely spreads across multiple segments. In this way, the handshape parameter was able to be minimally specified in its featural representations, which then spread right-ward across multiple segments of the sign until otherwise specified.

The advent of the Hand-Tier Model (Sandler, 1986, 1989) ushered in an autosegmental era during which time researchers addressed several of the perceived flaws of the sequential model. Well-formedness violations, such as those seen in the sign BUG with its hold-hold representation were solved by placing handshape on an autosegmental tier. Signs could then be specified for handshape separately from their movement and location (movement-hold) parameters, therefore eliminating violations of form.

Similarly, positing a separate autosegmental tier for handshape solved the issue of redundancy of handshape specification, as in the case in the ASL sign NOT. In this way, handshape was free to spread right-ward across each segment, therefore only needing to be specified one time (1986, p. 12). A handshape tier, allowed handshape change to be specified within that tier as a regular specification. Thus if a sign contained the handshape change S→5, such information could be specified along with the parameters of the handshape segment, but separately from the segmental information. This also allowed for a solution to the issue of restrictions on handshape-change, since the autosegmental tier allowed for specification of the change in handshape to be independent of the segment. This permitted predictable phonetic tendencies to be assumed, as they needn't be directly represented in the model (Figure 6). In the ASL sign LIKE, the handshape changes from flat-B-handshape to 8-handshape. Each handshape is represented on the autosegmental tier as an independent articulation which spreads across the articulation of the relevant segments.

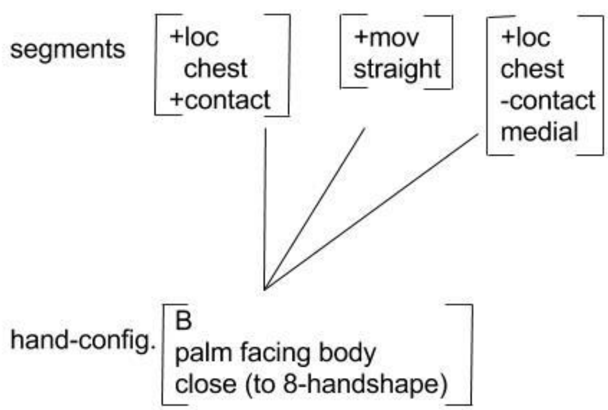

Figure 6) Autosegmental representation of sign-internal handshape change in the ASL sign LIKE (adapted from Brentari, 1998)

During this period, several alternatives arose to both the previous simultaneous, and segmental models. Linguists contributed their own models of phonology, each seeking to improve on perceived weaknesses of the former models. These proposed models developed increasingly complex formal representations to deal with phenomena important to generative analysis such as redundancy, basicness, predictability, and elegance (Brentari, 1998; H. van der Hulst, 1993; Perlmutter, 1989; Uyechi, 1996). Ultimately, one model emerged to become the prominent phonological model of the field for nearly two decades, the Prosodic Model of signed language phonology.

2.3.3 Prosodic Models

Introduced and formalized by Brentari (1998), the Prosodic Model of signed language phonology is a hierarchical model based in autosegmental theory. It is not unlike previous autosegmental models of signed languages; however, the prosodic model differentiates itself from previous models with the proposition that the handshape, movement, and location parameters are all part of the autosegmental structure of signed languages, rather than viewing handshape as the sole autosegmental tier. Another important aspect of this model is the claim that segmental structures are derived from the autosegmental units, so while there is a timing tier, it does not itself dictate the structure of the sign. A basic schematic of the formal representation of sign features using the Prosodic Model can be seen in

Figure *7*.

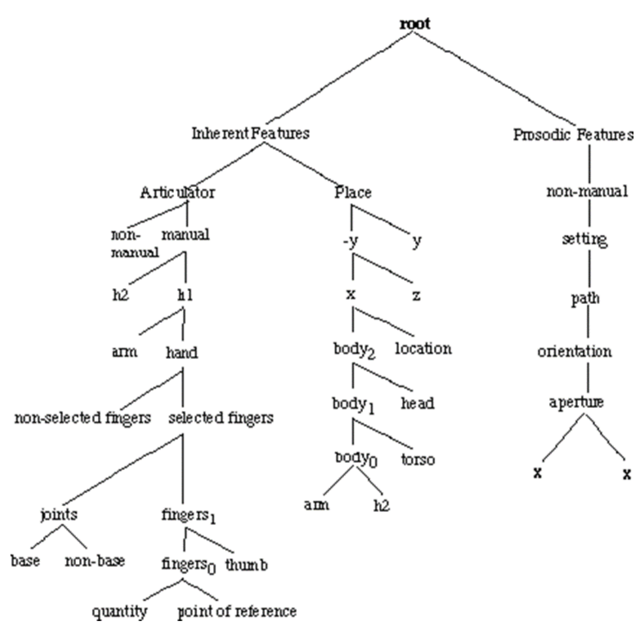

Figure 7) Skeletal structure in Prosodic Model of Phonology (Brentari 1998)

Within this model, features are organized according to feature geometry, dividing the primary nodes into Inherent and Prosodic features, where each node is maximally binary branching, and each branching structure consists of an elaborated head, and a less elaborate dependent. The difference between Prosodic and Inherent features lies in their role in the underlying structure of the sign. Inherent features do not allow their value to change within the sign, i.e. that the features are specified only once per lexeme, this includes Handshape (HS) and Place of Articulation (POA). Under the Inherent Feature Node, the Manual Node specifies the dominant hand or active articulator (DH or H1) which captures contrastive handshapes and the non-dominant hand or passive articulator (NDH or H2). The Place of Articulation Node specifies all of the contrastive places of articulation.

Prosodic features, on the other hand, allow for changes in their values within a single root/lexeme and specify the movements within the sign. Possible movements include aperture change, path movement, and orientation change. Orientation is derived from the relationship between the Articulator node and the Place of Articulation Node. The prosodic tier thus, accommodates movement. Brentari suggests several reasons for placing movement features on a separate branch including that movement 'migrates' from one joint to the next in distalization and proximalizations of signs, movements are linked to timing units differently than handshape, and location, and movement occurs between signs. These observations signal that abstract phonological movements are realized in the surface form specifications

The Prosodic Model, as well as all other current models of signed language phonology, describe handshape in terms of feature geometry, basing relationships between handshapes on featural similarities. Each handshape is then described by categorizing fingers which are divided into active or inactive fingers. Active fingers are said to be the only subset of fingers capable of moving in sign-internal handshape change. Sign-internal handshape change is constrained in that the two handshapes must have the same selected fingers. In this way, signs such as ASL THROW, articulated with a handshape-change from S→ U (as seen in Figure 8), are said to be underlyingly specified for the selected fingers (pointer and ring fingers) even while the primary handshape takes an S configuration.

Figure 8) ASL THROW handshape change S to U (adapted from HandSpeak," n.d.)

Also central to the Prosodic Model is the proposal that sonority in signed languages should be understood as relative movement, rather than a measure of 'loudness.' Articulations produced at a joint further from the torso, more distally, are considered to be less sonorous, while articulations produced more proximally, i.e. articulated at a joint closer to the torso, are considered to be more sonorous (Figure 9).

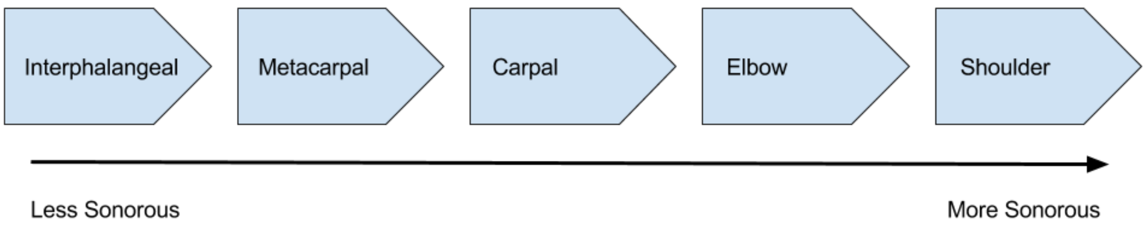

Figure 9) Sonority hierarchy for signed language movement

For example, a sign in which the movement segment in articulated at the elbow, is more sonorous than a sign in which the movement segment is articulated at the wrist. Likewise, a single sign can be said to become more sonorous if the movement is proximalized or less sonorous if the movement is distalized. Instances of proximalization are very common in both first and second language acquisition, and in child-directed signing (Holzrichter & Meier, 2000; Meier, Mauk, Mirus, & Conlin, 1998).

Sonority, as defined by amplitude of movement in signed languages, has been criticized by several scholars, including Sandler & Lillo-Martin (2006) who suggest that loudness and amplitude of movement are not easy to distinguish from one another. Alternatively, sonority has been detailed within subtypes of movement, such that path movement plus trilled movement was considered to be the most sonorous type of movement while contact at a location has been proposed to be the least sonorous (Sandler, 1993). Locations and handshapes in this alternate sonority proposal are conceptualized as obstruents.

Brentari's model of sonority also excludes non-manual articulations, so says little about how non-manual components of signed languages contribute to the sonority scale or to syllable structure as a whole. Interestingly, with the exceptions of work by Sandler and Lillo-Martin (2006) and Jantunen and Takkinen (2010), few attempts at reconciling the role of non-manual articulators in the structure of syllables have been put forth since Kegl and Wilbur's early suggestions.

The Prosodic Model, has been widely accepted within the signed language research community, and has allowed for several important discoveries in the field. Despite its widespread use, I argue that turning to a cognitive approach to signed language phonology will greatly increase the descriptive and explanatory power of linguists attempting to describe the distributional characteristics and structural properties of signs. In the following section I describe the current state of understanding vis-à-vis the formational properties of signs, many of these observations having grown out of research within the Prosodic Model.

2.4 Formational Properties of Signs

Summarizing what we know about the structure of signed languages from the past fifty years of research is not a feasible task within the confines of this chapter. Instead, I will briefly give an appraisal of currently accepted assumptions about signed language phonology, highlighting articulatory differences between signed and spoken languages, observations regarding contrastive parameters of signs, and formational constraints on signs. These highlights will serve as cardinal points of investigation for a cognitive model. Despite suggestions that there are 5 contrastive parameters, I focus on the three major parameters: handshape, location, and movement, with a primary emphasis on handshape. Non-manuals and orientation have been proposed as two additional parameters, due to a small number of minimal pairs which contrast only in orientation or non-manual marker, but I will not devote any real attention to these parameters as there is not widespread agreement across the field as to their status as phonological parameters.

First and foremost, it is crucial to recognize that unlike spoken language, the vast majority of articulations produced in signed languages are fully visible to the naked-eye. Signed languages are articulatorily transparent; the entire articulation can be seen without the necessity of ultrasound or other imaging techniques often needed to observe articulations in the vocal tract. Similarly, because signs are articulated using multiple large articulators, including the head, torso, arms, and hands, the articulatory space employed by signers is much larger than the articulatory space of the vocal tract.

Whereas the tongue is the major active articulator for spoken language, the hands are the primary active articulators in signed languages. Unlike spoken languages, which have relatively clear divisions between active and passive articulators, signed language articulators can be active or passive. This introduces many more degrees of freedom to the phonetic description in signed languages, as the articulatory role that a given articulator plays is not always predictable.

While the tongue does most of the dynamic articulatory work for spoken language, signers generally have a dominant hand. This is often, though not always, their preferred writing hand. Some signers are ambidextrous and switch the bulk of the articulatory load between right and left hands, but the majority of signers have some hand dominance. The dominant hand is responsible for the majority of dynamic articulatory movement. It is the least restricted articulator, and is free to take a wide variety of handshapes, movements, and contacts with different parts of the body. The non-dominant hand is generally more restricted in possible movements and handshapes. We will return to these more global properties of signs and the division between the dominant and non-dominant hands at the end of this section.

The parameter which generally receives the most focus in the literature on signed phonology is handshape, most likely because it is both easier to isolate than location and movement, and because it seems more amenable to concerns of contrastiveness. I too will focus my attention on the handshape parameter, though I will briefly discuss location and movement. Handshape, often referred to as 'hand-configuration', pertains to the shape of the hands during the articulation of a sign. Signs may be one-handed, consisting of a single handshape, or signs may be two-handed with either the same shape on both hands, or a different shape on each hand. I prefer the term 'handshape' to refer to the arrangement of joints and fingers of a given articulation of a particular hand, the term 'hand configuration' to refer to the relationship between the two hands with respect to one another within a given sign.

ASL linguists have yet to agree on the number of proposed/observed handshapes.

Proposals have ranged from the low end at 20 handshapes (including only alphabetic handshapes) through 100 (including all possible allophonic alternations as separate handshapes). It is still the case, as Corina and Sandler (1993) observed over twenty years ago, that we have yet to find a model which allows us to define a comprehensive list of the phonological units in ASL. This arises in part due to the large number of possible combinations of handshape, movement, place of articulation, non-manual markers, which results in smaller neighborhood densities, and fewer minimal pairs. This has major repercussions in terms of how signs are organized in the lexicon, how we categorize phonemes, and how signers process their language.

Handshape is further divided into "featural classes", which identify the active and passive specifications of fingers and joints in the articulation of a given handshape. These featural classes allow for handshapes to be compared to one another based on articulatory similarities. 'Selected fingers' and 'joint configuration' are two theoretical constructs thought to account for several phonological rules across signed languages. 'Selected fingers' refers to which fingers are foregrounded in a given handshape. For example, in the L-handshape, the index finger and thumb are considered to be selected, while the middle, ring, and pinky fingers are considered non-selected. Selected fingers are considered to be less amenable to coarticulation effects in fingerspelling (Keane, 2014), and underlie the claim that sign internal handshape-change does not consist of two different handshapes, but a single underlying representation for selected fingers. Joint configuration specifies which set of joints are involved in the articulation (base or non-base joints) as well as the individual configurations of the joints, as expressed through binary features [spread], [flexed] [crossed] and [stacked]. A detailed diagram of the features involved in describing handshape can be seen in Figure 10.

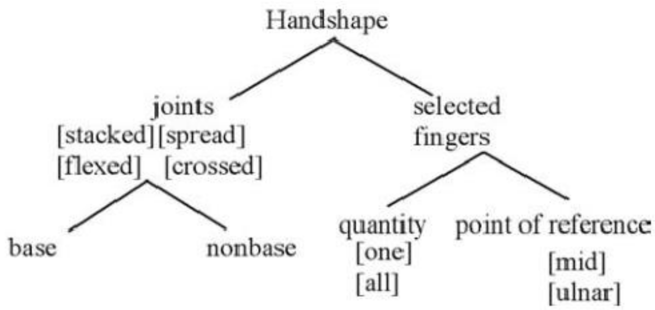

Figure 10) Phonological model of handshape (Brentari, 1998)

The location parameter, also often referred to as the place of articulation parameter, includes the three-dimensional point in space in which the sign is articulated. This may include a point on the body, such as the forehead, chest, or arm, a place just in front of the body, referred to as neutral space, or as we saw above, a place on the non-dominant hand. A sub-portion of signs involve contact at a location parameter. For example, the sign THINK (Figure 3 above) often includes contact with the temple, while the sign HIT involves an S-Handshape on the DH contacting the side of a 1-handshape on the NDH. Interestingly, recent work on iconicity suggests that when only one of the three major signed language parameters is iconic, it is most likely to be the location parameter.[13] Cates et al. (2013) found that in a database of 526 signs which exhibited approximate or actual contact with the body, 59.7% of these signs shared iconic mappings between meaning and form.

Movement is perhaps the least understood parameter, due in part to the difficulty in constraining movement into a countable, listable set in the grammar. As a result, several researchers consider much of the movement in signs to be non-linguistic, i.e. gestural. While

[13] Cates et al. (2013) uses a very conservative definition of iconicity and as such, percentages of iconicity across parameters is likely much higher. What is useful about this conservative estimate is that it shows that even under very strict definitions of 'iconic' motivation in parameters of signs is rampant.

there are consistent recurring movements across signs, as indicated by several attempts at listing the phonological possibilities, many signs are capable of having some type of augmentation or modification which deviates from the citation form. Perhaps most importantly, movement exists on its own branch in the Prosodic Model (Figure 11).

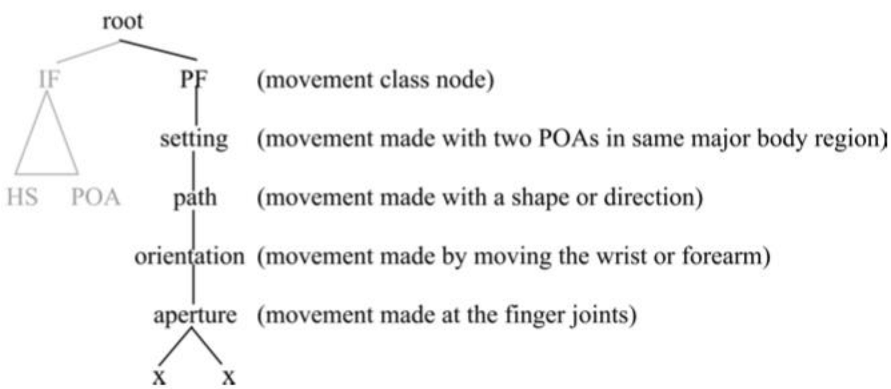

Figure 11) Prosodic Feature branch (Brentari 1998)

The prosodic features, i.e. movement specifications, are responsible in the Prosodic Model for generating timing slots. Path movement generates two timing slots, while all other movements generate a single timing slot. In this way, timing slots are predictable from the features. This is central to Brentari's argument regarding the differentiation between signed and spoken language structure, namely that feature material, "has a higher position in the structure and timing slots a lower position; in other words, the reverse of what occurs in spoken languages where timing units are the highest node in the structure," (2012, p. 37).

Movement is considered to be at the core of the signed syllable and as signed syllables are considered to be the basic structures of signs, movement is a required element of all signs. When movement if not specified in the underlying form, an epenthesis rule inserts a movement into the surface form of a sign, thereby conforming to well-formedness constraints.

Having reviewed the basic parameters of signs, we return now to the division between the dominant hand (DH) and the non-dominant hand (NDH). The DH is the most active and least restricted articulator. It is able to make contact with any location, take any movement, and any handshape available to the grammar. The DH is the primary articulator for one-handed signs, unless it is occupied by some other functional activity such as holding a cup. It is also the primary articulator for two-handed-asymmetrical signs in which the NDH articulates an unmarked handshape while the DH articulates any available handshape in the grammar. The DH in both one-handed and two-handed signs is the articulator that is free to articulate sign-internal handshape change. In two-handed symmetrical signs, the DH and the NDH both articulate sign-internal handshape changes simultaneously, making the NDH seem to simply copy or mirror the DH's articulation.

Many consider the NDH to be a largely redundant articulator. According to Sandler, "This means that the nondominant hand plays only a minor role in lexical representations. It represents *a meaningless phonological element*, and its shape and behavior are so strictly constrained as to make it largely redundant," (Sandler, 2006, p. 188) [emphasis added]. Interestingly, the NDH may play the role of either active or inactive articulator. For instance, the NDH can act as a place of articulation on which the DH acts. This can be observed in the ASL sign WARN, in which the dominant-hand, in a B-handshape, taps twice on the back of the non-dominant-hand, in an S-handshape. However, other times, the NDH mirrors the articulation of the DH, and acts as a 'doubled' active articulator. This can be seen in the ASL sign BOOK, in which two open-B-handshapes begin palms touching and open along the pinky edge of the palm, ending palms up (Figure 12).

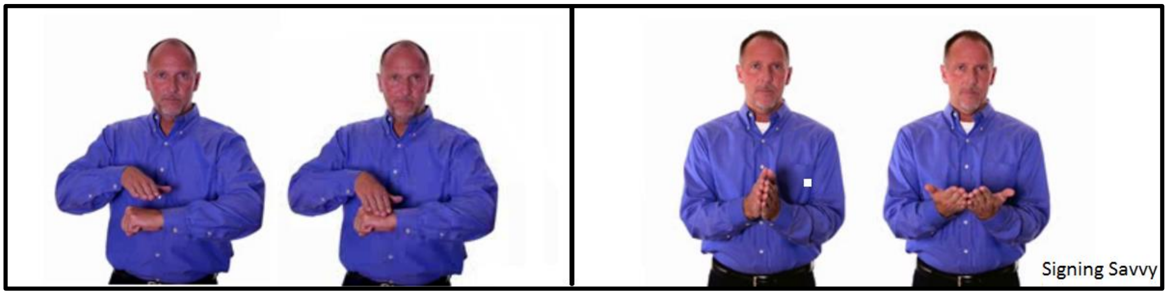

Figure 12) NDH as place of articulation ASL WARN, NDH as a doubled articulator ASL BOOK

During the articulation of signs in which the NDH is inactive, the NDH takes a handshape which is part of a highly restricted subset of possible handshapes. In ASL it has been proposed that the restricted set includes the 7 'basic' handshapes which include B, A, S, C, O, 1 and 5. These handshapes are considered unmarked based on their visual contrastiveness and overall frequency in ASL (Battison, 1974). The status of these seven handshapes as 'basic' phonemes has been assumed to extend to a typologically diverse set of signed languages.[14] This basic set of unmarked handshapes is said to be a) typologically frequent, b) articulatorily simple, and c) acquired early during acquisition.

In addition to the reduced number of the handshapes allowed on the NDH of asymmetrical signs, movement patterns also have some restrictions. A proposed constraint, called the *Dominance Condition*, states that, "For those signs which have "non-identical" handshapes, one hand must remain static, while the other, usually the dominant one, executes the movement," (1974, p. 6). Under such phonological descriptions, the NDH is a place of articulation which is restricted in movement and handshape, but which nevertheless is capable of articulating a subset of handshapes during articulation. But, the NDH is not always restricted to a place of articulation parameter. The NDH can also be an active articulator, which articulates the

[14] As few as 4, and as many as 8 basic handshapes have been proposed.

same handshape of the DH, as is the case in symmetrical two-handed signs. For some linguists, this ‘doubling’ or ‘mirroring’ of the DH underscores the articulatory redundancy of the NDH because the second hand is simply copying the articulation of the first.

In two-handed signs with the same handshape, there is an option for hands to move in-sync with one another or in the exact opposite movement, contra one another. The *Symmetry Condition* proposes, “if both hands move independently during a given two-handed sign (as opposed to one or both being static), then the specifications for handshape and movement must be identical, and the orientations must either be identical or polar opposites (reciprocals),” (Battison, 1974, p. 5). This “Weak-Drop”, is considered a purely phonological phenomenon which applies post-lexically to signs. Researchers have taken this as further evidence to support the redundancy claim.

Each of these observations about signed language phonology and the structure of signs is based in models which privilege abstract formal representation, minimal specification, and form divorced from function. While these approaches have helped to detect patterns of what signs *do*, they fail to make several important generalizations which I believe can only be arrived at through usage-based, cognitive approaches to language structure. The remainder of this chapter will be devoted to explicating such weaknesses and summarizing current preliminary attempts at addressing such gaps in the theory.

2.5 Challenges to Current Models

There are many ways in which current models are at odds with a usage-based/cognitive approach to phonology. Primarily, the goals of generative models and functional-cognitive models are at odds with one another. Due to the search for maximally abstract underlying representations, signers’ experience with the language, their use, and individual utterances have in many ways been ignored. In usage-based models, a primary motivation is to uncover how language users' experience with their language affects and shapes the language. The 'use' in usage focuses our attention on what speakers *do*. Bybee (2001, p. 4) suggests two more pillars of a usage-based perspective which interact with use, *substance* and *emergence*. Substance simply refers to 'the stuff' of language, this includes both the articulations and the meaning of utterances. Emergence, is the appearance of structure from the interaction of substance and use.

When we look at how considerations of these factors influence our perceptions of what is actually happening in language, we can see that the reality of the usage-event provides rich, contextualized data from which clear patterns emerge. We can simply look to our recent discussion regarding the 'inactive' nature of signed language articulators to see discrepancies between theoretical assumptions based on idealized underlying forms and actual usage events. Despite claims that two-handed asymmetrical signs (differing handshapes on DH and NDH) consist of an active DH and an inactive NDH, going so far to create a rule which reiterates this fact, in reality this may not be the case. In many asymmetrical signs the NDH seems to move toward the active articulator, as the active DH moves toward the NDH. Figure 13 shows the ASL sign THOUSAND, in which the DH articulates the bent-B-handshape while the NDH articulates an open-B handshape. Despite the asymmetry, it is clear that both hands move to meet one another in the dynamic articulation.

Figure 13) Asymmetrical ASL sign THOUSAND, showing articulatory movement on both the dominant and the non-dominant hand. ("Nyle Dimarco's ASL Survival Guide,")

In the proposed Dominance Condition, where the non-dominant hand is said to be inactive, it is clear that in many cases the inactive articulators move to meet the active articulators during dynamic articulations. This ‘inactive articulator’ movement also seems to occur for places of articulation other than the NHD. Prototypical inactive articulators such as the head, which have only been considered to be locations on which signs are articulated, have been shown to move to meet the active articulator (DH) (Mauk & Tyrone, 2012; Russell, Wilkinson, & Janzen, 2011; Tyrone & Mauk, 2012). Mauk and Tyrone observed that, “some signers not only moved their hands to reach the forehead location, but they also moved the head to facilitate contact between it and the hand…passive locations (such as the forehead) can play an active role in sign production, adapting to the articulatory demands for a given utterance,” (2012, pp. 136–37).

This raises questions, regarding the analogies between inactive articulators in spoken languages and signed languages. It seems that for spoken language, inactive articulators do not move, for example, when we say the tongue tip (active articulator) moves to meet the alveolar ridge (inactive articulator), there is no chance that the fixed alveolar ridge (which steadfastly holds the upper sockets of your teeth) is able to be moved or manipulated. However, when discussing the NDH as an inactive articulator, it seems that it is both capable of moving, and does indeed move during dynamic articulation.

Another obvious point of theoretical conflict between current models and usage-based approaches is in the postulation of underlying forms, to which derivational and phonological rules are applied to derive surface representations. Usage-based models do not subscribe to different surface and underlying representations. Surface forms i.e. usage events, are not derived by rules from a more abstract underlying form. Liddell and Johnson (1989b) posited that lexical roots were not fully specified and instead contained feature specifications in their underlying structure. For example, in their treatment of the sign family 1st-PLACE, 2nd-PLACE, 3rd-PLACE, etc., they propose, “morphological processes 'fill out' such incompletely specified roots with morphemes which consist of the small bits of phonological information used to fill the empty cells in the root,” (1989a, p. 256).[15] As we will see in Section 2.6, construction grammar approaches handle the description of such sign family patterns without appealing to underlying representations or underspecified form. This theoretical mechanism creates the need for many overly complicated representations and notably creates odd distinctions which arise from fitting data to the model. One such example of this is the claim that the movement feature is required for all well-formed signs.

Similarly, movement is also considered the only feature allowed to change within a sign. Under this rule handshape, is not allowed to change within a sign; therefore, sign internal handshape change is not treated as a change in handshape at all, but as a change in movement. Movement is specified on a different autosegmental tier and is allowed to undergo change during the production of a sign. Despite the fact that a sign begins with one handshape and ends with another handshape, and regardless of the fact that the change seemingly occurs within the handshape parameter, this parameter is relegated to a tier other than the one which specifies handshape. The model reconciles this anomaly by proposing that the initial handshape is actually underlyingly the second handshape in the sense that both handshapes are actually underlyingly the same selected fingers. So because the feature specifications for selected fingers are only defined once per lexeme on the Inherent Tier, the second handshape is already specified in the initial handshape, and an aperture change is specified on the Prosodic Tier to account for the change in shape.

[15] Sign family refers to a group of morphologically related signs

I theorize that different types of movement are not functionally equivalent. Movement within handshape change seems to have a different function than path movement which is also functionally distinct from trilled movement or orientation change. As I show in chapter 4, there are strong patterns of meaning associated with, for example, sign-internal handshape change. I also suspect, though an intense investigation of the subject will not be tackled in this dissertation, that path movement has similar patterns of meaning associated with it, such as the duration of an event, fictive motion, real motion, relationships between events and the interlocutor, reciprocals, etcetera. Examining these features from a functional perspective gives rise to important language internal categories which may also be revealed to have significant cross-linguistic relevance.

Likewise, models which do not take usage, substance, and emergence into account inevitably miss out on recognizing how variation across usage events both within and across speakers is meaningful and often associated with factors such as frequency and language change. When we look at actual usage, we can see that most signs exhibit varying degrees of variation. Importantly, this variation can give linguists insight into the lexicalization and grammaticalization of signed languages. For example, the sign HASHTAG which is a fairly new coinage arising with the advent of Twitter, has four distinct contemporary variations. Each of the variants are two handed, with the V-handshape articulated on the DH and the NDH. Variation arises however, with the orientation the palms take relative to each hand (Figure 14

).

Figure 14) Variations in ASL sign HASHTAG (adapted from CHS ASL, n.d.)

Another way current models are at odds with usage-based approaches are the ways in which they handle 'redundant material.' Brentari and Sandler criticize Liddell and Johnson's Hold-Movement model (1989) by stating that many holds are predictable. Thus, from a generative perspective the feature matrices in the Hold-Movement model contain too much redundancy. One of the major goals of the later Hand-Tier Model (Sandler, 1989) and Prosodic Model (Brentari, 1998) was to target and eliminate redundancy of multiple specifications in the tiered representation. Any sign component that is predictable can and should be derived through rules and therefore, need not be represented in the model.

However, Langacker (1987a) has argued that a word without its redundancy is not a recognizable word at all. This is further emphasized by Bybee (2001) who states, "Linguistic regularities are not expressed as cognitive entities or operations that are independent of the forms to which they apply, but rather as schemas or organizational patterns that emerge from the way in which forms are associated with one another in a vast complex network of phonological, semantic, and sequential relations" (p. 21). Thus while current models systematically strive to avoid redundancy in their rule governed representations, they fail to encode important information about the form and emergent patterns that arise from usage across multiple utterances.[16]

Finally, perhaps unsurprisingly, none of these former models of signed language phonology have figured out a way to explain or incorporate iconicity in any meaningful way into the analysis of signs. While some attempts at an Optimality Theory approach have attempted to account for iconicity as a 'faithfulness constraint' (Brentari, 1998; Eccarius, 2008; Eccarius & Brentari, 2010) generative theories fail to embrace the very cognitive mechanisms that give rise to iconic form-meaning mapping. This is a regrettable consequence of theories grounded in the separation of semantics and formal properties of language which divorce form from function. Though some linguists from pre-Chomskian era linguistics warned of this disturbing trend (D. Bolinger, 1965a), the field nevertheless turned to purely formal explanations of linguistic phenomena. In this model phonemes are without meaning and thus phonology does not need to account for sublexical iconicity which itself is a property of meaning.

Attempts to identify the pre-determined building-blocks of language — features, phonemes, segments, syllables and the like — have been imprudent. All of the previous models of signed language phonology discussed here, have emphasized the necessity to differentiate between contrastive/non-contrastive units, throwing out predictable information under the rationale that we need only account for what is *not* predictable. This type of discrete categorical view of language has a difficult time addressing variability. Variants are accounted for through derivations which arise from underlying forms. These variants appear by way of complicated

[16] While Bybee (2001) and Langacker (2000) have demonstrated this for spoken languages, it has yet to be shown for signed languages.

phonological processes in highly specific environments. This solution is contrary to natural language data in which variation is the norm, rather than the exception.

2.6 Future Directions of Signed Language Phonology

It seems that many signed language linguists are ready for a new approach which better allows them to account for findings relating to formal properties of signs. Whether documenting lesser-known signed languages, comparing formal properties of signs across typologically unrelated languages, describing grammaticalization processes, or explaining iconicity related effects in psycholinguistic studies on perception of signs, a growing consensus seems to conclude that current models cannot sufficiently explain many of these complexities of signed languages.

Several young researchers are rising to the call and proposing increasingly forward-thinking treatises which challenge current paradigms. A recently completed dissertation by Keane (2014) has advocated for an articulatory model of signed language phonology. Building on preliminary work on Articulatory Phonology in signed languages as pioneered by Tyrone and Mauk (2012; Mauk & Tyrone, 2012), Keane takes seriously investigations of variation in signed language phonology by describing coarticulation patterns in fingerspelling. Keane restricts his investigation to ASL fingerspelling rather than looking at the lexicon as a whole because, "fingerspelling is more sequential than other types of signing, so the resulting phonetic analyses will allow for more direct comparison with similar spoken language work in terms of assessing the effects of articulatory ease, frequency, and phonological processes in sign production," (2014, pp. 33–34).

In his articulatory model of handshape, Keane proposes that selected fingers are akin to active articulators and unselected fingers are akin to inactive, or in his words 'non-active' articulators. Keane observes, for example, that a coarticulation model is useful for describing phenomena such as pinky extension, the extension of the pinky finger in signs which do not 'specify' the pinky as part of the articulation. He finds that pinky extension is more frequently observed as a result of coarticulatory pressures when the pinky finger is non-selected, and that the preceding and following phonological contexts influence the emergence of pinky extension. Keane presents three hypotheses which gain support from his analysis, namely that non-selected fingers are more frequently the targets of coarticulatory pressure, selected fingers are the sources of this coarticulatory pressure, and coarticulatory pressures result in different configurations than the phonologically specified configurations.

Despite the fact that Keane focuses his research primarily on fingerspelling, he acknowledges that this approach has potential for application in other areas of signed language phonology. To my knowledge, prior to his work, the Articulatory Phonology concepts of active and passive articulators had yet to be formally applied to the concepts of selected fingers as active articulators and unselected fingers as non-active articulators. But while Keane's model proposes a novel method of analysis for the phonetics-phonology interface which inevitably moves the field forward, articulatory approaches still leave several issues related to signed language phonology unaccounted for.

A second emerging theoretical framework amenable to usage-based approaches, focuses on kinetic articulatory properties of signed languages. Wilbur and colleagues (Malaia & Wilbur, 2012; Malaia et al., 2013; Wilbur, 2003, 2004) have investigated the geometric and physical correlates of articulation as they relate to the telicity of signs. In her Event-Visibility Hypothesis, Wilbur states that the event-structure of signs is reflected in their phonological form. She argues that grammatical correlates of telicity, resultatives, and perfectives all have visible phonological correlates, and that these mappings, are systematic and pervasive across signed languages. In this hypothesis, Wilbur argues telicity, for example, can be marked in the phonology of a sign as aperture change (closed to open or open to closed handshape), change in location (path motion from location$_a$ to location$_b$, orientation change (e.g. palm-up orientation to palm-down orientation) or other such 'change of state' markers.

Most recently, Wilbur's comparative work on ASL and HZJ (Hrvatskom Znakovnom Jezik or Croatian Sign Language), using motion capture technology has looked at real-time usage events (Malaia & Wilbur, 2012; Malaia et al., 2013), and has shown that kinematic correlates of articulation map onto differences in linguistic meaning, namely telic versus atelic events have articulatory and perceptual differences in form which result in meaning differences. Unfortunately, despite these astute observations, much of the Event-Visibility Hypothesis literature is still very narrowly construed and only deals with very few event-structure mappings. The authors suggest that theses mappings reflect physical geometric properties as they relate to physics, rather than discussing such findings in a more cognitively oriented force dynamics paradigm. Still moored to generative paradigms, the patterning is explained in terms of interfaces between phonology, syntax, and semantics rather than discussing such mappings as constructions, which are extracted from usage events. Despite these drawbacks, the findings from these studies both confirm and support the cognitive phonology approach for which I am advocating.

In addition to articulatory approaches to signed language structure, other researchers are beginning to implement construction-based approaches to formal analysis. These models, which consider form and function as the necessary components of constructions, are much more capable of addressing the issues faced by signed language linguists. Lepic (2015) tackles the issue of so called ion-morphs (Fernald & Napoli, 2000) or sign families, looking at instances of initialization and numeral incorporation. Lepic shows how such lexical items can be construed as constructional blends, for example, in signs such as GROUP, FAMILY, TEAM, multiple signs share a movement and location parameter, but differ in their handshape. Lepic analyzes the location and movement combination as one construction and the initialized handshape as a separate construction which can then be inserted into the schematic handshape slot.

Similarly, Lepic suggests that numeral incorporation also warrants a constructional approach. As we saw above, Liddell and Johnson (1989b) treated these types of signs as combinations of roots with unspecified phonological material. However, under Lepic's analysis, numeric handshapes are schematized from a set of numeral constructions, such as ONE-WEEK, TWO-WEEK. In these signs, the dominant hand slides away from the body, palms together, across the non-dominant hand, but the handshape slot is filled with any numeric handshape from 1-9. Importantly, the movement and location parameters are fixed, i.e. not schematic; however, the handshape parameter is fairly schematic, in that the handshape must only be one of a subset of handshapes 1-9. What sets Lepic's analysis apart from previous models, is that despite the use of a more formal model of construction grammar, he employs a decidedly more usage-based approach. By looking at a functional distribution of handshape, he argues that handshapes gain their meaning from the constructions themselves, in that several handshapes have more than one functional mapping. He contends that initialized sign constructions are not derived from a building-block type model but that the associated meanings emerge as a result of usage events in which signers schematize across patterns.

Finally, it should be noted that despite the fact that none of these models directly address iconicity, the practitioners do recognize that iconicity is necessary for the description of signed languages. As Brentari has noted, "Just because a property is iconic doesn't mean it can't also be phonological," (Brentari, 2012, p. 46). This harkens back to the observation made by Wilbur, some 30 years earlier, "Describing something as iconic may be true, but it is also linguistically insufficient," (Wilbur, 1979: 169). I agree with both of these statements in that phonemes can and do encode meaning and thus can be both motivated and phonological, and that simply identifying something as iconic does not give insight into the mechanisms by which such iconicity came to be. However, previous attempts seem to have done exactly this, recognizing that iconicity exists in signed languages, but failing to account for its existence and failing to develop a model which accommodates such findings. Keeping these issues in mind, in the following chapter I develop a usage-based, cognitive model which accounts for iconicity (and arbitrariness) of the phonological properties, as they arise from usage events.

2.7 Chapter 2 Discussion

In this chapter I have discussed the development of the field of signed language phonology, from its inception, to its current theoretical manifestations. I have shown that the trajectory of theoretical frameworks has in many ways followed the evolution of spoken language frameworks. I have relayed the advancements made by each subsequent theory, and laid out the inadequacies and complications which led to new and novel application of theory to solve ever progressing complexities of the description of signed languages. I have suggested some differences between signed and spoken language phonology which are likely rooted in their respective modalities. I have briefly discussed the current beliefs regarding the important units for description of signed language phonology and discussed several proposed restrictions on form. Finally, I have argued that several new theories have emerged in the past several years which are challenging the status quo. Application of Articulatory Phonology and construction grammar approaches have given the field of signed language linguistics a much needed shove into twenty-first century linguistics.

In the following chapter, I review the state of cognitive phonology as it stands and as it has been imagined in the past. I lay out an innovative cognitive approach to sub-lexical structure which makes clear predictions about the nature of phonemic content. Building primarily on the work of Bybee (1994, 1999, 2000) and Langacker (1987, 1991, 2008) I describe how all levels of language schematization are tagged for meaning and as such, phonemes should be considered on par with any other language unit. I argue that phonemic content is extracted in the same way as morphosyntactic content and that no hard line can be drawn between morphemes and phonemes. In this way, I discuss phonemes as consisting of both phonological and semantic poles, rather than merely abstract formal representations.

Chapter 3

3 Cognitive Phonology

In this chapter, I describe how phonemes can be reconstrued as motivated pairings between phonological and semantic poles, rather than merely abstract formal representations. I begin with a brief summary of the important aspects of previously laid theoretical groundwork which has worked toward a new cognitive phonology in Section 3.1. In Section 3.2, I lay out several tenets of Cognitive Grammar and summarize what these theories suggest about phonological structure. I highlight that there exists no a priori reason to consider phonology to be any different from other 'levels' of linguistic structure. I argue that as is the case with other levels of language chunking, phonemes arise from the usage event, and despite their sometimes perceived arbitrary nature, semantic 'traces' are ever present in the minds of individual language users. I show how the extraction of phonemic material from the usage event leads to more than one possible outcome. Arbitrariness (duality of patterning) is only one possible endpoint on a continuum of possible outcomes in the schematization of phonemic material. It is also possible that forms, will retain schematic traces of meaning, resulting in highly abstract form-meaning mappings at the level of 'syllable', 'phoneme cluster', 'phoneme', or 'feature'.

Section 3.3 lays out a new model of cognitive phonology which builds on several developments in linguistics and psychology, making the theory both more consistent with other cognitive models of language while simultaneously creating a psychologically plausible account of the emergence of phonemic structure as it relates to embodiment. Specifically, I focus on phonemes as symbolic units discussing first the make-up of the phonological pole in Section 3.4, or formal representation, and then the substance of the semantic pole (Section 3.5), or conceptual contents. In Section 3.6, I provide evidence that these motivated pairings of form and meaning are by their very definition embodied, grounded in our experience with the world exactly because our conceptualization of the world is filtered through and gained by way of embodied experience, and that these associations can be either internally or externally motivated. Specifically, I discuss the different ways language-internal and language-external motivation contribute to our conceptualization of content and the emergence of symbolic units.

Section 3.7 briefly discusses the role of the individual in the process of meaning making and schema building, touching on the topic of individual grammars and how construal of experience influences what many consider to be global or universal categorization of language. I also touch on the relationship between embodiment, simulation, and construal of individual grammars. Finally, Section 3.8 summarizes the chapter, revisiting the way in which reconciling different points of emphasis from the theoretical frameworks of usage-based phonology, Articulatory Phonology, construction grammar, and Cognitive Grammar create a new model of phonological analysis, cognitive phonology.

3.1 The State of Cognitive Phonology

One of the most basic tenets of Cognitive Grammar is the assertion that a unit of language consists of three structures: the phonological pole, the semantic pole, and the symbolic structure. The phonological pole consists of all of the gestural (articulatory) material, the semantic pole consists of all of the conceptual material, and the symbolic structure is the relationship between these two phonological and semantic structures; thus there is no need to posit underlying structures or Universal Grammar as these three cognitively relevant structures are all that is necessary to describe language.

Paradoxically, cognitive grammarians, and cognitive linguists more generally, focus much of their energy on describing the semantic half of this bipolar structure, leaving the field of phonology largely untouched. Though a few have presented treatises on the topic of ‘cognitive phonology' (H. G. van der Hulst, 2003; Kaye, 1989; Lakoff, 1993b; Nathan, 2008; Välimaa-Blum, 2009), addressing topics such as connectionist principles, or the psychological implausibility of the derivation by rule application, these theories have not been widely embraced.

Among the first to introduce issues related to the application of cognitive models to the study of sounds was Paul Kaye, in his book, *Phonology: A Cognitive View* (1989). Kaye was sensitive to incorporating emerging evidence from advances in AI, computer science, and cognitive psychology into the field of phonology. Written as an introductory textbook to current issues in phonology, Kaye guides students through the development of phonological theory from generative to non-linear phonology. He addresses past and present concerns of the field, openly challenging what he considers to be the shortcomings of the generative approach. Ultimately, the book culminates in a chapter devoted to current issues (as of the late 1980s) and a challenge to think about phonology in a different way. Kaye asserts that generative models fail when it comes to the ontogeny or phylogeny of phonology. At one juncture, Kaye pronounces the death of the phoneme, as he recalls recent examinations into the true nature of "the ultimate phonological unit" (p.148). Kaye suggests that while the idea of a phoneme, as a segment, was "intuitively satisfying," its cognitive reality has come into question. Though he does not outline exactly what cognitively-oriented phonology would look like in practice, this text represents an early attempt at recognizing challenges to traditional phonological paradigms.

A more to-the-point treatment of a cognitively-oriented approach to phonology was written by Lakoff in the early 1990s. In a piece called *Cognitive Phonology* Lakoff (1993a) reacts to generative theories which posit derivations from underlying structures. He observed that while neural processes occur in real-time, it is impossible that phonological derivations and all of their intermediary steps occur in real-time. He argues that phonology should be treated similarly to cognitive approaches to grammar, in that one can use construction-based analyses and employ general cognitive mechanisms to arrive at a cognitively realistic model for representing the connections between morphological and phonetic sequences. Ultimately, Lakoff suggests such a model should be formally situated within a Parallel Distributed Processing (PDP) model, but for expository purposes, he situates his cognitive model within an autosegmental framework. Though Lakoff is adamant about doing away with ordered rules, cycles, derivations, and application principles, precisely because of their psychological implausibility, he fails to establish a phonological model which divorces itself completely from structuralist principles. In his attempts to detach from such views, Lakoff still implements a phonetic versus phonemic versus morphemic contrast that presupposes that phonological constraints are stored.

These implementational issues aside, Lakoff does argue that cognitive phonology must be an integral part of cognitive approaches to grammar, that it should be approached through the lens of constructional analyses, and that such implementations make other aspects of the grammar 'directly accessible.' In this way, a cognitive phonology, he suggests, becomes integrated with other cognitively-oriented pragmatic, semantic, and morphosyntactic approaches to grammar, and that these different levels work in concert to create overlapping bi-directional representations which are superimposed on one another to create a network of coherent form-meaning mappings.

Other attempts at a cognitive approach to phonology focus on particular pieces of the phonological puzzle rather than attempting to construct an entire model. One such attempt comes from Gitte Kristiansen (2006), a cognitive dialectologist who is interested in the representation of social variation, i.e., synchronic allophonic variation within the organization of phoneme exemplars. Kristiansen suggests, as does Bybee (2001), that phonetic detail should be represented in exemplar clusters of phonemes including sociological information relating to speaker information, such as dialectal features, or second language learner accented speech forms. She shows that sociolinguistic stereotypes must have representation in an exemplar model because elements of prestige and in-group solidarity often exert social pressure on languages which cause them to change and adapt in ways that are not driven by so-called ‘language internal’ pressures. Crucially, Kristiansen suggests that “our receptive and productive competence of lectal varieties also plays a role in the configuration of phoneme categories and inventories. In other words, a cognitive dialectology – including a cognitive phonology – may well serve not only to mediate between `language´ and `society´ but also to spell out in full the consequences of a truly multi-faceted approach to phonetic variation” (2006, p. 135). In this sense, a phoneme can carry content information relating to the speaker, as well as inferences made by the ‘hearer’ regarding the speaker’s relative social status.

The topic of cognitive phonology arises again in the late 2000s in Nathan (2008, 2009) and Välimaa-Blum (2005, 2009). Nathan’s text is similar to Kaye’s in many ways, except it has the advantage of being written almost twenty years later, and thus it benefits from the emergence of exemplar-based and usage-based models of phonology (Bybee, 2001; K. Johnson, 1997; Pierrehumbert, 2001). Nathan too addresses implementation of a cognitively realistic account for modern phonology, but does so for an introductory level audience. While Nathan includes issues regarding frequency effects, as well as the fact that the traditional sense of ‘phoneme’ has been under fire from cognitive linguists, he focuses much of the book on recounting basic assumptions about the structural nature of phonemic alternations and phonological processes. With the final chapter being dedicated to theory-based issues, there is no theoretical ground gained in this text.

One does not learn how to *do* cognitive phonology, nor is a framework for what cognitive phonology *is* proposed. Thus, like Kaye, this primer acknowledges movements in the field of phonology toward a cognitively integrated approach, but does little to establish the approach itself.

Välimaa-Blum's book, *Cognitive Phonology in Construction Grammar: Analytic Tools for Students of English* (2005) emphasizes the non-modularity of phonology and that as form does not occur separately from symbolic structures (i.e. does not exist independent of meaningful structures), we must assume that phonology is tightly coupled with meaningful units.[17] I completely agree with Välimaa-Blum's construal of the necessity of a cognitive phonology to, "relate the mental representation of the morphemes and other symbolic units to the phonetic sequences that realize them and vice versa, i.e., to relate the phonetic sequences back to the symbolic units" (2005, p. 30). However, I disagree with her characterization of what constitutes necessary and sufficient explanatory structure for phonology, i.e. the same units proposed by Lakoff in his treatise of cognitive phonology (1993a), morphemic, phonemic, and phonetic levels of structure. I suspect that like Lakoff, Välimaa-Blum is bound by tacit assumptions regarding the necessity of duality of patterning and the arbitrariness of the sign, as she writes, "it is essentially the duality of structure, that is the basis of the, in principle, infinite number of novel utterances that languages allow us to generate" (2005, p. 29). The building-block model of language that presupposes dual structures and inherent arbitrariness is a pervasive myth which many linguists accept without question. However, I will argue in this chapter that duality and arbitrariness are symptoms which point to a larger phenomenon, the schematization of events over multiple instantiations. In other words, both are possible outcomes from the emergence of

[17] For Välimaa-Blum this is at the level of the word.

linguistic structure, but neither are themselves necessary precursors to language; rather, they emerge as language emerges, through the schematization and abstraction of reoccurring patterns of form-meaning units over countless usage-events.

As we have just seen, despite various attempts to advocate for some type of cognitive phonology as a necessary component of any cognitive approach to language analysis, a full account of such a theory has yet to be proposed. Previous attempts at cognitive phonologies still seem at odds with truly cognitive approaches to language analysis, always leaving one foot firmly planted in the realm of underlying structures and an insistence on the separation between the phonological and the semantic. The fact remains that for many linguistic circles the concepts of underlying structure, surface structure, rule ordering, and derivations still remain central to doing phonological analysis. Likewise, within these confines, the definition of a phoneme tends to remain unchallenged, unless specifically talking about phonaesthemes or other sound symbolic structures, with a few notable exceptions (Blevins, 2012; D. Bolinger, 1965b; Ladd, 2012). In most other cases, phonemes at best are conceptualized as 'a minimal unit of form without meaning', and at worst they are regarded as, 'a minimal unit of sound.' Irrespective of these assumptions, the issue of form-meaning pairings at all levels of language is generally not extended to include phonemic content, as the very notion of meaningful phonemes flies in the face of received linguistic wisdom over the course of the past century.

It is likely that the lack of attention to phonology within the cognitive framework is due to several factors, including unquestioned propagation of the Saussurean idea of 'arbitrariness of the sign' as primary and central to linguistic structure, and the concomitant assumption that iconicity is less linguistically valid than arbitrariness. Additionally, a regular bias toward spoken language as 'primary' and therefore 'normal' permeates the field of linguistics, even among some signed language linguists. Similarly, people often remark that phonetics, and by extension phonology, should be considered a-theoretical in the sense that the goal is to simply describe what we see. While this is an easy way to avoid critically reassessing fundamental theoretical assumptions, the fact remains that all of these factors have contributed to continual neglect in addressing cognitively realistic dynamic approaches to phonology, especially within the realm of signed language linguistics. Interestingly, while iconicity/motivation have been embraced as a legitimate driving force for the organization of form in larger constructions, phonological motivation has continued to be relegated to the periphery, with few exceptions (Abelin, 1999, 2015; B. K. Bergen, 2004; Dingemanse, 2013; Dingemanse, Blasi, Lupyan, Christiansen, & Monaghan, 2015; Nobile, 2015).

However, several recent advancements in the field of linguistics have provided a fertile ground in which to plant the seeds of a new kind of phonology. With the gradual but growing acceptance of usage-based phonology (Bybee, 2001), the explosion of iconicity studies in signed language linguistics (Ortega & Morgan, 2014; Perniss, Thompson, & Vigliocco, 2010; R. Thompson et al., 2010, 2010), the expansion of the field of cognitive linguistics (Raymond W Gibbs Jr, 2005; R.W. Gibbs, 2012; R.W. Gibbs & Matlock, 2008; Langacker, 1987, 1991, 2008, Matlock, 2010, 2011, Tuggy, 2005, 2007), the introduction of Cognitive Iconicity (S. Wilcox, 2004), the application of Dynamic Systems Theory (DST) to language processing(Beckner et al., 2009; Elman, 1995; Thelen & Smith, 1996), and challenges to the theoretical necessity of Duality of Patterning (Blevins, 2012; de Boer, Sandler, & Kirby, 2012; Ladd, 2012) and the centrality of arbitrariness (Blevins, 2012; Givón, 2015), a critical mass of data is available for the next phase of phonological theory.

Much like the doctrine of Anekāntavāda, as illustrated through the parable of “The Blind

Men and the Elephant" it is only through combining a multiplicity of viewpoints that we can begin to see that each of these individual data points is related to a larger, holistic structure.[18] Across multiple disciplines, linguists, psychologists, biologists, and the like have come to several seemingly unrelated conclusions, using different methods, analyzing different pieces of the data; nevertheless, the data is converging on a central point: Language is an embodied, emergent, dynamic system.

The following sections review the central principles from usage-based phonology, and Cognitive Grammar which allow for the creation of cognitive phonology. By following the propositions put forth in these theories to their logical conclusions, a very different view of phonology emerges than the one which currently dominates the field of linguistics.

3.2 Setting the Stage: Cognitive Grammar and Cognitive Phonology

In many ways, like the relationship between Articulatory Phonology and Bybee's usage-based phonology, Cognitive Grammar (Langacker, 1987a, 1987b, 2008), and usage-based phonology are also highly compatible. Both approaches emphasize the necessity of redundancy and frequency in the emergence of linguistic schemas as usage events.

> Substantial importance is given to the actual speaker's knowledge of the full range of the linguistic conventions, regardless of whether those conventions can be subsumed under more general statements. [It is a] non-reductive approach to linguistic structure that employs fully articulated schematic networks and emphasizes the importance of low-level schemas (Langacker, 1987, p. 494).

Though the terminology associated with usage-based phonology and Cognitive Grammar

[18] Loosely translated as "skepticism," a central tenet of Jainism.

models are superficially different, these theories can be viewed as two sides of the same coin. What differences do exist between these models lie primarily in the fact that each focuses on different descriptive goals. As such, some details specific to each theory may be marginally misaligned, including details regarding internal descriptions of phonological schemas and the role of semantics in schema formation. Nevertheless, both theories utilize very similar frameworks as they relate to the emergence of linguistic patterning from a domain general perspective, evoking ritualization, entrenchment, and schematization as central mechanisms for language emergence.

Cognitive Grammar establishes a view of grammatical structure in which form and meaning are inseparable, and the lexicon and grammar exist on a continuum rather than being independent modules. Cognitive Grammar aims to redefine the general conceptual foundations that linguistic theory rests on, and to resolve the false dichotomies and cognitively unrealistic representations that follow from Generative approaches. In many ways, these are the same general goals of usage-based phonology, to replace conceptual foundations of generative theories of phonology with more cognitively realistic accounts of form.

I will focus on just a few of Cognitive Grammar's central tenets, most importantly the nature and provenance of symbolic structures. The Content Requirement assumes "the only elements ascribable to a linguistic system are (i) semantic, phonological, and symbolic structures that actually occur as parts of expressions; (ii) schematizations of permitted structures; and (iii) categorizing relationships between permitted structures," (2008, p. 25). These can be conceptualized within a broader cognitive model as meaning or function, form, and the pairing of form and meaning.[19] From this perspective, each and every usage-event necessarily includes

[19] I have chosen to use Langacker's Cognitive Grammar framework as his description of what constitutes phonological and semantics poles are sufficiently broad for these purposes. I frame this section in terms of his

these three structures and only these three structures.[20]

If we are to take a truly non-reductionist view of language, we take the construction as the basic linguistic unit (cf. Croft, 2001). The usage-event consists of gestural content[21] produced by the language user (or perceived by the interlocutor) and the semantic import or function of the utterance. We discover the symbolic unit through our construal of the relationship between the communicative intent paired with a specific gestural utterance. Linguistic units of various sizes are then gleaned from the usage-event and chunked into smaller and smaller pieces by comparison with other usage events. Importantly, we do not experience linguistic form without meaning, nor linguistic meaning without form. In this sense, each unit regardless of the level of linguistic complexity is the combination of form, meaning, and the association between the two. To summarize this relationship, as Langacker has succinctly stated, “Semantic units are abstracted from the contextual understanding of occurring expressions, phonological units from apprehension of their phonetic properties, and symbolic units from the pairing of the two,” (Langacker, 2008, p. 220).

An additional caveat to this formulation is the claim that the phonological pole is part of semantic space, since we can conceptualize sounds (Langacker, 1987, p. 78) and more generally, gestural articulations. Similarly, semantic space is itself subsumed by conceptual space, in the sense that there exist things that we conceptualize that do not have semantic associations, or linguistic signs to represent. Thus, rather than representing form and meaning in a traditional Saussurean sign, I suggest a more appropriate representation of the phonological and semantic

---

vocabulary, though keeping in mind that this model is equally applicable across a variety of cognitively oriented frameworks including usage-based and construction grammar approaches.

[20] Nathan (forthcoming) seems to suggest that to incorporate phonology into Cognitive Grammar requires us to stray from the Content Requirement by adding an intermediary level of abstract structure for the phoneme. This seems to be based in Nathan’s belief in the psychological reality of phonemes in the minds of language users.

[21] Gesture is used here in the articulatory gesture sense, in this way we can directly compare both vocal and manual articulatory gestures as the source of the formal content of linguistic units.

poles of a symbolic unit are schematized in Figure 15.

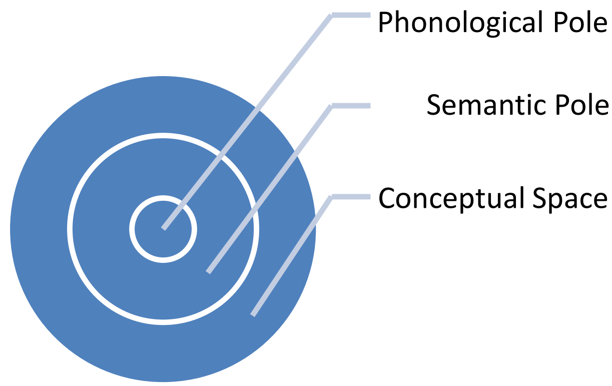

Figure 15) Schematic representation of a symbolic unit consisting of a phonological and semantic pole

Though Langacker does not devote much space to elucidating the emergence of phonemes, he does imply that the process of abstraction is the same regardless of level of linguistic complexity. All linguistic material is discovered by the language user in the sense that usage-events provide raw, untagged material from which users perceive, categorize, and schematize pairings of form and function. Similarly, as Bybee states, “the articulatory and acoustic stream that constitutes speech is continuous and does not yield to exhaustive segmentation. Yet recurrent parts of the continuum can be associated to yield units of different sizes –namely, features, segments, syllables, and rhythmic units,” (2001, p. 31). Since form does not (naturally) occur without meaning, and linguistic units, regardless of size, are extracted from embodied and semantically-rich contextually situated environments, it should come as no surprise that even sub-lexical formal structures are extracted with meaningful content attached.

Similarly, this realization taps into the fact that the phonological pole has no less conceptualization in semantic space than the semantic pole. After all, although articulatory scores are typically thought of as a type of procedural knowledge, in functional terms, in that we perform them as routinized, entrenched, subconscious motor routines, we need to also be able to conceive of articulatory scores.[22] If you have ever tried to teach someone how to roll their r's or unfurl their fingers in sequence, you know that humans can actively conceive of articulations, and make our procedural knowledge explicit. Similarly, we can conceptualize how these motor routines feel in production, and look in perception; each of these pieces of information constitute what we know *about* the articulation, hence this knowledge can be made to be propositional.

Theoretically then, the semantic poles of 'phonemes' likely form high-level schemas much more quickly than linguistic units with less variation across usage events, exactly because they are built-up from all of the instances of the given pronunciation, across all usage events in which it occurs, and a schematization of meaning from contextual, pragmatic, social, gestural (in the Articulatory Phonology sense), and audio-visual content. Thus high frequency of occurrence without consistent form-meaning co-occurrences, leads to high levels of schematization of the semantic pole of phonemic content. But high levels of schematicity do not necessarily imply that the unit is devoid of form or devoid of meaning.

By following the tenets of Cognitive Grammar to their logical conclusions, I suggest that a truly cognitive approach to phonology must allow for the possibility that phonemes possess a semantic pole. Thus I suggest that in the same way that other linguistic phenomena at the morphosyntactic or clausal level are able to be conceptualized as having very specific semantic poles, but fairly schematic phonological poles, the reverse is also possible: that content smaller than the level of the word or morpheme can have highly specific phonological poles but highly schematic semantic poles.

In the following section I discuss in depth the makeup of each unipolar structure of the

---

[22] The term 'scores' is used here in the Articulatory Phonology sense (Browman & Goldstein 1992)

symbolic unit of ‘phoneme’ and reveal how the form and meaning of the sub-lexical linguistic units arise. I follow this discussion with a look at how language-internal and language-external associations influence the conceptualization of linguistic units.

3.3 A New Cognitive Phonology

While several factors have likely contributed to linguists overlooking the semantic poles of phonetic content, including the adherence to arbitrariness of the sign and generative grammar’s general lack of attention to semantic content in general, a central reason is that, for spoken languages, the level of schematization of the semantic pole of phonemic level content is so high that there is little ‘meaning’ that can be gleaned. Because it is very hard to answer the question “what does /p/ mean?” spoken language researchers have not generally had to deal with such questions. It is true that from a spoken language perspective, perhaps asking such questions seems unnecessary or superfluous; however, signed language researchers are forced to confront this reality on a daily basis.

Given the emergent properties of linguistic units, and given that usage-events encode both form and function, such a view necessitates that form and meaning are extracted together. The resulting structures, of varying sizes, will inevitably have some degree of schematicity or specificity in both form and meaning. As mentioned previously, this belief is uncontested within the functionalist literature, up to a point. Morphemes, even when consisting of a single phonetic unit, such as /s/ marking plurals or third-person present tense, are still considered to be extracted from the repetition of form-meaning mapping across a multitude of usage events. But what mechanism is responsible for drawing a line between morphemes and phonemes? Are they not extracted in the same way? I suggest that like other linguistic phenomena, there exists a continuum from prototypically morphemic to prototypically phonemic, and that the majority of linguistic forms smaller than the level of the word, exist somewhere in the middle. That is, what makes a phoneme a phoneme is very high degrees of abstraction over multiple usage-events, in which the gestural unit occurs in a wide array of phonotactic positions, across a wide array of constructions with high degrees of variation at the semantic pole. What makes a morpheme a morpheme is a fairly restricted distribution of form and meaning across multiple usage events[23].

Gradience is a given for all linguistic constructions, i.e. for any symbolic unit, there are degrees of specificity and degrees of schematicity, whether in the syntactic slots, the morphemic slots, or the phonological slots insofar as there is a distinction between these levels at all. This is true for language regardless of modality, but what this means for signed languages specifically, is that one can think of each signed utterance as a construction in which each parameter, and in some instances sub-parameters, exist on a continuum of specificity or schematicity for both the phonological and semantic poles of the symbolic unit. When using such an analysis, even a sign such as the ASL sign HIT, with a single word gloss in English, consists of multiple schematic and specific parameters each of which can be extracted from the construction. These form-meaning pairings are compared and contrasted with other similar constructions which either sanction said symbolic unit as an example of an existing schema or require that new schema be created for the form-meaning mapping.

For example, in the sign HIT the non-dominant hand articulates a vertical 1-handshape, while the dominant hand articulates a closed fist S-handshape which then makes contact via a straight path movement with the non-dominant hand. Other constructions might share, for example, the patterning of the location in neutral space, plus the short path movement (though the aspect associated with the path movement may also change) which reflects a force dynamic pattern of interaction, and the non-dominant hand form-meaning mapping of *patient* even though

[23] I must point out that the existence of morphemes and phonemes are convenient for linguistics as categories of description, but the scalar nature of these units suggests they are not categorical in the minds of language users.

the dominant hand's handshape may take various forms. As we can see in Figure 16, multiple schemas arise from this single verbal construction (Cx).

Formal Parameter	Cx1	Cx2	Cx3	Constructional Schema	
	HIT	REMIND	FLATTER	Form Schema	Meaning Schema
Dominant Hand	S	Bent-B	Open-B	(schematic DH)	Agent
Non-dominant Hand	1	1	1	1	Patient
Path	direct path	direct path	none	(schematic movement toward or at NDH)	(schematic agent acting on patient)
Manner	forceful	repeated/ soft	repeated/ soft	(schematic manner of articulation)	(schematic aspectual meaning)
Contact	single/ knuckles	repeated/ fingertips	repeated/ flat hand	(schematic contact DH on NDH)	(schematic outcome of force dynamic interaction)
Location	Neutral Space	Neutral Space	Neutral Space	Neutral Space	(3-D space for interaction)

Figure 16) Schematization of Transitive Construction

I must point out that insomuch as gradience is a central component of linguistic categories, schematicity or specificity in their own right are not a determining factor of whether something is present or absent, they are simply descriptions of possible outcomes of the extrapolation of content and material from countless usage-events. Exploring the evidence as to whether phonemes indeed have an associated semantic pole requires a detailed discussion of how several mechanisms contribute to this outcome. Thus the phonological pole of a sign can be specified for handshape, location, orientation, and non-manual marker, but be schematic in terms of its movement parameter.

Interestingly, schematicity is often associated with more grammaticalized material; the fact that the movement parameter, including path and manner of movement, of signed constructions is often quite schematic within families of sign constructions, suggests that this parameter likely marks more grammatical information within a given sign.

To emphasize the idea that constructions necessarily contain varying degrees of schematic or specific information regarding form and meaning, we can turn to several examples from spoken language which show constructions can be fixed in some aspects of the phonological pole, but be schematic in other aspects. One example from the English 'way-construction' as in to 'VERB one's way' as described by Goldberg (2006), shows that while the 'one's way' is fully specified phonologically, the phonological pole of the verb slot in this construction is highly schematic, to the point that only knowledge of the most abstract phonological shape of verbs in English may be part of this construction. At this level, we know that language users have some very abstract sense of what a verb in a given language looks like which has been schematized from every exposure to every verb in a language.

To further illuminate the importance of gradience as it relates to specificity or schematicity in constructions, let us review a widely accepted example of schematic versus specific form-meaning mappings as it pertains to grammatical knowledge. In Cognitive Grammar, THING and PROCESS roughly corresponds to nouns and verbs respectively. Humans perceive entities physically bounded in space and which on a human time-scale have very persistent properties across time, as groupings of matter, as thing-like, and they generally have the linguistic property of being referential. We label these stable entities and use those labels to refer to them in the set of things that is the universe. Thus, a prototypical noun like *cat* can be modified *big fluffy cat*, or predicated upon *the cat slept*, but the core of its being is THING.

In contrast with THING, which represents stable entities, we also conceive of events, which unfold over time and do not prototypically exhibit stable properties. The label PROCESS refers to things which we construe as changing over time. For example, if a construction profiles the movement of entity x from y to z, that movement might be construed as a process.[24]

Importantly, in the same way that we can conceive of semantic properties shared across nouns, so too can we schematize the formal properties of "things" and "processes". In other words, that schematic semantic pole of thing-ness arises from usage events which are manifested through the formal, gestural articulations which instantiate these nouns. Phonological schemas arise from language-specific distributional properties of phonetic segments which occur across the given distribution of THING. Thus, just as the semantic content across a large and diverse category can be schematized, we schematize the form as well, including distributional properties of where noun-like-things occur in phrases, but also the phonological properties of what all instances of THING entails. Thus, in some languages nouns and verbs have different phonological properties, such as stress patterns.

Hollman (2013) has shown that when speakers are given nonce words whose forms are possible but not occurring words in English, they have a sense based on the form alone of whether a given nonce word is a nouny-thing or a verby-thing. This intuition is possible only because speakers are sensitive to the distribution of formal properties. Thus a language, may have a strong pattern for CVC corresponding to THING but CVCVCC corresponding to PROCESS, or visa-versa. This is an important addition to our understanding of what constitutes "speaker knowledge." As Hollmann rightly points out, speaker knowledge generally supposes purely

[24] Of course, as with all categorization, we can conceptualize these as two ends of a continuum whereas there are several things/events, such as what in English we might call a stative verb, which across different languages are sometimes construed as PROCESS while others construe as THING.

distributional and/or semantic knowledge, i.e., we know what a verb looks like because of where verbs occur and what gets attached to them. But clearly it is limiting to assume that speakers only pay attention to distributional characteristics: language users also pay attention to form, and formal characteristics, thus the shape of a word has as much impact on its representation as the distribution.

These symbolic units have become highly schematized at both the phonological and semantic pole, but this does not mean they do not exist in the mind of the language user. Clearly language users have some awareness of what makes ‘a good noun’ or ‘a good verb.’ Units which are highly schematic units are generally grammatical categories. In the same sense that we can conceive of a highly abstract formal schema across such a varied semantic category as ‘noun,’ so too are we capable of conceiving of a highly schematic semantic schema, for a given formal property. Like the high degree of schematicity for the formal pole of THING, the high degree of semantic schematicity for phonetic content is due to the high degree of variation of distribution with which a given form is associated. To take an example from English, if we are to look at all of the instances of English /p^h/, we not only keep track of the distributional parameters such as its tendency to occur syllable initially, but we also will have a notion of what meanings are associated with those words in which /p^h / occurs. And, perhaps, more importantly, we have associations across those contexts which relate to physical, articulatory, kinesthetic, audio-visual perceptual properties associated with /p^h /. Additionally, phoneme inventory size is limited by motor automation which forces ‘phonemes’ to be recycled over and over again in various positions in a word. Consequently, because phonemic level content is used and reused combinatorily across a wide-array of form-meaning contexts (and with generally little impact from language external motivations) it is possible for these mappings to schematize quickly to a degree which the semantic pole is no longer readily accessible.

As a simple analogy, let us think about the semantics of the color red. If you consider red in the context of a stop-light, red means *stop*. In this context red always mean stop. There is no variation. This is much like the morphemic form-meaning mapping, a one-to-one mapping which doesn't vary in a given context. Now if we are to consider the semantics of red in the context of candy, it's still semantic, in that we know about what types of flavors tend to be associated with red…strawberry, cherry, raspberry (though that is trending toward blue now). So we understand the form, red candy, to have a more schematic semantic association, but it has meaning nonetheless. We know what red means because over candy-eating usage events, we extract color-flavor mappings. Simply, color-flavor mapping is built up as we experience what red candy (the form in our analogy) tastes like (the meaning in our analogy). Finally, if we are to consider the color red within the context of a box of 96 crayons, the color red is really only in paradigmatic opposition to other crayon colors, i.e.) not yellow, though we still have a schematic semantic association of what things in our world are prototypically red, such as apples, or roses. This last example is much closer to how we can construe phonemic meaning; its meaning is bleached in the context of possible colors of the world, but we still know the context and meaning of red.

Returning to our notion of the schematicity of form and meaning in linguistic units, we can see that lower level, less variable form-meaning mappings make better morphemes, while higher level, many-to-one form-meaning mappings make better phonemes. Therefore, I argue that phonemes and morphemes exist on a continuum of one-to-one to many-to-one form-meaning mappings. That is to say, units which seem to function as morphemes, do so simply because of a regularity of mapping between form and meaning which is comparatively restrained in terms of variability across forms and contexts. Units which function as phonemic content, or units which seemingly have no formal meaning ascribed to them, are perceived as such because the form-meaning mappings are *not* restricted and therefore not consistent across multiple instantiations.

For example, in signed languages, handshape is often thought of as a type of phonological parameter, however some handshapes seem to be more or less meaningful as compared to other handshapes. This variation across handshapes is due to the fact that some handshapes have a many-to-one mapping across form and meaning, while other handshapes are more restricted in their distribution and occur in two-to-one, or rarely, one-to-one mappings of form and meaning. In ASL, the E-handshape, overwhelmingly occurs in signs which map the form to initializations of English translation equivalent, such as in the signs EMERGENCY or ECONOMY. This means that for signers, there is a reinforcement between the occurrences of the articulation of the handshape-E with the meaning "maps to spoken language spellings which begin with E." Contrast this with, for example, the handshape Claw-5 which as we will see in chapter 4, has at least five primary mappings of form and meaning, with many sub-mappings within the primary schemas. Therefore, in signs with a Claw-5 handshape, the distribution of form-meaning mappings is more variable, and therefore does not benefit from the same type of reinforcement of low-level schemas.

For spoken languages, while we tend to think of morphemes as sequences of sound, individual phonemes can also have morphological properties when they occur in regular form-meaning mappings. For example, in English, the phoneme /ɑɪ/ is one of the most frequent sounds in the language; however, 40% of its occurrences result from a single form-meaning mapping, that of the first person singular *I*, which has also been shown to be of the most frequent words in the English language (Mines, Hanson, & Shoup, 1978). Thus 40% of our exemplars for the phoneme /ɑɪ/ results from a singular mapping. Notice, this is not to say that the phoneme /ɑɪ/ doesn't occur outside of its use in the word *I*; nor does this mean that every instance of /ɑɪ/ references the morpheme *I*. Nevertheless, we can contrast this with, for example, /p/ which while also one of the most frequent sounds in English, has a distribution across many variable lexical and morphemic constituents. As such, /p/ does not benefit from consistent low-level instantiation of a morphemic schema in the same way that the phoneme /ɑɪ/ may.

Consequently, phonemes and morphemes differ only in the degree to which the phonological pole has been extracted with a more specific or more schematic semantic pole.[25] We will return to this semantic cline between morpheme and phoneme in a later section in chapter 4 where I will provide evidence for this idea from signed language handshapes.

In developing a semantic theory of the phoneme, it is necessary to acknowledge that this is an apparent contradiction of the definition of the traditional phoneme, which is a meaningless unit of form. The idea that phonemes must be meaningless is based in the Structuralist tradition which prized arbitrariness and duality of patterning as central components of any real language. By virtue of the definition of symbolic structures within cognitive approaches, the concept of arbitrariness and the concept of duality of patterning are neither necessary, nor the only plausible outcome of schematization of formal material. Needless to say, there are several recent contributions to the field of linguistics and other relevant disciplines that put the 'facts' regarding these design principles of language into question. These implications, as we shall see, have deep theoretical impact if followed to their logical conclusions.

---

[25] Many thanks to Ryan Lepic for countless conversations regarding this idea, which for a time made us both feel crazy, but eventually came to feel very uncontroversial and a natural outcome of construction-based approaches.

3.4 The Phonological Pole of Phonetic Content

In cognitive phonology, the phonological pole is the realization of phonetic or articulatory components. This pole represents all of the detail of all past sequences of phonetic content, including both our perceptual and procedural knowledge of the articulation. Though Cognitive Grammar is primarily a theory based on spoken language data, and as such the phonological pole is discussed as the representation of perceptual experience from auditory input, ‘perceptual knowledge’ does not mean only auditory perception. Included in this conceptualization of the phonological pole are at least three broadly conceived formal domains: auditory/visual perception of the event, the embodied motor routine, and the kinesthetic or haptic feedback of an articulation event. The first of these three is perhaps the most obvious in that formal properties are instantiated by our perception of them, however as I discuss below, this is only one component of the formal pole. The embodied motor routine is the production piece of the form. This includes how we articulate a given form. Motor routines are the primary focus of Articulatory Phonology. Finally, kinesthetic/haptic feedback is both perceptual and production based. It includes, for example, the fact that /b/ is marked by a bilabial closure followed by an opening; we feel the lips close and a corresponding release of pressure when the labial closure is released. Likewise, this includes the feeling of your hands touching palms in a clapping motion, in the ASL sign SCHOOL. Of course these schematizations of the articulatory event are not necessarily available at the conscious level. Language is embodied, but we need not actively pay attention to such characteristics in order to glean information from them. These aspects of perception and articulation are coordinated as part of the phonological pole, as seen in

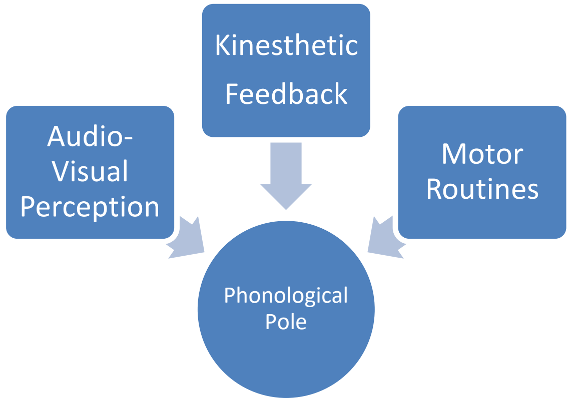

Figure 17.

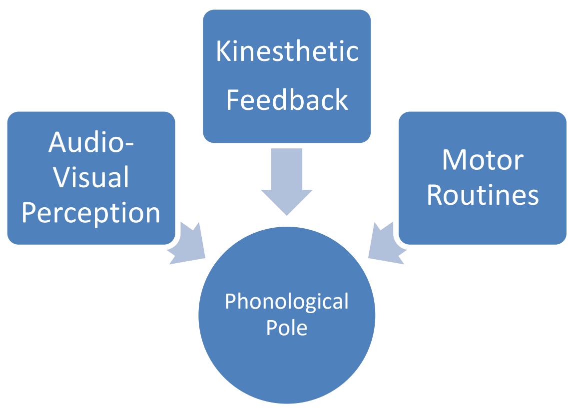

Figure 17) Schematic representation of phonological pole and its content

As multiple facets of the form contribute to the emergence of formal schemas, including the bodies and perceptual abilities of the language users, schematization is truly an embodied phenomenon. When we think of what constitutes the content of the phonological pole, linguists are often biased by the prevalence of spoken language and are primed to think of an acoustic schema. Because of this general propensity to conceptualize linguistic structure as it relates to spoken language, and because the majority of linguists are not signers, sound is the basis for the experience of hearing users of a spoken language and therefore consideration of signed language is often left to the wayside. Acoustic properties are an obvious factor, but we must realize that they are not the only factor.

In an embodied approach to form, we must assume that form schemas include a wide variety of redundant data. This data is not necessarily contrastive, nor is it necessarily central to our representation, but nevertheless is present, and in some linguistic contexts is called upon to disambiguate situations in which auditory signals are degraded or less than prototypical. Thus when extracting patterns of form from gestural events, we must have a way of encompassing the vast degree of variable formal characteristics.

The phonological pole includes information about other perceptual characteristics of articulatory gestures such as auditory and visual perception and kinesthetic feedback, as well as the procedural information for the production of the gestures (which I have labeled gestural schemas). These properties are extrapolated from usage-events; as they occur, they are compared, contrasted, and categorized according to shared properties. We can see a schematic representation of the types of information which become part of the phonological pole in Figure 18 as schematized from usage-events including word initial /b/.

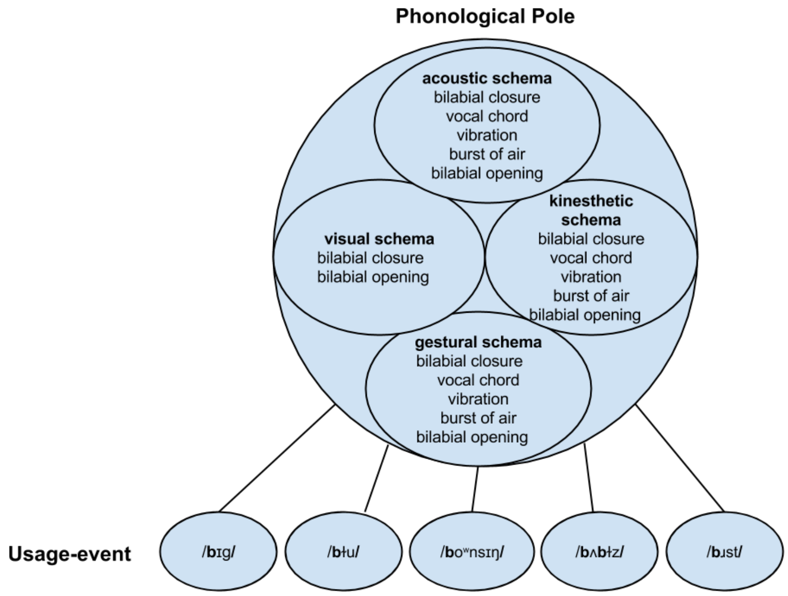

Figure 18) Phonological pole schematization of /b/

As we have already seen, acoustic properties are by no means the entirety of the content of a phonological pole. If we are to include signed languages in a usage-based model, we also must include visual properties of the gestural score. But we need visual properties to be represented for spoken language as well, in that expectations of visual properties of a given speech signal play a role in perception of those sounds (Massaro & Cohen, 1983; McGurk & MacDonald, 1976).

Likewise, signed language users also have some degree of acoustically-based concepts in their representation of phonological structure. In fact, not only do many signs have requisite mouthings that are often accompanied by specific vocal gestures, but many Deaf people, especially those raised orally, have had extensive speech therapy so that specific vocal articulations (gestural scores) are associated with specific sounds or their orthographic counterpart. Additionally, the majority of Deaf signers are bilingual and have acquired a spoken

L2 to varying degrees of proficiency in reading, speaking, or both.[26]

A cognitively oriented model of phonology which seeks to describe actual language usage, should be able to account for all of the heterogeneity that exists between people who have varying degrees of language exposure and access. While the vast majority of language users are hearing, and raised in a spoken language environment, at the other end of the continuum are Deaf people, born to Deaf families whose acquisition experience exists in an entirely signed language environment.[27] For the majority of deaf and Deaf language-users, their experience exists somewhere along this continuum and thus a working model for these users must be able to accommodate both spoken and signed language exposure and experience, and must include both visual and acoustic properties of the signal.

Understandably, the nature of acoustic representation and coordinated vocal motor routines of Deaf signers is limited by comparison, though not necessarily entirely absent. In a cognitive phonology model, rather than having separate phonologies in which aural-oral, and visual-manual phonologies are discrete and mutually exclusive of one another (Petitto, 2013), we would expect that these formal-functional pairings are all stored together in a single integrated phonological network. Interactive effects between sign, speech, 'gesture', and orthography are welcome and expected in a fully integrated system. The world does not come pre-tagged as different types of events; we experience a signal (form) with a function (meaning) and extrapolate accordingly, depending upon our individual perceptual, experiential, embodied

[26] The percentage of Deaf people who have no access to auditory signals is small to say the least, thus sound must have some representation for these individuals. We must also not forget that many deaf people have not been afforded the opportunity to become proficient in a signed or a spoken language and thus have some hybridized version of sign-assisted English with heavily accented speech.

[27] It is possible such extremes on a continuum do not exist. While there is a large degree of variation across cultures, speakers cannot remove themselves from a world in which so-called co-speech gestures are concurrent with spoken articulatory gestures. Likewise, signers are, from a young age, immersed in bilingual situations because Deaf people, in most cases, live in a hearing-world. Perhaps then, the grammar of signers will always have some representations of the culturally dominant spoken language from repeated usage-events in which signers and speakers interact.

apparatus. Similarly, though the nature of acoustic representation of coordinated vocal motor routines of Deaf signers is limited by comparison, I would argue that it is not necessarily entirely absent either. Deaf signers are an extremely heterogeneous group, but often have residual hearing, cochlear implant experience, and even early spoken language exposure for post-lingually deaf, thus in a cognitively realistic model, auditory stimuli should be expected to play some role in representation. Importantly, the model being proposed here accounts for all sub-types and intersections of experience of language users. A hearing and Deaf person may represent the same usage event with a different balance or acoustic, visual, motoric, or haptic features.[28]

While we have made the case for including both visual and auditory representations of form at the phonological pole, we must also consider the inclusion of kinesthetic schemas. Kinesthetic schemas are extracted from the information we receive through our own proprioceptive feedback regarding what the articulations look and feel like as we produce them. Does the tongue retract; do the lips close? Do the dominant and non-dominant hands touch, or move in a circle around one-another? These types of kinesthetic feedback result in the schematization of physically embodied features which are experienced in language production. It is important to disentangle kinesthetic schemas, which are perhaps easier to consider to be effects of articulation, from the articulation itself. So if acoustic/visual phenomena are under the rubric of perceptible material, kinesthetic schemas sit on the fence between perceptual and production material, as we perceive it from our production.

For both signed and spoken language the gestural score, the coordinated movements of the articulators in space and time, are represented at the phonological pole. It is these gestural

[28] This is central to the issue of whether an articulation is categorized as "gesture or sign" (S. Wilcox & Occhino, 2016).

scores that Articulatory Phonology is concerned with. As with any motor activity, speech and signing become practiced and fluid over time. The entrainment of motor activity allows smaller units such as syllables[29] or still smaller, phonemes[30] to become streamlined into a single motor action. In many ways, it is perhaps the gestural schemas that are the central piece of the phonological pole. We know that humans do not perceive the medium, as much as they perceive the gestures which caused the medium to change. As Fowler (1996, 2010) has suggested, "Even though it is the structure in media (light for vision, skin for touch, air for hearing) that sense organs transduce, it is not the structure in those media that animals perceive. Rather, essentially for their survival, they perceive the components of their niche that caused the structure" (Fowler, 1996, p. 1732). In this view the gestures themselves are central to our embodied linguistic experience.

Another reason to consider gestural content as an important aspect of the phonological pole can be found in arguments by Pagliuca and Mowery (1987), who have suggested that the ability to derive consonants and vowels from speech signals lies in the fact that consonants represent articulatory maxims in which muscle activity is heightened and the articulation itself is at a peak. Vowels on the other hand exist as the transitory state between maxims. An interesting extension can be applied when analyzing signed languages in that handshapes and locations make very good onsets and codas while movements make very good transitions, including those movements which occur during sign-internal handshape change. In many ways, despite

[29] Syllables have been argued on many grounds to be the basic unit of speech. Importantly, regardless of modality it seems that infants babble in syllables, not in individual segments (Studdert-Kennedy, 1981).

[30] Morais et al (1979) show that illiterate speakers are unable to do basic phonological insertion tasks at the beginning of nonce words, suggesting that phoneme awareness does not arise from general cognitive maturation, but from training acquired while learning to read. This provides evidence that perhaps syllable is the smallest "natural" gestural unit and that only language users with formal training (i.e. learn to read and or write) are likely able to overtly access anything smaller than a syllable. To my knowledge such studies have not been carried out on signed language users, though I suspect, due to the visual modality that salient features such as handshape and location might be separable even without a formalized writing system for signs.

articulations existing in entirely different modalities, a gestural analysis of phonetic content brings signed and spoken language substance closer than ever, because of domain general, motor-neuron pressures which shape each of the gestural systems.

In conclusion, the phonological pole is essentially a summation of abstractions from usage-events. Specifically, humans extract formal properties of the gestural score, the kinesthetic feedback, and the visual and acoustic content of the signal. These abstractions lead to the formation of exemplars which represent a multi-faceted, embodied sense of form. Many usage-based linguists will have no problem with this description of the formulation of the phonological pole; however, this is only one half of the equation. In the subsequent section, I explain how it is that phonetic content (which by its very nature seems devoid of meaning) can come to be attached to meaningful material. How do phonetic structures develop semantic poles? Additionally, I will address how the coupling of these units suggests that motivation and arbitrariness are scalar phenomena which interact with frequency, language internal and language external relationships, and individual experience.

3.5 The Semantic Pole of Phonetic Content

What constitutes the semantic pole of a phonological unit? As I have already argued, formal units are schematized from usage-events. Maybe not surprisingly, this same process is involved in the extraction and schematization of meaning as well. I take as my starting point the assumption that everything that is perceived as part of a usage event is subject to possible schematization. Within that assumption, anything that is not related to the articulatory and perceptual nature of the form must be tagged as part of meaning. What is leftover is ‘the rest’ of the usage event, which comprises a complex array ‘meaning’ that varies in degree of schematic representation. This type of knowledge about the phonetic concept is encyclopedic, as is our knowledge of lexical units. We do not discriminate regarding what is useful or not useful to our linguistic knowledge, everything is taken in, subconscious calculations are made, and we store it all. Langacker asserts that, "meaning is not identified with concepts but with conceptualization…broadly defined to encompass any facet of mental experience… subsuming (1) both novel and established conceptions; (2) not just "intellectual" notions, but sensory, motor, and emotive experience as well; (3) apprehension of the physical, linguistic, social, and cultural context; and (4) conceptions that develop and unfold through processing time (rather than being simultaneously manifested)" (Langacker, 2008, p. 30).

While the phonological pole arises from the schematization of perceptible properties and production routines of a usage-event, the semantic pole arises from the realization of the network of associative meanings as related to a usage-event. In its most fundamental conceptualization, the semantic pole includes anything that is meaningful within a usage-event. Unlike truth conditional approaches to semantics, cognitive and functional approaches to grammatical description view semantics as a network of associated frames.

Thus the semantic pole of a piece of phonetic material (a syllable, consonant cluster, phoneme, or feature-level phenomena) includes not only the sum of all semantic experience (in the traditional sense of the term), but also includes: phonetic details of individual speakers or communities of speakers detailing characteristics such as gender, age, and ethnicity, relative social standing of speakers and regional information, environmental cues such as setting and context, pragmatic information regarding speaker attitude, subjectivity, and affect, embodied visual cues such as body posture, facial expressions, visual characteristics of the configuration of the articulators, auditory characteristics of the configuration of the articulators, and countless other possible perceptible characteristics (Eckert, 2009; Johnson et al., 1999; Kristiansen, 2006; Langacker, 1987, 2008; Walker & Hay, 2011) as seen in Figure 19. It is important to note that only the parts of the usage event that are reinforced across multiple instantiations, are reinforced. The more repetition across instances, the stronger the representation; aspects which are not continually reinforced across events, loose their strength of representation and ‘fade into the background.’

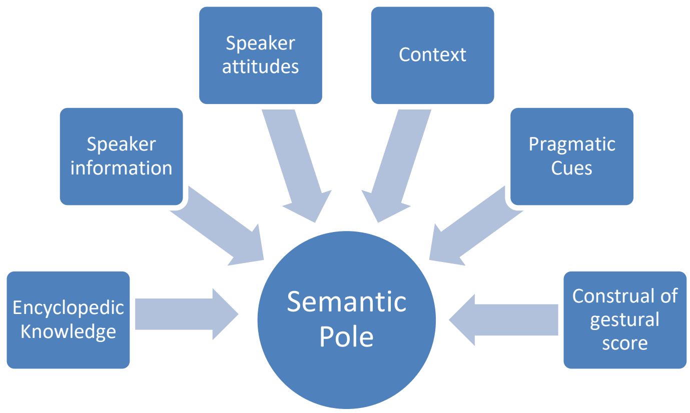

Figure 19) Schematic conceptualization of contents of the semantic pole

At this point the reader may wonder, “What is meaningful about /p^h/?” While meaning for many linguists refers to conventionalized form-meaning associations, this idea presupposes that conventionalization arises from arbitrary pairings of form and meaning, but this is a belief based in precedence of theory over fact. Conventionalization is of course a matter of degree, and as such we must expect that any given linguistic unit will fall along a continuum of conventionality.

Cognitive linguists do not limit their definition of meaning to only include conventionalized semantic material. Belief that semantic knowledge is encyclopedic in nature is now well-attested in functional/usage-based frameworks; arguing from this perspective that knowledge of the world is not limited to truth conditions is central to cognitive models of semantics. Bolinger observed, “The sound lemon becomes a part of the sensory complex 'lemon' just as the sound of a bell, heard frequently (but not always) when other bell-stimuli are presented, becomes part of the sensory complex 'bell'. The ‘form’ lemon is now a part of the ‘meaning’ *lemon*, and may be abstracted from it to represent it, on the basis of the part standing for the whole, just as a pictorial image or a smell or a taste may be abstracted from the whole and used to represent it” (Bolinger, 1965). Though these concepts were proposed in the early twentieth century, ideas regarding the multi-sensory, multi-modal, multi-dimensional meaning of meaning, these ideas have not been integrated into conventional linguistic theory.

More recently literature on embodied language use has added a considerable amount of experimental support for this view of semantics. In fact, research on neurolinguistics has shown that upon hearing a word, our brain, which is synesthetic by nature in that the brain’s white matter integrates signals between different areas of the brain in order to be able to synthesize different sensory input[31] grounds concepts in multi-sensory detail. Figure 20 depicts an adaptation from Kemmerer (2015) which shows how the word ‘banana’ is grounded in a multi-modal sensory experience. Thus, language is embodied in every sense of the word.

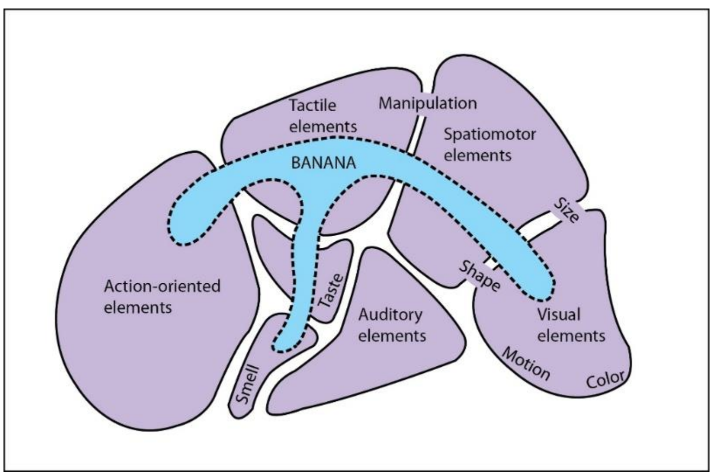

Figure 20) Multi-sensory activation of 'banana' (adapted from Kemmerer, 2015, p. 275

[31] True synesthetes seem to have greater amounts of white matter connectivity as compared to “non-synesthetes” (Rouw & Scholte, 2007)

It was Fillmore's proposal of Frame Semantics (1982) that changed the way linguists, or at least semanticists, were thinking about meaning; rather than a narrowly defined truth-conditional sense of a word's meaning, Fillmore showed that words evoke entire frames based on experiential knowledge. In an excerpt in the section regarding dictionary-like versus encyclopedia-like knowledge Fillmore says,

> [C]ertain scholars insist on a distinction between purely semantic information about word and encyclopedic information about the designate of words. Somebody holding this view might expect to be able to justify certain characteristics of carpenters (or the concept CARPENTER) as belonging to the semantic category of the noun, other distinct characteristics of carpenters as simply being true of the individuals who satisfy the criteria associate with the category. A frame-semantic approach would rather say that communities of men contain individuals who by trade make things out of wood, using particular kinds of tools, etc., etc., and would note that these people are called CARPENTERS. The possibility of separating some features of a full description of what carpenters do as related to the concept and others as related to the people does not seem important. There is a distinction to be made between knowledge about words and knowledge about things, but it is not to be made in a way that serves the interests of the semanticists I have just been describing. True 'encyclopedic' information about carpenters as people might say something about wages, union affiliations, job related diseases, etc.; such information is not a matter of dispute (1982, p. 134).

It is clear from his formulation that it is not up to the linguist to make arbitrary distinctions between what is 'semantic' and what is peripheral. There are various kinds of sociological, pragmatic, and linguistic knowledge that are able to be gleaned from any linguistic signal. That they are not considered to be part of our semantic knowledge lies largely in the fact that semantics is traditionally construed too narrowly.

Related to the separation of semantics from pragmatics is the idea that rather than viewing semantics as a disembodied, externally-located, social construct, our individual conceptualizations are the primary source of our meaning-making and meaning-understanding apparatus. Langacker argues that his conceptualization of the meaning of ‘electron’ cannot begin to approximate what the meaning of electron is for a theoretical physicist, thus showing that personal experience, including frequency of exposure and depth of knowledge and the detail of the semantic frame in which conceptualizations lie, are all part and parcel of ‘meaning’ and therefore are represented in the semantic pole of a symbolic unit. How we feel and how we think about things, how we interact and engage with any concept has direct effects on its semantic representation. Consequently, using the metaphor of encyclopedic versus dictionary knowledge of semantics better captures what cognitive linguists believe to be the case regarding the nature of semantic knowledge. Taking this conceptualization of semantics even further, I intend to extend meaning to incorporate social, pragmatic, and contextual meaning. In the same sense that we cannot make arbitrary decisions between core and peripheral meaning, linguists should not imagine a fixed boundary between semantics and pragmatics.

Across any sum of usage-events, meaning is gleaned from pragmatic, and sociolinguistic cues. Johnson (1999) showed experimentally that language users store detailed information of phonetic material that reflects what they know about their interlocutors. In an early study, Johnson was able to manipulate perceived speaker identity by adjusting the fundamental frequency (F0) of the English vowels /u/ and /ʌ / as in *hood* and *hud*. By synthetically modifying F0, Johnson showed that vowel identification can be both predicted from perceived speaker identity, suggesting that people store information about the gender of the speaker in the phonemic representation of a vowel.

Similarly, Eckert (2009) has shown that affect can be represented in modulation of F2. In a case study of two adolescent girls, Eckert showed that negative affect, associated with gravity of adolescent issues, was positively correlated with backing of /o/ and /ay/, while fronting of these same vowels was associated with pre-adolescent innocence. Others have shown similar correlations of vowel height or fronting as symbolic for various kinds of social affect: Anderson (1990) found that when imitating important men such as fathers or doctors, children backed their vowels, and Hamano (1994, 1998) showed that palatalization in Japanese alveolars correlated with child-like-ness and immaturity as well as extended meanings of unreliability, lack of coordination, noisiness and other child-like features.

These social inferences are extracted from usage-events and associated with specific formal properties. Thus, the social context imbues meaning on linguistic units, which are smaller than the word, smaller than a morpheme, even smaller than a phoneme. Featural associations in this case are overt markers of affect, stance marking, epistemicity and evidentiality.

In addition to traditional semantic, social, and pragmatic meaning, I also claim that the semantic pole consists of meaning related to the construal of the gestural score. Recall that within a Cognitive Grammar framework, "…sounds (at least for many linguistic purposes) are really concepts" (Langacker, 1987, p. 78). This means that we can conceive of our articulations and recognize that they are events that unfold over time. These 'facts' or what we know *about* articulations are part of their meaning and influence how we use and organize form. In other words, the semantic pole also contains construals of perceptual elements associated with the phonological pole, such as what the mouth or hand looks like, or feels like during an articulation. The fact that language users can (and do) reflect on perceptual elements of formal properties allows for an important element of cognitive phonology, construal of form. Construal of form is the basis for externally motivated linguistic motivation.

In signed languages, this effect has been previously identified with Cognitive Iconicity

(S. Wilcox, 2004). In signed languages, because the articulators are perceptually available at all times, signers are able to capitalize on their ability to construe handshapes, movements, and articulatory locations as having meaning. Wilcox points out that hands make good THINGS and movements make good PROCESSES in the Langackarian sense. Consequently, signers can easily construe the V-handshape as meaning two-of-something such as legs or eyes as seen in the ASL signs STAND or SEE, or the S-handshape as a fist in HIT, or a round, compact thing as in ROCK. Likewise, path movement of a sign makes good path motion of an event, and repeated movement makes a good repeated event as in the ASL signs GO and CONTINUE, respectively. These types of mappings are made possible by the ability to construe articulations within the semantic pole of a symbolic unit.

Though this phenomenon may be more opaque for spoken languages, this is only because the articulators are for the most part hidden from view, and there are fewer things that make sounds than there are things that have forms. In other words, all objects and events which are perceivable to us in Newtonian space, have a visible form, but only a subsection of perceivable events in the universe have sounds. Evidence for this bias comes from a study of verbs of perception by San Roque et al. (2015) which studied 13 languages from around the world and found that for 12 out of 13 languages, vision verbs accounted for two-thirds of perception verbs while references to vision were more frequent than other sense words for all 13 languages. This study supports the long cited case for visual dominance in the human and even more broadly speaking, primate experience.

Nevertheless, we can see the construal of form for spoken languages reflected in various types of sound symbolisms ranging from sound-sound motivations, as in the case of *chickadee* where the name of the bird reflects the birdsong *chickadee-dee-dee*, to sound-motion symbolism as found in Siwu, a language spoken in Ghana, such as the ‘jerky walk of a turtle’ *kpɔtɔrɔ-kpɔtɔrɔ* (Dingemanse, 2011a). In fact, Dingemanse has proposed an implicational hierarchy of sound symbolisms which suggests if a language (spoken) has sound symbolism, the most common type is sound-sound motivation. However, if a language has sound-vision based motivations, it will also have sound-sound symbolic motivations. The full hierarchy as proposed by Dingemanse can be seen in Figure 21.

Sound < Movement < Visual Pattern < Other Sensory Perceptions <
Inner Feelings/Cognitive States

Figure 21) Sound Symbolism Implicational Hierarchy (adapted from Dingemanse, 2011)

Each of the examples presented here exhibit mappings between construal of some language external concept and the construal of an articulation. Be it children’s backing of vowels to imitate deeper adult voices or mapping of the duality of the extended fingers of the V-handshape to the duality of legs or eyes, it should be clear that languages make use of the ability to construe formal properties as representing construal of an external referent in many ways. This type of mapping is often referred to as iconicity, which is taken to mean any correspondence between a form and an external referent. But the term iconicity as it is used in signed language description is often applied broadly and without precision. Iconicity is sometimes conflated with motivation, meaning simply that there is something external to the linguistic system that drives a pattern, or it can be used concomitantly to mean transparent or phonologically iconic as in the case of onomatopoeia or signs which appear to ‘look-like’ their referent. This is a gross misinterpretation to assume that the linguistic form reflects properties of entities in the real world as these mappings are subjectively mediated through the construal of form and the construal of meaning. Because of these issues, I will continue to refer to these iconic mappings simply as external associations, or external mappings which I will consider in more detail in Section 3.6.

3.6 Internal versus External Associations

Externally motivated form-meaning symbolism is not the only type of construal which operates within the semantic pole of phonemes. The 'content of the semantic pole of phonemes has origins in two sources, language-internal and language-external motivations. Language-external associations, as we have seen, arise from the construal of articulations as they relate to construals of the objects or events in our experiential world. It should be noted that 'transparent' mappings of sensory-motor routines such as the ASL signs DRINK (Figure 22) or SMOKE (Figure 23), which are often considered the prototypes of iconicity are not the only type of external motivation in signed languages.

Figure 22) ASL DRINK (adapted from SPREADTHESIGN)

Figure 23) ASL SMOKE (adapted from SPREADTHESIGN)

In the same way, for spoken languages, onomatopoeia is not the only type of externally motivated iconicity. Such mappings should not be considered the sole origin for language-external mappings. Diagrammatic iconic mappings are also rampant in both signed and spoken language. As Haiman (1980, 1983, 1985) has shown, diagrammatic iconicity also often reflects externally motivated states such as temporal organization of events being represented in a linear representation of clauses. Likewise, reduplication often iconically signals ‘more of something’ be it intensity, number, or repetition. In other words, both imagistic and diagrammatic iconicity can be externally motivated. A multitude of construal operation processes are available for creating different types of externally motivated mappings including metonymy, and metaphor (Mandel, 1977), but to review these in depth is beyond the scope of this dissertation. What is important to note is that externally motivated mappings are widely recognized in both signed and spoken languages and that they are not restricted merely to transparent one-to-one mappings. A language can use reduplication to signal plurality, while also using repetition of form to signal continuous aspect. In the case of Bikol, a Philippine language, there are five types of productive reduplication, which range in form from partial reduplication to full reduplication. The full reduplication form has a high degree of polysemy, that is, this formal pattern is used for plurality, imitation, attenuation, diminution and more (Mattes, 2014, p. 43). Clearly this formal repetition serves many purposes of mapping one form to multiple language external construals of meaning. Signed languages, similarly can use many-to-one form-meaning mappings as we will explore in chapter 4, for now, suffice it to say that external mappings, in that they represent a type of iconicity, importantly take advantage of multiple possible construals of form and meaning, for the simple reason that humans can perceive multiple properties simultaneously without conflict.

Language-internal associations arise from connections made between linguistic forms which share similar form and similar meaning. We are able to use fine-grained statistical information to create expectations about which types of words frequently or likely appear in which type of construction, forming potential prototypes for these dynamic categories (Goldberg 2006; Ibbotson & Tomasello 2009). These schemas allow humans to make predictions about the function or meaning of novel utterances so that when we experience a new utterance we are able to analogize on previously experienced forms to discern the function of that new form. In this way, patterns are extracted at varying levels of complexity.

While this encompasses traditional morphological associations, which are etymologically related, it also includes construals of language-internal associations which are only relevant in the mind of an individual speaker. Language-internal associations are at the heart of schema construction. Perceived similarities across form-meaning mappings allow morphemes to arise. Through analogy, we compare and contrast new usage-events against previously experienced usage-events, we extract commonalities and abstract away schematic patterns. Bybee (2001) has diagrammed this phenomenon as seen in Figure 24.

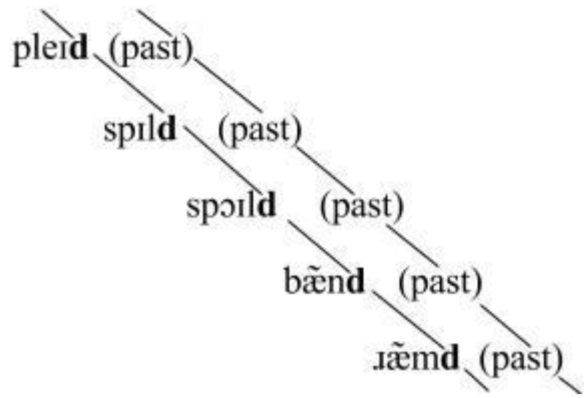

Figure 24) Emergence of morphological relatedness (adapted from Bybee, 2001)

In this case, a single sound unit /d/ has been schematized across several usage-events where the sound occurs in a similar position and carries a similar meaning. In the same sense, signed language users can extrapolate a single parameter. Taking for example handshape, across several usage-events, a single handshape may occur in a similar construction carrying a similar meaning and as a result, become a stable form-meaning association. Schematization of the A-Handshape as it occurs across several usage-events of the CUT-construction can be seen in Figure 25.

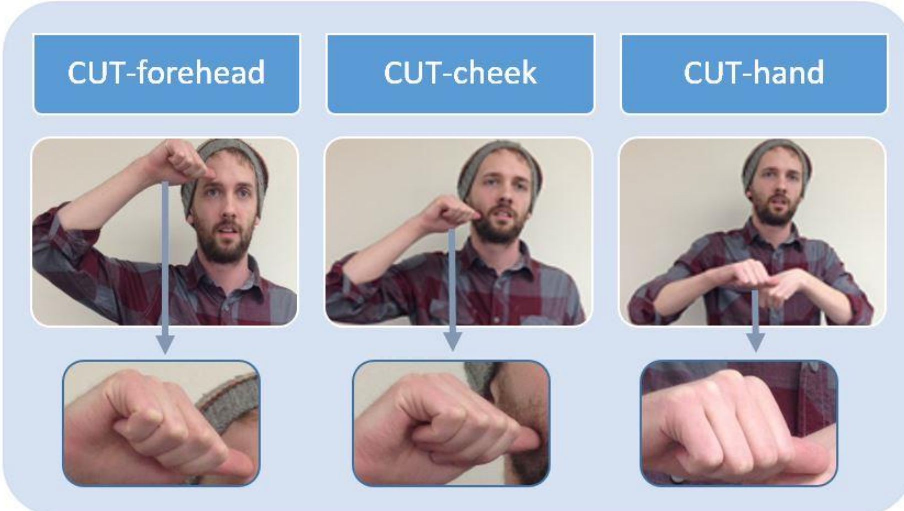

Figure 25) Schematization of A-Handshape from CUT-Constructions

In this way each parameter of a sign is subject to schematization of form-meaning units just as spoken language structures are extracted from their usage events. In the CUT-construction, the location parameter is extracted semantically as (roughly) the place the cut occurred, and phonologically this is represented by a schematic representation of 'location on the body'.[32] This variable location parameter has been called gestural due to its analog nature. Liddell (2003) argues that for some signs it seems that handshape parameters are fixed, and therefore listable in the grammar, i.e. *linguistic* but that the other parameters of such signs, such as beginning and ending locations are variable, gradient, and unlistable in the grammar. Liddell refers to the fixed parameters as ones which reference the lexical meaning, but that the schematic parameters are gesture. I argue that within a cognitive phonology framework, there is no need to appeal to 'gesture' as a sufficient label for such variation. In the case of the CUT-construction, parameters may be more or less schematic, each of which are capable of being schematized to

[32] While 'location as location' can be construed as externally motivated, it is important to note that 'location' as a schematic parameter of a construction is extracted as a form-meaning mapping with internally motivated patterning. Thus parameters may be at the same time both externally and internally motivated, these motivations are not in conflict, but instead reinforce one another.

greater or lesser degrees based on variation in formal and semantic properties. While handshape, beginning and ending locations, and path movement are specified for the basic articulation of the sign, other articulatory dynamics such as contact, duration, extent of path, etc. may or may not be specified depending on the degree of detail a signer wants to convey. Nevertheless, these unfixed parameters are part of the construction which have formal and semantic representations in the minds of signers.

Research has shown that analogy and distributional analysis (Tomasello 2003) are central to the formation of abstract schemas or schematic slots within constructions. [33] Gentner and Colhoun define analogy as a general cognitive capability which allows humans to "perceive and use relational similarities," (2010, p. 35). As it pertains to language, analogization occurs when structured similarities between form-meaning units spur language users to make changes to the language which bring disparate mappings closer in conceptual space. These mappings can occur at any 'level' of language structure, from the subphonemic to the prosodic, to the clausal level and everything in between. Of importance is the fact that analogization is essential for language change; it is in many ways the primary motivation behind the regularization of morphological patterns, specifically irregular or less-frequent patterns have a tendency to move toward formal properties of a regular patterns.[34] Bolinger suggests that semantics can be a catalyst for analogical changes in that popular etymology, or folk etymology as it is often referred to, allows language users to analogize similar form-meaning mappings to create a more parsimonious formalization of a word.

In this way, the perceived relationships between form and meaning are as important to

[33] For an excellent overview of analogy as it relates to human cognition please see Gentner and Colhoun (2010)
[34] Also called analogical leveling by Bybee, who points out that high frequency patterns are often resistant to analogical change (morphophonemic change) because they have stronger mental representations and thus are more easily accesses as compared to lower frequency patterns (2001, p. 6).

the emergence of categories and storage of linguistic associations as are historically grounded relationships. Thus, in the same way that /d/ can be extracted as 'a real morpheme' from an array of usage-events with patterned past tense markings, or an A-Handshape can be extracted from a series of CUT-Constructions, so too can categories arise from perceived relationships which have no real historical relationship. The fact that we can think about possible relationships between forms or between forms and meanings allows us to posit possible relationships that may not be grounded in actual historical relationships. Thus, in cases where the formal or semantic poles of a symbolic unit are partially obfuscated by perceptual difficulty of a given articulation or cultural shifts in semantic knowledge, linguistic units can gravitate toward preexisting mappings. For example, *guy-wire* is often interpreted as *guide-wire* as the original meaning of 'guy' as a small rope or chain became obsolete and therefore no longer accessible. Similarly, *buck-naked* has, for many American English speakers, become *butt-naked*, arising from the formal ambiguity of the perception of the final consonant (is it /k/ or /t/) and the construal (in the real world) that when you are 'butt-naked', your bum is showing.[35]

It is by virtue of the fact that we can construe form-meaning mappings as relating to the real world that many folk etymologies arise. In ASL, the sign GIRL which is articulated by brushing the A-handshape against the cheek was originally motivated by the bonnet straps worn by young girls, but as the loss of cultural connection with wearing bonnets was lost, so too was the motivation behind the location parameter of the sign GIRL. Current folk etymologies include explanation of locations which instead refer to the softness of the cheek, or even simply that in ASL the lower part of the face is used for feminine-gender in which case the location has become only internally motivated.

Thus the perceived relationship between form-meaning pairings is just as robust, and

[35] Such changes occur alongside the loss of cultural connection with the previously motivated form

perhaps even more important in the structuring and storage of the individual language user, as the professional linguist's 'correct' interpretation of etymologically sound morphological relationships. As such, folk etymology should not be so easily cast aside by linguists who are interested in how form-meaning relationships form and change over time, as this is valuable data into how naïve speakers interpret their language. All of these associations are subject to construal and are likewise subject to participation in form-meaning mappings of a given linguistic structure.

Language-internal motivations can also interact with language-external patterns. It is important to note that language users likely do not have a strict division between word forms perceived as formally or semantically related or internally or externally motivated. Internally motivated forms can be construed as having language-external motivation, even when the historical, etymological evidence does not corroborate such intuitions, and likewise, externally motivated constructions can become overridden by language-internal patterning. Thus, rather than being mutually exclusive or even divided into strict categories of motivation, language-internal and language-external patterns interact in intimate ways. In fact, it is not hard to find language-internal motivations which have at their core, some salient language-external prototype member(s) which motivates an entire category of form-meaning mappings to move toward that existing exemplar.

Let us take for example the ASL sign ROCK, which is articulated with two S-handshapes which profile the rounded, compact nature of a stone, accompanied by a downward path movement in which the dominant-hand strikes the top-back of the non-dominant hand, profiling the solid nature of the referent. [36] This sign refers to a physical entity of a stone or the solidness

[36] A dialectal variant of ROCK is articulated with one-hand under the chin. In another variant, the NDH is articulated with HS:B, profiling a surface instead of profiling "rock hitting rock".

of a physical object. A related sign exists, likely formed from semantic extension of externally motivated ROCK which refers to a concrete referent, but which means HARD meaning 'difficult.' Interestingly, the bent-V-handshape is related to other signs which profile difficulty or complexity such as PROBLEM, TOUGH (mentally, emotionally), but also is utilized in signs such as PHYSICS and BLIND. The articulatory contrast between bent and straight fingers is motivated by a semantic contrast, namely straight fingers map onto the idea of 'well-formedness' or 'being in existence.' Thus, in discussing a group of signs which includes WEAK-MIND, WEAK, BLIND, DOUBT, MULL-OVER, SUSPICION, and WISE, P. Wilcox observes, "the single consistency in all of the signs is the bent finger that alludes to thoughts or ideas that are *not fully existing*," (2000, p. 136). Similarly, the signs PROBLEM, TOUGH, HARD, and to a lesser extent PHYSICS, share the semantic schema of 'difficulty.' It is not hard to see the contrast then between the core schemas of STRAIGHT IS NORMAL or 'well formed' and BENT IS DEVIANT or 'ill-formed' and the subsequent semantic extension to BENT IS PROBLEMATIC or 'bent is not easily understood.'

What is important to note here is that the articulation itself, i.e., the shape of the hand, can be construed in a way in which it represents the construal of some state of being in the world, and as such is representative of image schemas which reflect these states of being. Wilcox points out, "We see these image schemas everywhere in nature. They represent dying or limp objects or brand new creations just unfurling or being born. Image schemas of bent objects that are not fully in existence map on to the target domains of each sign as comprehension that is not fully in existence," (2000, p. 137). Without appealing to cognitively motivated image schemas relating to the articulatory pattern of bentness, one misses out on the generalization that across multiple handshapes, a pattern of bent versus straight articulation maps onto a shared semantic schema.

For ASL this applies to bentness in a variety of handshapes including but likely not limited to handshapes 1, 2, 3, 4. For each of these handshapes there exists a formal distinction between the bent and extended variants; however, if we simply speak of 2 and bent-2, and 3 or bent-3 in relation to each other, then we miss out on a broader semantic pattern which exists. Thus for many of the bent variants across all of these handshapes, there is also a pattern where bentness can represent something deviant, decrepit, ill-formed, not clear, or simply not straight. Clearly, in at least some instances, there is a robust mapping across multiple handshapes that maps bentness to a variety of related semantic construals. Thus, both language-external and language-internal forces are colliding to reinforce regular patterns within the language, patterns which are neither wholly internal nor external to the system.

Unsurprisingly, both language-internal and language-external meanings only arise from the schematization of usage-events. In one instance, language-internal patterning arises from regular form-meaning mappings across linguistic units, which then imbue the semantic pole of the recurring phonological form with schematized shades of meaning. On the other hand, language-external patterning can arise from regular form-meaning mappings between the construal of the formal properties of articulations and the construal of events or things in the world.

Allowing for aspects of the phonological system to be grounded in language use and embodied experience, does not imply that ‘everything is motivated.’ This is the most common question people ask upon first exposure to cognitive phonology. The fact that ‘phonemes’ *can* and *do* have semantic poles does not preclude ‘phonemes’ from becoming so highly schematized that these units may seem to be arbitrary. In the same sense, the model does not preclude ‘phonemes’ from having semblances of lower level semantic schemas, which for many, in traditional terms may be labeled as ‘morphemes’ the difference between which is simply a matter of degree of abstraction and the influence of internal versus external motivations. Thus, this framework makes clear the gradient nature between what have traditionally been deemed morphemes and phonemes. Since formal content at all levels, including those smaller than ‘the word’ are abstracted in the same way, and subject to the same language-internal and external pressures, we should expect the same types of form-meaning structures to emerge. We will return to this idea of the phoneme-morpheme continuum and the semantic pole of the phoneme in Chapter 4.

3.7 Group Variation, Embodiment, and Construal

One final consideration, is the importance of group variation and individual differences in this process of extracting patterns from usage-events. Cognitive linguists view grammar as being as individualized as the person to whom it belongs. Individual grammars are subject to personal experiences including where a person is raised, the types of interactions they have, languages, cultures, modalities, and even differences in individual bodies. Experience varies by group, and by individual, thus no two people are likely to have the same experiences to contribute to an identical set of schematizations of linguistic events. That which we extract and which potentially becomes the phonological pole, is dependent on our individual experience — if the multiple experiences are varied enough, or if certain elements lack commonality as perceived by the language user, then that user will not extract a shared schema for the tokens at hand. If individual experience can somehow be condensed into ‘group’ experiences, we will likely find patterns of agreement across different groups. We do after all, have many similar experiences within a given culture, or group of language users.

In a recent study investigating perception of iconicity in ASL and German Sign Language (DGS), Occhino, Anible, Morford, & Wilkinson (in press) found that regardless of the task, ASL signers found ASL signs to be more iconic than DGS signs, and DGS signers found DGS signs to be more iconic than ASL signs. The authors suggest that these results reveal that the perception of motivated form-meaning mappings is intricately related to language-specific experience. These findings show that motivated mappings are not only influenced by transparent form-meaning mappings based on an external, objective reality but instead rely also on the construal of internally related regularities across form and meaning which likely strengthen both internal patterns and any relevant external motivation.

These regularities in form-meaning mappings, within individual grammars, and across language users, must reflect our embodied experience with the world. Thus, for something to be externally motivated, a speaker has to construe that mapping as relevant to her experience with the world and with the language. What is iconic for one, might not be iconic for another; and what might be internally related (morphologically) to one, might not be related to another. Frequency of exposure, prototype effects, cultural saliency, education levels, exposure to more than one language, and perhaps even individual personality traits, likely influence the emergence of such schemas. What is important is that all of this has potential to influence the organization of language.

We are all humans with similar embodied experiences. What we must keep in mind is that we do not all share the same perceptual apparatuses. We should expect that hearing and deaf people, insofar as they represent two extremes on a scale of perceptual ability, would have different schematic representations of usage-events. What is common across multiple experiences for a deaf person might not be as common or (at least) as perceptually salient for a hearing person and visa-versa. Part of the embodiment of language is that our individual bodies act as perceptual tools to detect and process information. Embodiment is after all, situated cognition, and cognition in situ, means cognition in and of the body.

A misconception commonly propagated is that signed languages are *more* embodied than spoken languages because they *use the body* to create the language. While it is true that there may be a greater number of general motor routines which can be co-opted by signed languages as part of the language (for example the sign SHOVEL in ASL uses a highly schematized version of the motor routine for shoveling, whereas most spoken language words do not get to piggyback on general motor routines to create linguistic articulatory motor routines) this does not imply signed languages are more embodied. Embodied language means that we take into account the role our existence in these bodies, as we interact and move through the world, plays in our understanding and construction of language. In fact, evidence from studies on mental simulation reveal that spoken language users engage areas of the brain responsible for motor routines (without producing the physical action) (Glenberg & Kaschak, 2002), and vision (Kosslyn, Ganis, & Thompson, 2001) when engaging in linguistic tasks. Winter and Bergen (2012) have suggested that when people engage in linguistic tasks which reference what something sounds like, they engage perceptual representations of what those objects/events sound like. Work on simulation clearly shows that vision, motor routines, audition, and proprioception are all at work in the simultaneous construction of meaning. Language is embodied for all language users, but the bodies we have affect our perceptions and interactions with the world and thus impact, most broadly, categorization of events and experiences, and more specifically the categorization of what constitutes linguistic content.

3.8 Chapter 3 Discussion

We began this chapter with a summary of the current literature on cognitively oriented approaches to phonology. Usage-based approaches provide the most promising model for phonological analysis thus far. They take into account findings from various other fields of psychological and physiological inquiry, and present a theory which better represents general cognitive contributions to the structure of language. Through a usage-based approach we can begin to understand the nature of phonology as emergent and dynamic. What cognitive phonology adds to well-established frameworks, is the inclusion of phonemes in the same echelon as other symbolic units, schematized from usage-events. This model views phonetic content in the same vein as all other usage-events. Usage is usage, articulation is articulation. Linguistic units of all sizes are extracted from the contextually relevant, semantically rich environment. All linguistic form must be discovered from usage-events. When a usage-event occurs, it occurs in a context, and that utterance is a pairing of form and meaning. From this event, we store both predictable, redundant information and unpredictable, contrastive material. This formal representation is tagged for the contextual, pragmatic, semantic, and inferred meaning. Just as a sentential level construction such as a ditransitive construction arises from schematization across multiple instances of the usage of that form paired with that meaning, uttered in a specific context, so too phonemes, and even feature level patterns arise from the discovery of pieces of larger constructions, which co-occur in specific contexts with specific meanings. If we as linguists of a cognitive persuasion agree that prosodic, syntactic, and morphemic form is gleaned from this environment, there exists no reason to treat phonetic material as any different.

By simultaneously embracing the theoretical underpinnings of usage-based phonology and Cognitive Grammar as they relate to phonology and semantics respectively, we can deepen our understanding of the organization and storage of sub-lexical content and begin to understand the relationship between motivation and arbitrariness. I suggest that the application this cognitive model insists that arbitrariness is but one possible outcome of high levels of schematization at the semantic pole. Despite this apparent arbitrariness, it is clear that phonetic contents can encode important information regarding function, social status, affect, and even traditionally construed semantic content.

At the heart of this issue is that usage-events are the source of language experience. Usage-events are not tagged for form or for meaning, the user must discover units of various sizes based on repetition of form-meaning pairings, within a given social, linguistic, and temporal context. This discovery process holds for linguistic units at all levels of meaning and complexity. Regardless of the formal level, form is not experienced without meaning, form is not extracted without meaning, and form is not stored without meaning. Unfortunately, there has been a long tradition of accepting the separation between meaning-building and meaning-making units of language. In this sense, even died-in-the-wool cognitive linguists often create an unfounded and artificial separation between morphological and phonological content (Lakoff, 1993b; Välimaa-Blum, 2005). Despite warnings regarding the blind adherence to structuralist traditions without question (D. Bolinger, 1965a; Givón, 2015; Langacker, 1987, 2008) phonology is still trapped in a different module, separated in kind from the other linguistic strata.

I have advocated that we accept form-meaning pairings of symbolic units to be the only necessary structures for all linguistic content, extending this to the description of phonetic content. In other words, phonetic content can be viewed as consisting of a formal component and a meaning component within a constructional or symbolic unit, as others have argued is the case for morphological or syntactic units within such paradigms. Under this rubric, the difference between phonemes and morphemes is that morphemes have lower level schemas (are more specified) for a particular form-meaning mapping. In other words, phonemes, due to their high frequency of deployment and high degree of variation in terms of distributive properties, become more schematic at a faster pace and thus have less specificity for their form-meaning mappings. It seems clear that when considering the general cognitive mechanisms at work in usage-based approaches, phonological content should be treated as any other 'level' of linguistic complexity.

If we are clear by what we mean when we discuss conventionalization and meaning, and we are inclusive in our understanding of encyclopedic knowledge, as Fillmore and others have challenged us to be, then we gain an immense degree of explanatory power in regards to what we might consider phonetic meaning. With this broad conceptualization of meaning, I intend to define the semantic characteristics of phonemes using a fully embodied approach to language. Experiences that we derive from the world via the bodies into which we are born have a marked effect on how we categorize the world. In the same way, it is not up to the individual semanticist to draw lines in the sand in regards to what is meaningful and what is not; it also not our job as linguists to draw lines concerning individual's experiences and how they categorize them. This can apply generally to any type of language structure, but here I am specifically discussing what is capable of being conceptualized as motivations to formal structure. Many studies exist, especially within the field of sociophonetics, which find surprising evidence of meaning attached to phonetic form where there 'should be none.' While some may categorize these findings as outside of the semantic domain, I argue that in fact we must include these as types of meaning, for the simple fact that encyclopedic knowledge incorporates everything that is able to be conceptualized about any given unit of form. Thus the central tenets of the cognitive phonology framework which arise are: a) that phonemes are conceptualized as symbolic units in the same vein as any other construction and b) that the embodiment of language directly influences our categorization of linguistic material at all levels.

In chapter 4, we will see how a truly usage-based approach to language gives us incredible explanatory power for signed language data. The application of the tools of cognitive phonology and more generally, usage-based phonology will uncover patterns of semantic regularity across both static and dynamic handshapes in ASL and Libras. I show how the exclusion of semantics, in the description of organization and structure of signed languages misses many useful generalizations which reflect the nature of language as a whole.

Chapter 4

4 Cognitive Phonology and Signed Languages

As I have suggested above, cognitive phonology makes several predictions regarding the make-up of phonological units, based on premises central to usage-based and cognitive approaches to linguistic analysis. For this dissertation it will not be enough to simply layout what I believe to be the necessary tenets for a working cognitive model, sufficient for describing and predicting behavior of phonemes in signed and spoken languages. It is also necessary to provide evidence as to how this theory accounts for a variety of phonological phenomena.

As previously mentioned, current theories of phonology do not adequately address the role of iconicity at the phonological level for either signed or spoken language. However, while spoken languages are afforded the luxury of discounting phonological motivations as peripheral to phonological description, the ubiquity of motivation in signed languages places this burden squarely in the lap of signed language linguists. Moreover, increasing evidence from psycholinguistic (Bybee & Eddington, 2006; Connine, Ranbom, & Patterson, 2008; Pierrehumbert, 2001), computational (Beuls & Steels, 2013; Spranger & Steels, 2014), and biologic approaches to language as a dynamic system (Elman, 1995, 1998; Thelen & Smith, 1996) suggest that a linguistic model which takes into account frequency effects, non-modular cognitive processes, and dynamic properties, is likely a better representation for how language users acquire and process their language. While spoken language theorists have already made transitions toward such a model as it relates to phonology (Bybee, 2001, 2007, 2010), signed language linguists lag in their adoption of these concepts as they apply to analysis at all levels of language complexity.

In the following section, I show how cognitive phonology can be used as a tool to understand several patterns which arise from motivated links between form and meaning and additionally, explain how such patterns arise. Cognitive phonology, for example, both predicts and accounts for the iconic behaviors of signed languages. The way in which linguistic units of all sizes are extracted from usage-events implies that form will always convey meaning. Defining meaning in a truly encyclopedic manner, including traditional ideas of propositional knowledge, but also procedural knowledge, functional knowledge, distributional knowledge, sociocultural and pragmatic knowledge, underscores the diversity of associations imprinted on formal characteristics of language. Imbued with rich and meaningful representations, formal elements nevertheless continue to be deployed over various usage-events in different formal contexts, and these iterations attenuate these meaningful associations until they are so schematic that many assume they no longer exist. But assuredly, this is simply a matter of understanding schematicity and the roles played by frequency, prototypicality (both formal and semantic), and categorization. This includes how we categorize emergent linguistic phenomenon. Schema building is central to the understanding of distribution and categorization of all linguistic content, including what we might consider phonemic content.

I focus my application of cognitive phonology on two case studies involving signed language phonology, namely, the distribution of static handshapes (Chapter 4) and the distribution of dynamic handshapes (Chapter 5). 'Static handshape' refers to signs in which a single handshape articulation is maintained throughout the duration of the sign, while 'dynamic handshape' refers to signs in which the handshape changes within the articulation of a sign. Preliminary observations of clustering of static and dynamic handshapes around semantic prototypes has led me to investigate broader distributional patterns. More specifically, features of signs systematically encode semantic properties; this phenomenon is not restricted to the codification of visual properties of referents (as iconicity is traditionally understood), but is extended to grammatical concepts as well. In spoken language research, both image schemas and force dynamic patterns are descriptive tools of cognitive semantics. They characterize how language users encode observed patterns of objects and their interactions in the world.

I suggest that these tools can be used to describe the formal properties of signed languages, as they encode concepts in ways which often retain externally motivated construals of objects and their movements through space. As such, I argue that while phonetic considerations such as 'ease of articulation' may play some role in organization of sublexical structures, 'phonological classes' condense around certain functions which are then entrenched, conventionalized, proliferated, and maintained as dynamic, but stable, attractors in the language.

Previous research has suggested that handshape distribution is a function of markedness (Ann, 1996; Battison, 1978), with unmarked phonemes making up the majority of the distributional frequency (Henner, Geer, & Lillo-Martin, 2013), while marked handshapes make up a minority of the handshapes in a given language. This assumption is based on two major claims, the first of which is that typological frequency is a reflection of ease of articulation which can be accurately measured as a summation of selected fingers and joints. This first claim is further reinforced by a second claim concerning the relationship between ease of articulation and the order in which children acquire a given handshape during language acquisition (Boyes-Braem, 1990). Thus, the earlier a handshape is acquired, the easier the articulation, the less marked the handshape, the more frequently it appears in the lexicon; the later a handshape is acquired, the harder the articulation, the more marked the handshape, the less frequently it appears in the lexicon. Articulatory ease is also often employed as an explanation of allophonic distribution of articulatorily similar handshapes because it is conflated with markedness. For example, Handshape (HS):B and HS:bent-B are said to be allophones in ASL, assuming that the bent-B variant arises in environments which put strain on the wrist joint during the articulation of a B-handshape.

In addition to the claim that markedness and ease of articulation are the primary drivers of distributional characteristics of the handshape parameter, handshape is also considered purely phonological, except in cases of ‘classifier predicates’ also known as ‘polycomponential predicates,’ in which case handshape is considered morphemic. Because of this perceived distinction between instances of handshape as phoneme versus handshape as morpheme, linguists have divided signed language lexicons into several subclasses according to their adherence to structural rules. The proposed divisions within signed language lexicons and grammars are such that signs which fall under the “foreign” or “borrowed” vocabulary category are said to follow different phonological rules than the so-called “native” vocabulary, which is characterized as an instantiation of “co-phonologies” [37] (Brentari & Padden, 2001). Within this division, *native vocabulary* includes “core” lexical signs and classifier predicates which are thought to originate within the natural signed language, while the *foreign vocabulary* includes initialized signs and lexicalized fingerspelling, which are said to be borrowed from English by way of the manual alphabet. One reason for such a distinction between foreign and native lexicon is that several handshapes seem only to occur in signs which have origins in the fingerspelled alphabetic handshapes (foreign signs). For example, the E-handshape is said to only occur in initialized signs, in which the handshape represents the English letter E. One example is EMERGENCY, which is articulated on the dominant hand with a lateral shake of the wrist while articulating the E-handshape in neutral space.

[37] Co-phonologies were first proposed by Itô & Mester (1993), but this theory was later adapted by Padden and later by Brentari and Padden (2001).

A further division is made within the native lexicon between core and classifier signs, in part because of the varied distribution of the handshape parameter but also due to large degrees of variation across the location and movement parameters in classifier predicates. Within the native lexicon, handshape is considered morphological in classifier predicates, while handshape is considered phonological in the core lexicon (Brentari & Padden, 2001). Handshape is often considered morphological in classifiers because they are thought to participate as topics of polycomponential predications, in which each part of the classifier is meaningful. The handshape encodes information about the participant, while the movement and location encode how or where the participant moved. The movement and location parameters are thus often characterized as gestural components rather than linguistic components, due to their analogue nature (Liddell, 2003).

Furthermore, while handshape in the native lexicon straddles a line between meaningless phonemes in the core lexicon and meaningful morphemes in classifier constructions, handshape in the foreign lexicon is considered meaningful only insomuch as it represents English orthographic constituents. Location and movement parameters are considered meaningless linguistic units, equivalent to phonemes in both the foreign and core lexicon component of the native lexicon, but considered gestural, analog, and meaningful within the specific subclass of the classifier lexicon. All of these considerations regarding distribution, contrastiveness, semantics, iconicity, and variation create a complicated multi-part model of the signed language lexicon.

To be fair, what is beneficial about the divisions across the lexicon is that that the proposed rules have at their basis observed distributional patterns of handshape within the lexicon. It is likely that as is the case in spoken language, articulatory limitations constrain phonotactic patterns. It also may very well be the case that handshapes such as E have their origins in the manual alphabet, which itself is a representation of English orthographic characters (Padden & Gunsauls, 2003) which exists to facilitate the conversion of spoken language words into ASL. Unsurprisingly, as a result, the E-handshape may primarily show-up in words which have some connection with English orthography, such as in initializations or lexicalized fingerspelling. Nevertheless, once a handshape becomes part of the grammar of a signed language it is available to participate in various constructions, and as such is no longer restricted to its origins as a representative of an alphabetic character.

The following analysis of static handshape distribution is motivated by work on several other signed languages including Italian Sign Language, also known as Lingua dei Segni Italiana (LIS), Israeli Sign Language (ISL), and Sign Language of the Netherlands, also known as Nederlandse Gebarentaal (NGT). HS:B and HS:bent-B are overwhelmingly considered to be allophones across signed languages of the world, due to their similarities in articulatory feature specifications, namely the sole articulatory distinction is the bending of the metacarpal joints. Pizzuto et al. (1995) first suggested that a semantic motivation was underlying the distribution of HS:B and HS:bent-B in LIS in that the B-handshape was used in neutral contexts but HS:bent-B was used in signs in which temporal events or spatial configurations were delineated.

Still others have investigated this question on the basis of whether base-joint specification is in fact necessary for description of phonological form. Crasborn and van der Kooij (2003) examined 225 signs in NGT and found that “other phonological factors”, including aperture, relative orientation, and semantic motivation of the articulator shape were the only factors needed to account for the surface form of these signs. Interestingly, even with their conservative estimate of semantic motivation, it accounted for 31% of the data. When examining the distribution of these signs with underlying semantically motivated joint specification, Crasborn and van der Kooij found that while both HS:bent-B and HS:B could be used to depict a surface, only HS:bent-B was used as a metaphorical delineator of time, or as a 3-D representation of shape, such as in the word BAL "ball." NGT also seems to exhibit the HS: B/HS: bent-B spatio-temporal delineation mapping, as was seen in LIS. Bent-B handshape occurs in NGT in signs such as VOOR "before" and ACHTER "behind," although the researchers maintain their doubt regarding this mapping for the reasons that their informant failed to confirm the meaning of "delineation" for this handshape and that the bent-B handshape only occurs in front-back and high-low dimensions. Thus they argue that phonetic factors and not semantics primarily influence this distribution.

Most recently, research on ISL (Fuks & Tobin, 2008) examined the proposed allophonic variations of HS:B and HS:bent-B to determine whether phonetic articulatory constraints or iconic factors influenced the distribution. Fuks and Tobin found that, contrary to previously proposed allophonic distributions, ease of articulation was not the primary determiner of where HS:B and HS:bent-B occurred in the lexicon. Instead, for 70% of the signs, the distribution of HS: bent-B could be explained by iconic or "semiotic" properties of the sign. Thus only 30% of the signs articulated with HS: bent-B could be accounted for by articulatory pressures alone in which bent-B arises as an allophone of B in environments which create wrist strain.

What these studies have in common is the recognition that semantics must be considered as a motivating factor in the organization of signed language form. Though the percentages of influence attributed to semantics differ across languages and across methodologies, these studies all find some role for iconic or motivated factors. I take this as evidence that in order to understand the distribution and organization of phonological parameters of the lexicon, we must have a theory which does not relegate semantic motivation to a paralinguistic side-effect of modality, and does not consider form and meaning to be separate phenomena.

In sum, under current theoretical paradigms the following assumptions are made regarding phonological parameter of handshape:

1) Handshape in the core and foreign lexicon is meaningless (phonological).
2) Handshape in the classifier lexicon is meaningful (morphological).
3) The distribution of handshape is governed by markedness and articulatory ease.
4) Handshape change is governed by phonotactic constraints on the specification of selected fingers in the underlying representation.

However, as we have also seen, despite the inability of current theories of signed language phonology to account for motivation, several researchers have independently arrived at the conclusion that semantic motivation plays some role in the organization of signed language structure.

In this chapter I aim to show that native and foreign divisions within the lexicon are unnecessary and that the distributional differences in the handshape parameter are due to grammatical and semantic influence on the organization the language. While I focus my efforts on handshape, I am indeed implying that all parameters fall along a continuum of more or less schematic elements which vary depending on the individual constructions in which they occur. Thus the differences perceived between morphological and phonological classes of the same parameter are merely differences in the schematicity of form-meaning mappings. More form-meaning mappings attributed to a single parameter permit the user to extract higher level schemas and thus add to its perceived phonological status. Fewer form-meaning mappings lead to lower level schemas which contributes to the perception of morphological status. But of course these two extremes are simply representative of two ends of a continuum on which a vast number of tokens lie somewhere in the middle.

I hypothesize that handshape distributions are neither randomly dispersed among the lexicon, nor based on articulatory constraints alone. I suggest that distributions cluster around motivated construals of individual handshapes. That is, cognitive phonology allows for the phonetic material itself to be conceptualized, as form and meaning are both bound in conceptual space. By recognizing that phonetic content is available for interpretation we create the possibility that users associate (construals of) linguistic form with construals of the semantic properties of the referent or action. As traditional approaches to sign language phonology consider handshape (and other parameters) devoid of meaning throughout the core and foreign lexicon, distribution should not be organized by semantic motivations.

4.1 Data Collection and Coding

Data for the studies were collected for both ASL and Língua Brasileira de Sinais, also known as Brazilian Sign Language, and henceforth, Libras. These languages were chosen in part because ASL is the signed language used in the United States and Canada, as well as the most widely studied signed language, while Libras, the national signed language of Brazil, is also well studied and used by a large population of Deaf Brazilians. Libras is also historically related to ASL, through their shared relations with French Sign Language. This allows for comparisons between forms and observations of diachronic changes for historically related signs. Because both the United States and Canada, and Brazil, cover large geographical areas, ASL and Libras also have some level of regional variation, which while I will not address directly in this dissertation are of great interest from a usage-based perspective and will become the focus of my future investigations. Additionally, both ASL and Libras had readily available sign databases which had already been coded for phonological parameters. These databases are described below in Sections 4.1.1 and 4.1.2.

Data collection consisted of extracting tokens of phonologically coded handshape parameters from an ASL corpus (Morford & MacFarlane, 2003), and a corpus of Libras (Xavier, 2006). To supplement the corpus data, I consulted ASL dictionaries: *The ASL Handshape Dictionary* (Tennant & Gluszak Brown, 1998), and *The Canadian ASL Dictionary* (Canadian Cultural Society of the Deaf & Bailey, 2002), as well as a dictionary of Libras, *Dicionário Enciclopédico Ilustrado Trilíngüe da língua de sinais Brasileira* (Capovilla & Raphael, 2001). Both the static and dynamic handshapes analyzed in these studies were selected based on their existence in both and overlap of form in both ASL and Libras, and on their quartile distribution in ASL (based on Lepic 2015).

All tokens of the selected static and dynamic handshapes from ASL and Libras were extracted and analyzed for their distributional properties. Handshapes were then coded by the author and ASL and Libras consultants as to whether the parameter contributed to the meaning of the sign. If signs we coded as having ‘contribute meaning’ these signs were then extracted from the overall database and coded a second time for the type of semantic information contributed by the handshape. Labeling of the semantic contribution was an open ended task. Consultants and the author were not given pre-determined labels. Therefore the second round of coding contained open-ended, often phrasal descriptions of the meaning an individual handshape was contributing. These signs were then categorized according to similarities across the ‘semantic labels’. For example, when coding the semantic contribution of handshape for the sign AUDIENCE, labels included phrases such as “the fingers represent people in a row” or “individual chairs”, while labels for the sign RAIN included “individual raindrops” – thus the signs AUDIENCE and RAIN were grouped as being part of the same schematic semantic domain of ‘parts of a whole’ or ‘individuated parts’.

4.1.1 Morford & MacFarlane Corpus of ASL

The Morford and MacFarlane corpus[38] consists of 4,111 signs, collected from videotaped conversations and narratives which range in register from formal to casual. The corpus contains signs produced by 27 signers, who range in age from child to adult, including both male and female signers and representing eastern, central, and western regions of the United States. Importantly, this corpus is representative of real usage and was coded for all sign types which occurred in the discourse context, including core lexical signs, which can be found in a dictionary of ASL, as well as classifier predicates, indexes/deictics, fingerspelling, number, and name signs, which are often not included in dictionaries.

In addition to coding for sign type, the conversational data was coded for several sociolinguistic properties related to speaker information and geography, as well as phonological description of the sub-lexical properties of the sign. Morford and McFarlane did not use any formally proposed phonetic/phonological coding system and instead coded for phonologically distinct properties of the sign. Handshape properties for both dominant and non-dominant hands, including initial and final handshapes for each hand were coded. The location parameter was coded for both initial and final positions. Movement of the signs was not coded. Variations in phonetic properties are not coded; for example, handshapes were not coded according to proposed allophonic relationships. In such cases, if the sign SEE, which is canonically signed with a V-handshape, was produced with the thumb extended, it was coded as a 3-handshape. Notably, at the time of dissertation, the Morford & McFarlane corpus was the only corpus available to me which included naturally occurring ASL data.

[38] For a more detailed treatment of the methodology used in collecting and coding the Morford and MacFarlane corpus see Morford and MacFarlane 2003.

4.1.2 Xavier Database of Libras

Libras data was collected from a database compiled by Xavier (2006), who extracted 2,274 lexical signs from the Dicionário Enciclopédico Ilustrado Trilíngüe da língua de sinais Brasileira (Capovilla & Raphael, 2001) and coded each sign for multiple phonological parameters using Liddell and Johnson's (1989a) phonetic coding system. The Xavier database is organized in terms of sign 'handedness,' therefore handshapes were tallied separately depending on whether they occur in a one-handed or two-handed sign. Two-handed signs were further divided into symmetrical or asymmetrical signs (sharing the same or different handshape), and balanced or unbalanced signs (movement is mirrored or alternating).

The Libras database includes a total of 1,002 one-handed signs, 780 of which have a static handshape throughout the duration of the sign, and 222 of which have sign-internal handshape change. A total of 1,267 two-handed signs, of which 1,065 have no sign-internal handshape change and 202 have sign-internal handshape change, are also included in the database.[39] Static handshape data for this corpus is discussed in study 1 and sign-internal handshape change data is discussed in study 2.[40]

4.2 Pilot Study of Static Handshape in ASL:claw-5

Before embarking on a larger scale study, a pilot study was first conducted in order to establish whether semantic clustering of handshape was a viable hypothesis. I collected a short list of signs containing the HS:claw-5 (also known as bent-5) from the ASLHD (Tennant & Gluszak Brown, 1998) and presented this list to Deaf ASL-English bilingual consultants. Selected signs were restricted to two-handed symmetrical signs, so as to maintain similarity

[39] The total number of one and two-handed signs reported here does not equal the 2,274 reported in the Libras database due to the exclusion of five signs entirely non-manual signs: WHISTLE, FART, CHEW, STEAL, SEX.
[40] Note that the Morford and Macfarlane corpus represents token frequency, while the Xavier database of Libras represents type frequency, as such, data extracted from the Morford and MacFarlane corpus was converted from token to type frequency to allow for direct comparison.

across forms, and eliminate the need for describing the role of the non-dominant hand which may be influenced by separate factors.[41] In all, 26 words were collected and presented to three Deaf consultants, all of whom were fluent signers who use ASL as their primarily language of daily communication. Consultants were asked to describe what, if any, semantic information was being contributed by the handshape. Consultants were not prompted with information about possible mappings, or semantic categorization of the handshape, and "none" was considered an appropriate answer.

Results from the pilot study showed a large degree of overlap in responses from the consultants. Form-meaning mappings were very consistent. While the task of labeling the sematic contribution was open ended, resulting in differences in exact wording, consultants overall used similar verbiage in describing perceived semantic mappings. Even with a very small data set and a small pool of consultants, five separate, stable clusters of meaning emerged relating to the concepts of individual units which were part of a larger whole, curvature of the palm, hands representing hands or fingers representing fingers, the locking of the fingers of the dominant and non-dominant hands, and the spaces between fingers indexing some lack of compactness or loose adhesion of a substance.

We will return to a more detailed analysis of each of these recurrent mappings in the section on the distribution of the claw-5 handshape in Section 4.3.2; however, even with this preliminary sampling of claw-5 handshapes we can begin to see the existence of many-to-one form-meaning mappings. Already, evidence suggests that any given handshape has the ability to be construed in several ways depending on what part of the form is profiled in the form-meaning mapping. Thus, for example, concaveness/convexness mapping is simply one way to construe

[41] In symmetrical signs, it is assumed that the second hand is simply a doubling of the dominant hand, in which case the redundant articulation does not introduce other externally motivated factors such as figure-ground relationships which are often represented in asymmetrical signs.

HS:claw-5, which profiles the curvature of the palm (or the curvature of the back of the hand). In the ASL signs BOWL and BALL the handshape is construed as curved, or more specifically, the curvature of the hand is profiled and mapped to the construal of curved objects.

The following sections will address the distribution of static handshape across the four selected handshapes in ASL and Libras. Keeping in mind a cognitive approach, which assumes that constructions imbue their parts with meaning, rather than the individuated pieces combining to create some componential meaning, we can understand these individual construals as arising out of the particular constructions in which they appear. I first describe the individual type frequencies, then subsequently discuss the specific form-meaning patterns for each handshape.

4.3 Study 1: Distribution of static handshapes

The first study concerns the distribution of static handshape (HS) in ASL and Libras. If it is the case that the handshape parameter in the core lexicon is meaningless, and the distribution of handshape is dictated by ease of articulation and well-formedness principles, then we should not expect to find patterning based on meaningful properties of the handshape. To test this hypothesis, four handshapes were selected as the focus of this study: HS:claw-5, HS:V, HS:3, and HS:open-8 as seen in figure (Figure 26).[42]

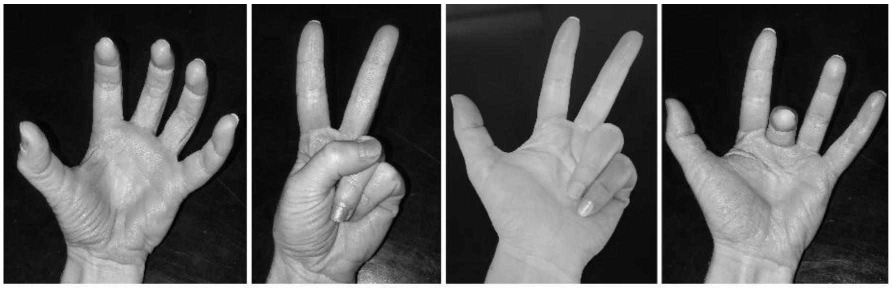

Figure 26) Four handshapes in descending order of frequency per quartile: HS:claw-5;HS:V; HS:3; and HS:open-8

[42] As previously mentioned, all four of these handshapes occur in both ASL and Libras.

Both one and two-handed signs with static handshapes were examined including balanced and unbalanced two-handed signs. Proposed allophonic variations of these handshapes were not included in the analysis, for example bent-3 tokens were not extracted as part of the HS:3 data. Such distributions are not taken for granted in a cognitive phonology analysis; instead each handshape was considered as constituting a separate ‘phoneme’. For the purposes of this study, I include tokens which have movement classified as ‘wiggle’ but exclude tokens with sign-internal handshape change in which the handshape begins and ends with a different handshape. This decision is based on previous claims that there is a distinction between secondary movement and change of handshape. According to Corina, “In secondary movement a single handshape alternates repeatedly between its specified shape and some restricted degree of closure” (1990:32) such as bending or wiggling. Examples of secondary movement are seen in signs like COLOR, where the fingers of the 5 handshape wiggle. I agree that these seem to be distinct patterns and I hope to show that there is an underlying functional differentiation to be made between these types, not just one based on formal characteristics.

While flicks are also often included in this grouping of secondary movements, as in ASL ELEVEN or UNDERSTAND, I consider these to be functionally closer to what is observed in sign-internal handshape change and thus exclude these tokens. In this way I depart from previous analyses and consider flicks to be functionally between internal handshape change and secondary movements. Thus the definition of static handshape for the purposes of this dissertation does not include flicks, or signs with aperture change.[43]

Based on Lepic’s (2015) analysis of handshape distribution across 1,956 signs extracted

[43] It should be noted, while the displacement of movement from a more proximal joint to a hand-internal joint can result in secondary movement, it does not result in handshape change. Likewise, secondary movement can occur within a handshape change but because it is already within the domain of a change of handshape, these cases of secondary movement will be excluded from static-HS analysis.

from the *American Sign Language Handshape Dictionary*, henceforth ASLHD (Tennant & Gluszak Brown, 1998), I selected these four handshapes (HS:claw-5, HS:V, HS:3, and HS:open-8) to represent each quadrant of frequency of occurrence across the 40 recognized handshapes listed in the dictionary.[44] In this way, a single handshape was selected randomly from each set of 10 high frequency, 10 frequent, 10 less frequent, and 10 low frequency handshapes.[45] As Lepic has pointed out, we must remain cautious of such counts as the dictionary, though comprehensive, may not correctly approximate the frequency of occurrence of handshapes in lexical items in ASL. This is especially relevant when we consider the general lack of classifier constructions, and other 'non-core' lexical items which exhibit large degrees of formal variability and thus are excluded from the dictionary, unless they have been recognized by the lexicographers as lexicalized.[46]

However, to determine whether the Morford and MacFarlane corpus and the supplemental data from the ASLHD reflected the same distribution, I compared the handshape distribution directly. I first extracted the token frequency of only the core lexical items for the four selected handshapes and then converted and compared the type frequency from the Morford and MacFarlane corpus to the type frequency of the ASLHD. I first extracted only the core lexical items from the Morford and MacFarlane corpus because the ASLHD only represents fully lexicalized signs and as such classifier constructions and other variable signs are not represented. Figure 27 shows the raw token and the converted type frequency[47], while Figure 28 shows the

[44] The Morford and MacFarlane corpus calls the handshape claw-5 by its alternate name, bent-5 while Xavier's Libras database refers to the handshape using Stokoe notation. I refer to this handshape as claw-5 due to the more descriptive nature of the label.
[45] These quartiles represent type frequency, as each sign is only given one entry in the dictionary, in the few cases where a sign was listed twice (in the case of one vs. two-handed variants) tokens were collapsed into a single type.
[46] Until a large corpus of phonological data becomes available for ASL, our frequency counts for various phonological parameters and processes will remain very rudimentary.
[47] The slightly greater token frequency of the handshape V as compared to bent-5 (claw-5) was due to a the sign LOOK which appeared 23 times across the corpus and was the fourth most frequent verb, and the twentieth most

direct comparison across type frequencies for the ASLHD and the Morford and MacFarlane corpus confirming the corpus and the dictionary data reflect similar distributional patterns.

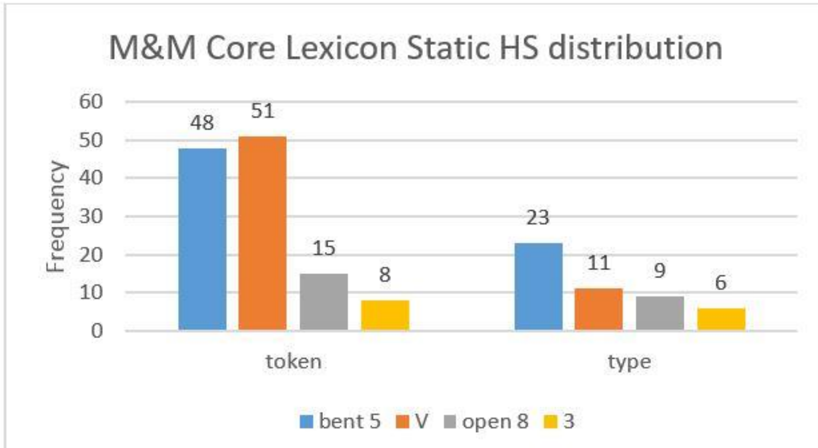

Figure 27) Token and type frequency of four selected handshapes in the Morford and MacFarlane Corpus

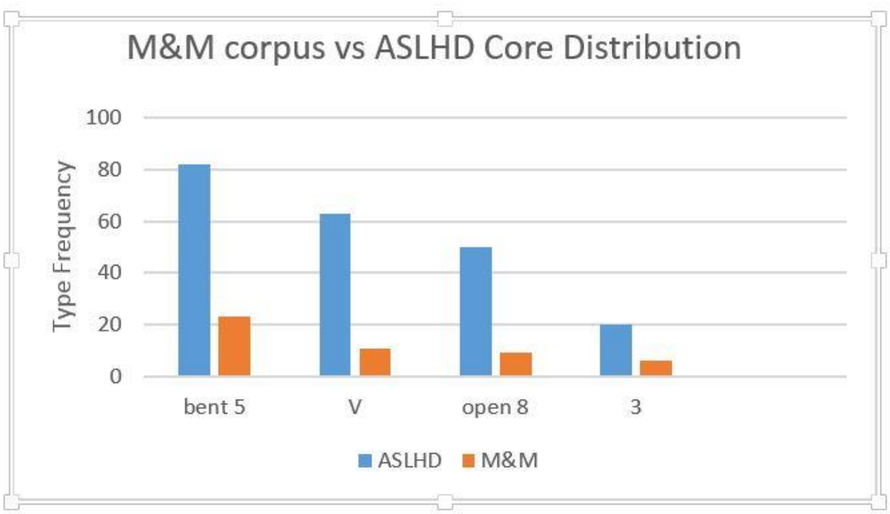

Figure 28) Comparison of distributional patterns across the Morford and MacFarlane Corpus and the ASLHD

Once the frequency of core lexical items was established across the ASLHD and the Morford and MacFarlane corpus, I expanded the token count of handshapes to include all corpus data, including core lexicon, classifier constructions, deictics, numerals, and foreign vocabulary,

frequent sign in the entire corpus with a token frequency of 6.3 occurrences per 1000 signs.

with the noted exception of fingerspelling. Fingerspelling, though annotated in the corpus and tagged as a separate sign type, was not included in the handshape frequency count due to methodological issues of how to count individual handshapes.

The inclusion of classifier constructions presented an additional problem in the conversion from token to type frequency. In instances where the gloss denotes a fixed representation of a sign, as in SEE, it is easy to collapse tokens into type frequency. For classifier constructions, the same handshape used within a given construction may be used to convey slightly different predications regarding the same referent, and as such are not glossed exactly the same. In a conservative estimate, tokens of handshape for classifier constructions were collapsed into type frequency only if they received the same gloss. For example, for the bent-5 handshape "CL: jar on dog's head" occurred twice and was considered one type, however in instances such as "CL: monster opening mouth," which appeared three times, and "CL: monster's stance", which appeared twice, I considered these two types of three and two tokens respectively.

The addition of other sign types increased the type frequency for all handshapes except HS:open-8 which only occurred in the core lexicon.[48] For example, for the bent-5-handshape, 18 additional tokens all from classifier constructions, were added, but for the 3-handshape, seven additional tokens were added, three from the numeral sign type and four from the classifier sign type. Overall, the addition of other sign types did not alter the distribution of handshapes relative to one another. In other words, while additional tokens were extracted and converted to type frequency, the overall proportion of handshape distribution did not change as seen in Figure 29.

[48] This suggests that open-8 participates in a more limited number of construals as compared to the other three handshapes which affects its overall type frequency.

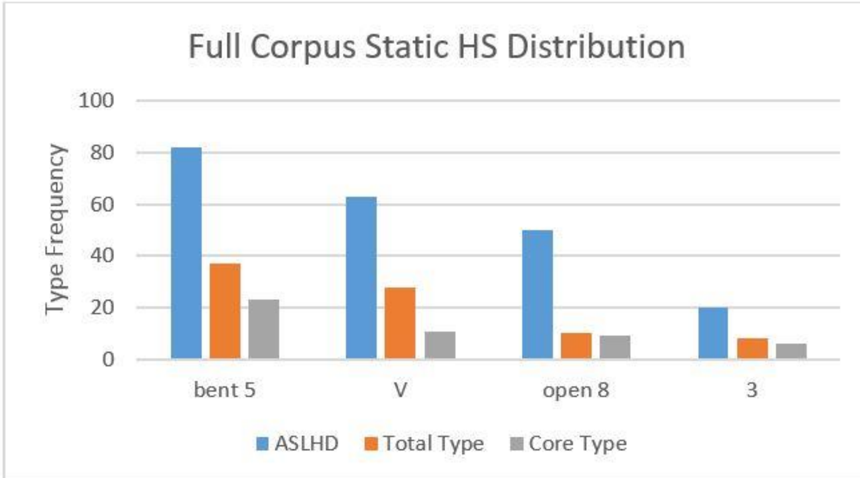

Figure 29) Type frequency for the full Morford & MacFarlane corpus (minus fingerspelling) as compared to the Morford and MacFarlane core lexicon type frequency, and ASLHD type frequency

Finally, data were extracted from the Libras database (Xavier, 2006) and compared with to the ASL frequency data. The Libras data, which will be further discussed in the following section, exhibited the same patterning seen in the ASL data.

4.3.1 Overall distribution of static handshape in ASL and Libras

After establishing distributional characteristics across these four handshapes with regard to their frequency, I examined the individual handshapes' internal distribution patterns as they relate to form-meaning mappings. The following sections outline the specific distribution of individual signs and the semantic prototypes associated with the internal schematic constructions of each handshape.

Beginning with HS:claw-5 (as seen in Figure 26), which represents the most frequent quartile of handshapes, a total of 51 signs were extracted from the ASLHD, and 66 static tokens from the Morford and MacFarlane corpus, resulting in a type frequency of 37. From the Libras database of lexical signs, which reflects type frequency, 81 Libras signs with static HS:claw-5 were collected. The V handshape, which was selected to represent the 2nd most frequent quartile, was less frequent in the Morford and MacFarlane corpus and the Libras database, but had the exception of a slightly higher token frequency in ASLHD. A total of 55 signs articulated with HS:V were extracted from the ASLHD, as well as 72 tokens from the Morford and MacFarlane corpus which amounted to a type frequency of 28. The Libras corpus contained a total of 51 signs which were articulated with a static V-handshape. The HS:open-8, representing the 3rd quartile of the handshape frequency distribution, occurred 39 times in the ASLHD, and had a token frequency of 15 and a type frequency of nine in the Morford and MacFarlane corpus. The Libras database contained 14 signs which utilized the open-8 handshape in a static configuration. The final handshape HS:3, which represents the least frequent quartile of handshapes, occurred 16 times in the ASLHSD with only one word doubled between the corpus and the dictionary. In the Morford and MacFarlane corpus, HS:3 had a token frequency of 15, and a type frequency of eight. The Libras database contained only three signs with HS:3. Figure 30 shows the total number of signs by handshape for each of the three databases.

Figure 30) Type Frequency of four handshapes across M&M Corpus, ASLHD, & Libras Database

The general trend in decreasing type frequency for each handshape across the predicted quartile divisions can be observed across all three data sets. This comparison both independently supports the findings of Lepic's type frequency count of handshape in the ASLHD, using naturally occurring corpus data, and also suggests that Libras may have a similar, though not identical, distribution of handshapes. It should also be noted here, that Libras contains handshapes that are not found in ASL and vice-versa. This dissertation does not compare across all handshapes, and as such cannot speak to a comprehensive comparison of handshape inventories. The four handshapes which comprise the data for this dissertation, occur across both languages and thus do allow for direct comparison.

After calculating the type frequency for each of the four handshapes across the ASL and Libras databases, tokens were coded for schematic semantic categories in the same manner as the pilot study. For the Libras data, one native signer and one non-native signer were consulted for the coding of signs from the Xavier database. For the ASL data, one native signer, one non-native signer user, and the author all provided individual coding.[49] Signers were first asked to indicate either 'yes' or 'no' in regards to what, if any, meaning the handshape parameter contributed meaning to the sign. If signs were coded as 'yes' with regard to handshape contributing meaning, coders then provided a brief description of what the handshape encoded semantically. If signs were coded as 'no' no meaning is contributed by handshape, no further analysis was completed, and signs were simply tallied as 'unmotivated'.

For each handshape analyzed, clear patterns emerged which clustered around distinct semantic prototypes. Though coders were able to use open-ended answers when describing the semantic contribution of individual handshapes, similar verbiage was used. Examples of such

[49] Cohn's Kappa was calculated the ASL data only.

patterns included examples such as, “ball like”, “spherical”, or “round” or similarly “locking mechanism” or “things that fit tightly together.” Semantic prototypes were then determined by the author, according to factors which Lakoff determined to be active in basic-level categorization, including gestalt perception, motor activation, mental images, and cultural importance, noting that “basic level objects constitute the center of such schemas while radial categories arise from conceptual metonymies, image schema transformations and conventional mental images,” (1990, p. 110).

Similarly, in positing basic and peripheral members of these schemas, we must keep in mind that while prototype theories emphasize the individual members of categories and operate synchronically, inductive generalization emphasizes the role of members of a category diachronically. Geeraerts (1997) discusses the case of the Dutch verb *kruipen* ‘to crawl’ which originally meant to crawl on hands and knees, but was later extended to include the manner by which this is done i.e. slowly, Geeraerts suggests, “Taking a synchronic perspective, a prototype-theoretical approach might note that of all the diverse kinds of movement that may be designated by the verb *kruipen* ‘to crawl’, those kinds of movement where one goes slowly are special, in the sense that they occupy a central position in the category. Analogously, the inductive generalization view takes a diachronic perspective, showing that the same instantiations of *kruipen* are singled out in the historical development of the verb as they give rise to specific new developments,” (69).

As an aside, it is important to note that diachronic reality is not necessarily central to synchronic states but also not completely removed from such analyses. Dixon’s description of the classifier system in Dyribal for example, proposed cognitive motivations behind the classification of nouns within the system though critics suggested that these categories were "mere historical relics" and not parts of a "live cognitive system". However, Lakoff points out that Dixon reported the acquisition of the system shows that children, "do not learn the system one case at a time but use general principles," and thus the relationships between the elements within the system must play a role in the organization of the system itself (1990, p. 110). Lakoff cites criticisms of the psychological reality of such synchronic representations of these classifications in the minds of speakers. Likewise, as I have suggested, construal of form-meaning relationships is just as relevant to the system, if not more relevant, than the actual historical facts of the language, in that the history of etymological relations is much less real in the mind of the average speaker than their construal of such relations or the imagination of other undocumented but nevertheless tangible relations. Thus, synchronically constructed webs of extended meaning, while likely historically organized based on some prototypical source meaning, are dynamic and influenced by individual construals of language users.

Both Lakoff and Geeraerts emphasize the roles of diachronic and synchronic perspectives in the development and maintenance of linguistic categories. I suggest that these generalizations can be applied to the analysis of signed language constructions as a whole, including formal components. By analyzing the type and degree of semantic overlap between members of the categories, one can posit a prototypical schematic instantiation of a form-meaning mapping which encompasses degrees of meaning shared across the members of the construction. Emergent form-meaning mappings for each of the four handshapes are discussed below in descending order of frequency. As we shall see, frequency of distribution seems to comingle with the existence of a larger number of form-meaning mappings in which the form participates.

As a result, the handshapes with many separate form-meaning mappings, such as the claw-5 handshape in ASL, exhibit stronger phonological properties and exhibit weaker morphological properties. The frequency of occurrence of a handshape, across multiple constructions with variable form-meaning mappings, leads to a more abstract, or diluted, relationship between form and meaning. Alternatively, the fewer the number of form-meaning mappings associated with a given handshape, the more morphological the properties of the handshape. When a handshape participates in a small cohort of constructions, this constrains the form-meaning mapping, strengthening its associations, resulting in a lower-level schema. These handshapes also seem to be more likely it is to participate in foreign or peripheral lexicon, as is the case with ASL HS:3.[50]

I also suggest that the ability to conceptualize multiple form-meaning mappings is likely correlated with the markedness of handshapes, for the simple reason that the more complex is an articulation of a handshape, the less likely it will easily map onto visually salient characteristics of multiple conceptual schemas. In this way, we might expect handshapes such as HS:R, which is highly marked, to be a 'less-good' representation of multiple form-meaning mappings as compared to a handshape like claw-5 which as we shall see, has multiple meaning construals related to its form.

4.3.2 Distribution of HS:claw-5

Based on the above proposal regarding frequency of handshape and number of mappings available for construal, HS:claw-5, being the most frequent static handshape examined, was predicted to have the greatest degree of variation across form-meaning mappings. Analysis of HS:claw-5 revealed patterns consistent with the five previously observed schematic form-meaning mappings identified by the Deaf consultants in the pilot study. Each of these five mappings have been outlined below, detailing the profiled formal component, as well as the

---

[50] It may also be the case that handshapes which are primarily used for foreign vocabulary resist becoming more productive

profiled semantic component. These five mappings represent separate, unrelated construals of formal properties, though each mapping has several semantic extensions unique to that construal.

1) **Curved Palm = Concave**: the palm of the hand is profiled as a concave surface (or similarly the curved back of hand profiles a convex surface)
2) **Fingers = Unitary elements of a whole and/or Straightness:** the fingers of the hand are profiled as straight elements which belong to a larger grouping
3) **Hand = Hand**: in which the entire hand is profiled as a hand, either human or primate
4) **Gaps between fingers = Non-compact matter**: the gaps between the fingers are profiled as not solid matter or not wholly contained matter
5) **Gaps + Fingers = Gap-fit**: the fingers interlock, profiling interlocking components of objects such as gears, and by extension tight fit of adjoined objects

An interesting finding from this first analysis of the claw-5 handshape, is that the several schematic meaning associations are actually profiled by different phonetic properties of the handshape. Thus, it seems that no two mappings of the claw-5 handshape arise from the profiling of the same formal properties, instead individual features of the handshape are exploited to create different schematic form-meaning mappings. This is not to say however, that sub-schemas do not emerge via semantic extension of any one of these given mappings, just that the basic level construals arise from independent form-meaning profiles.

As we shall see in the discussion of the individual mappings, the basic level mapping is frequently extended metonymically and metaphorically. By metonymic extension, I do not intend the classical understanding of metonymy which is a simple ‘stand for’ relationship, or as Panther and Thornburg refer to it as “the substitution theory” of metonymy in which “the source and the target are, at some level of analysis, considered to be equivalent ways of picking out the same referent," (2010, p. 237). Instead, I intend metonymic extension to refer to the way in which cognitive theories view metonymy, as a mapping within a single domain matrix, but more specifically, as a tool available for extending meaning, as Koch (1999) has suggested by showing that meaning changes can be accounted for by relating components in a conceptual frame through metonymy. Semantic extension of basic mappings can also occur through metaphorical extension. In this case, the mapping occurs across domains, generally when the more concrete domain is used to structure the more abstract domain. As suggested by Lakoff, the direction of metaphorical extension extends "from concrete basic-level objects to other things," (106).

With these semantic tools in hand, without appealing to diachronic processes, we can synchronically construct webs of extended meaning based on some prototypical source meaning which shares the basic characteristics with its extensions. The five mappings are pictured in Figure 31 & Figure 32 with examples of ASL signs which contribute to the individual schemas.[51]

Figure 31) Four form-meaning schemas that arise from the use of HS:claw-5

[51] The fifth mapping, *gap-fit* cannot be represented utilizing palm-out orientation and is therefore depicted separately

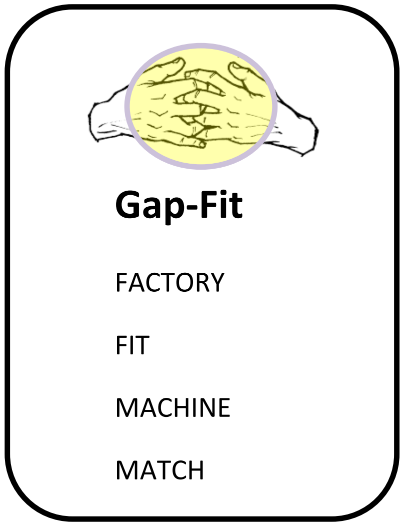

Figure 32) Gap-fit form-meaning schema that arises from the use of HS:claw-5

In both Libras and ASL, the claw-5 handshape is able to be construed as a many-to-one mapping of a single handshape to multiple schematic meanings. Likewise, because a handshape can be construed in one way within a given form-meaning mapping, does not mean that the claw-5 handshape does not participate in other constructions with overlapping properties. This point is central to the concept of construal and analogy as it relates to the extension of constructional schemas.

Beginning with the mapping I called the c*oncave/convex schema*, which can also be seen as part of the larger *handshape as object-shape schema* the formal property profiled is the curvature of the palm of the hand, which is then construed as profiling a concave surface. This mapping is based on several of the basic-level organization factors identified by Lakoff, including the mental image of such a shape, the motor interaction of interacting with objects[52] with a curved shape, and even the cultural importance of objects such as bowls or balls which are

[52] This schema interacts with the hand-as-hand schema which maps interaction of hands with objects

ubiquitous and therefore easily imagable (Coltheart, 1981).[53] In the ASL data from the corpus and the dictionary, 12 signs utilized this mapping of *spherical-object*, this included signs such as BALL, in which two claw-5 handshapes come together twice to touch at the fingertips profiling the shape of a ball and SHOCK in which two claw-5 handshapes 'fall from' the location in front of the eyes and bounce twice, profiling eye-balls falling out of one's head in disbelief. In Libras, 14 signs were identified as having this primary mapping, including the signs ALFACE "head of lettuce" which profiles the round shape of the lettuce and CACHORRO "dog" which profiles the shape of a dog's muzzle.

The second patterned mapping identified for HS:claw-5 is the *unitary elements of a whole schema*. The formal profile in this mapping is two-fold: firstly, the fingers are individual units which are part of the hand as a whole, secondly, the fingers are extended. The semantic profile in this mapping is that of multiple individuated elements belonging to a larger grouping, i.e., parts of a whole. In ASL, signs such as COMB and SPIDER easily sanction this kind of mapping, where the teeth of the comb and the legs of the spider are construed as individuated parts of a whole. In a more abstract extension of this mapping, we find signs such as ASL RAIN and Libras CHUVA in which individual drops of rain can be construed as part of the event of "raining". In Libras, signs such as RANGER-OS-DENTES "grinding teeth" and FELINO "cat" map teeth and whiskers respectively, and clearly participate in this schema where fingers represent individuated parts of a whole. Like COMB, SPIDER, and RAIN in ASL, we can also notice that part of this construal is straightness of the virtual lines created by the moving claw-5, reflecting the straightness of referent.

The third schematic mapping identified for the claw-5 handshape I call the *hand as hand*

[53] Imageability is generally considered the measurement of how easy it is to imagine a concept (either visually or acoustically).

schema, in which formally, the entire hand is profiled, and is construed as a hand. This construal of form and meaning capitalizes on the fact that hands (as articulators) make good hands (as referents)[54] . This basic schema consists of sub-schemas which cluster around what kind of action the hands are performing, i.e. whether the fingers wiggle or are in a static configuration. In the first case, fingers of the claw five articulate a wiggling motor routine in which the individual fingers move as they would to interact with an object. In signs such as TYPE and its cognate in Libras, DIGITAR, and in the sign PIANO in both ASL and Libras, metonymic extension allows the construal of hands as instrumental tools which play the piano (the action), to become representative of the object, not just the action. Another sub-schema occurs in which the fingers are stationary and the hand, in the claw-5-handshape, articulates the shape of a hand interacting with a round object such as a doorknob. The *hand as hand* schema thus contains the sub-schema of the handling construction which has recurring mappings across several handshapes. Specifically, those handshapes such as claw-5, which participate in handling constructions, profile the way in which humans interact with objects, such as how we hold a broom (profiled formally with the HS:S, closed fist handshape). The handling sub-schema of the *hand as hand* mapping is most frequently instantiated by way of metonymic extensions, and can be seen in the corpus data from ASL in signs such as CHANNEL which profiles the hand turning a knob, and in ESPREMER "juice an orange" in Libras.

Now that we have reviewed the *unitary elements schema* and the *hand as hand schema*, we can raise the subject of constructions which can participate in multiple schemas due to overlap in mapping profiles. For example, in the case of SALAD in ASL, as seen in Figure 33,

[54] This basic mapping can also be extended to semantically profile hands of other primates, as in the case of MONKEY in ASL and MACACO in Libras.

the claw-5 handshape can easily participate in the *hand as hand schema*, if one construes the two articulators as ‘hands tossing a salad.’

Figure 33) ASL SALAD articulated with the HS:claw-5

At the same time, the claw-5-handshape in SALAD could be alternately construed as profiling the unitary tines of the utensils often used to serve salad. These claw-like tines can be mapped to the extended fingers of the HS:claw-5 because the fork-like characteristics of said utensils match the construal of fingers as individuated straight elements of a united whole. Because construal is rooted in individual experience, it is possible that only one of mappings be present for a given language user; however, if one is cognizant of *both* possibilities for construal, the similarities of the semantic schema can be shared, reinforcing the mappings: ‘fingers of hands’ and ‘tines on salad servers’.

The fourth mapping, called the *non-compact matter schema*, formally profiles the gaps between the fingers which are then mapped to the construal of “not wholly contained” or “not-solid matter” in the sense that the matter is porous or not easily contained within the hand. Both ASL and Libras exhibited evidence of this basic mapping in signs such as CLOUDS and MIX, and ESPUMA “foam” and TEMPO/CLIMA “weather.” Other examples from the corpus data include VOMITO “vomit” and FUMAÇA “smoke” in Libras, as well as SMOKE in ASL and LION which maps to the fluffy mane of male lions.

The last of the five identified mappings, which I call the *Gap-Fit schema*, profiles the interlocking capability of the fingers in two handed signs with the claw-5 handshape and maps the interlocking fingers to schematic properties of objects which exhibit similar interconnected characteristics. By necessity, these signs are all two handed because the construal requires joining of two entities in a tight coupling. Through metonymy, this construal can be extended to represent the whole of a machine, not just the gears, or interlocked parts, as seen in the ASL signs MACHINE or ENGINE. In signs such as FIT/MATCH the path movement brings the hands into alignment and the final content ends with the interlocking of fingers, while the sign MISMATCH begins with the fingers interlocked and the path movement moves the hands away from each other, essentially breaking the connection of the fingers and representing the movement of an idea or object out of alignment. Interestingly, the Libras database did not contain any tokens of the *gap-fit schema*.

After completing this initial analysis of data in ASL, a handful of signs remained which did not map with the previously identified claw-5 schemas. Subsequent review of the Libras data with a Libras consultant revealed a sixth mapping for the claw-5-handshape which was not previously identified in the ASL data. The informant suggested that a possible sub-mapping of the *hand-as-hand schema* in Libras makes reference to 'feeling,' in which case the fingertips of the claw-5 handshape profile the metaphoric extension of FEELING IS TOUCHING. Most evidently this mapping occurs in signs such as JEITO, which can be translated as 'his/her way of being' and ANGUSTIAR "distress" (Figure 34).

Figure 34) Libras ANGUSTIAR "distress"; utilizes the claw-5 handshape mapping FEELING IS TOUCHING

After identifying this mapping in Libras, it became clear that a similar semantic extension of the *hand-as-hand* mapping was also present in ASL, but seemed to only be restricted to negative emotions in signs such as DISGUST and ANGER (Figure 35).

Figure 35) ASL ANGER utilizes the claw-5 handshape, mapping FEELING IS TOUCHING

There are many ways which we can conceptualize this construal. Fingertips, as the most sensitive part of the hand, are especially emblematic of feeling things physically. This physical reality then gets metaphorically extended to feeling things emotionally or mentally. In ASL as previously stated, this mapping of HS:claw-5 seems to be prototypically associated with negative feelings and is found in a number of signs such as ANGRY, DISGUST, COMPLAIN, MAD, GROSS, etc.. For Libras the mapping of this sub-schema seems to extend to both position or negative feeling or emotion. Interestingly, as we shall see in 4.3.4, ASL utilizes the open-8-handshape to fulfill the same metaphoric extension of FEELING IS TOUCHING, in which case the middle finger tip is mapped as the point of sensation. The profiling of fingertips is thus employed across both the open-8-handshape and the claw-5-handshape to map the metaphorical meaning of TOUCHING IS FEELING.

4.3.3 Distribution of HS:V

The second most frequent handshape under investigation is the V-handshape. HS:V represents the 2nd most frequent quartile of handshapes in ASL, with the caveat that the token frequency of HS:V was slightly higher in the Morford and MacFarlane database at 72 tokens, as compared to 66 tokens of the HS:claw-5; however, when adjusted for type frequency the previously expected decrease in frequency was upheld, with a total of 28 types of HS:V and exhibited 37 types of HS:claw-5. The marginally higher token frequency of HS:V when compared to HS:claw-5, was due in part to a large number of occurrences of the verb SEE which likely acts as an evidential marker in many of these instances, thus slightly inflating the overall distribution of HS:V.

The V-handshape was the second most frequent handshape of the four in the Libras database. HS:V is especially interesting because it participates in several very distinct and frequent constructional types, all of which are active in the lexicon simultaneously. For example, HS:V was found to pattern with numeral constructions, where it represents the number two, but is then extended metonymically to represent 'two-of-something' and is a frequent participant in two robust constructions in which the handshape represents 'two-legs' and 'two-eyes.'

A simple count of the 72 tokens of HS:V extracted from the Morford and MacFarlane corpus revealed 24 tokens were related to the *two-eyes schema*. After conversion to type frequency and combining the Morford and MacFarlane data with the ASLHD data, repeated types were removed, a total analysis of 61 ASL signs revealed a strong dominance of the *two-eyes* or the *two-legs* mapping across multiple constructions related to seeing or mobility on two legs. These mappings can be viewed as a sub-domain of the numeral-two construction. The V-handshape also participates in the broader *shape* construction which profiles multiple instances of two-prong-shaped things such as fork-tines, scissors blades, and horns. One type count of the classifier construction TURN-INSIDE-OUT, was coded as part of the "2" mapping as it may be an extension of the 'two-of-something' mapping in that there is 'an inside and an outside'.

The remaining tokens were distributed across mappings relating to the numerical mapping of '2' where it referred to the actual number rather than an example of a paired thing, and HS:V as the letter 'V' representing English orthography. However, as with the other handshapes, there were some tokens which were not well accounted for by a lower level mappings, most notably for the HS:V in the sign MEANING (8 tokens). Historically the sign MEANING is related to the French sign COMPAS, "compass" as in the drawing instrument used for drawing arcs and measuring angles. In this mapping the extended fingers of the 2-handshape profiles the legs on the compass.[55] The French sign COMPAS came to mean 'technique' or 'budget' but more broadly 'measure' which is the source of the semantic extension in ASL (Shaw & Delaporte, 2014, pp. 171–172).

The final token/type which occurred without classification in the HS:V data set occurred in the sign PEOPLE, which at least according to the ASLHD is an initialized sign with two P handshapes moving in an alternating cyclic motion in neutral space. This is likely an occurrence of HS:V arising for purely articulatory factors.[56] In this articulation of HS:V it appears to be an allophonic variant of HS:P/K, which includes the same selected fingers (pointer and middle) but has the additional articulatory feature of flexing of the middle finger's metacarpal joint; thus HS:V can be considered a slightly less articulatorily complex gesture as compared to HS:P/K and

[55] Notably in English we extend the use of the word *legs* to refer to the compass's two extended components.
[56] It is not possible to rule out 'reanalysis' of HS:P to HS:V by signers as V participates in the 2-legs construction

may arise in PEOPLE for this reason.

In the Libras database, the V-handshape displays several similar form-meaning mappings. Like ASL, it shares the initialization mapping of 'V', the numerical mapping of 'two' which is then extended to represent 'two-of-something' such as 'two-antennae' in the Libras sign BARATA 'cockroach.' It also occurs in the constructions mappings 'two-legs' and 'two-eyes' as in the Libras signs ANDAR-A-PÉ 'to walk-by-foot' and OLHAR 'to look'.

4.3.4 Distribution of HS:open-8

For ASL, the total occurrence of HS:open-8 across the Morford and MacFarlane corpus was 15 tokens, resulting in nine types. After calculating the type frequency for the open-8-handshape in the corpus, this data was combined with the HS:open-8 types from the ASLHD. Overall, 28 examples of HS:open-8 occurred across both ASL datasets. The open-8 handshape did not occur outside of the core lexicon in the corpus. This is interesting in itself, as it suggests that HS:open-8 does not participate in many highly productive constructions due to its lack of numeral status, letter status, and perhaps even classifier status. In the Libras database the open-8 handshape occurred 14 times, with no tokens of unbalanced two-handed sign with HS:open-8.

The most frequent mapping of the open-8-handshape was to the semantic domain of 'feeling' in ASL. Interestingly, it seems to share more or less the same semantic load as the claw-5-handshape in Libras, accounting for several positively and negatively correlated emotional states. The profiled articulatory feature for this schema is the tip of the extended middle finger of the open-8-handshape. The fingertip acts as the point of contact with another articulator, be it the non-dominant hand or body, or in some instances may make no contact but maps the orientation of the fingertip as a virtual point of contact oriented toward the interactant.

The most basic mapping for this schema likely stems from the physical act of touching a surface; and thus the *touching as contact* schema occurs in ASL signs such as CONTACT (both in the nominal and verbal forms). This mapping then in turn capitalizes on the physical side-effect of touching an object which is the experience of physical sensation or ‘feeling’ an object. The ‘physical feeling’ implicature is then extended metonymically to ‘touching is experiencing’ which can be seen in the sign TOUCH-FINISH. This construction translates to ‘finished experiencing X,’ and ‘touching as mental or emotional feeling’. *Touching as contact* when realized with a path movement, can also be extended to profile the physical aspect of smoothness of the entity in question, such as in the signs EMPTY and NAKED. The extension here relies on the basic human experience that something in which the touch glides easily over, is unobstructed and thus bare or smooth. This ‘surface’ mapping is further extended in the signs such as SHINE and SPARKLE, where the combination of handshape + path movement + manner movement, profiles the shininess or reflective component of the smooth surface. When combined with the forehead place of articulation the ‘shiny surface’ mapping takes on the meaning ‘shining mind’ i.e. BRILLIANT (Wilcox & Wilcox, 2013).

The *touching as contact* schema is also metaphorically extended to TOUCHING AS FEELING, where feelings are internal states such as emotions (Hopper & Traugott, 2003). This extension is realized in signs such as DEPRESSED or EXCITED, which also combine with the movement parameter to blend the metaphorical constructions DOWN IS NEGATIVE and UP IS POSITIVE correspondingly(Lakoff & Johnson, 1980). What is interesting from our proposed usage-based perspective, is how any one of the individual form-meaning mappings is not profiled until it participates in a construction. For example, in the sign OBSESSED the formal property of continuous contact of the dominant hand HS:open-8 with the non-dominant hand HS:S, metaphorically expresses ‘continuous mental attention’ when occurring with a continuous cyclic movement of the hand-configuration. However, continuous contact between the middle fingers of the dominant and non-dominant hands in INTERNET, when paired with a radio-ulnar twisting motion, profiles the sense of ‘continued connectivity’. In other words, the formal property of continuous contact does not carry one specific meaning; instead, the meaning arises from the use of this feature in a given construction.

Figure 36 represents a possible semantic map of semantic extensions from the prototype ‘touch as contact’ for the open-8 handshape, light-blue nodes represent signs in ASL while darker-blue nodes represent metaphorical extensions which promulgate new schematic form-meaning mappings. Note that semantic relatedness is only partially represented by closeness to the hub node, not necessarily in the proximity of daughter nodes.

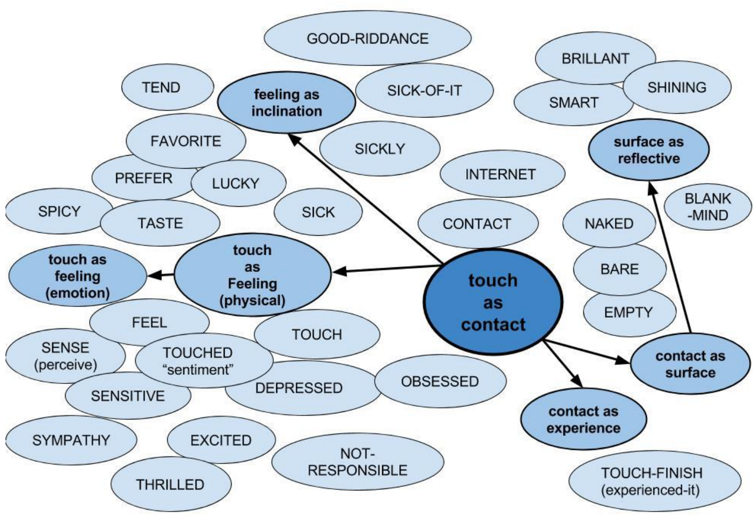

Figure 36) Primary form-meaning mapping for HS:open-8 as "touch"

In Libras, the open-8-handshape primarily patterns with the ‘contact’ and ‘touch’ mappings and has the prototype mappings of these schemas in the signs CONTATAR, whereas ASL primarily maps ‘touch’ in the physical and the emotional senses. While Libras does have signs which make use of the ‘touch as feeling’ or ‘sensing’ extension, as in DELICIOSO ‘delicious’, there is a noticeable lack of the extension of ‘touch as feeling emotion’. This mapping is likely taken up by the claw-5-handshape as we saw above in Section 4.3.2. Thus, in Libras, HS:open-8 is utilized in constructions pertaining to touch and feeling, just to a less productive degree.

4.3.5 Distribution of HS:3

With so few tokens of the 3-handshape across the Libras database and Morford and MacFarlane corpus, the majority of the signs in the analysis of HS:3 were mined from the ASLHD. In total, 19 tokens of HS:3 were extracted across the ASLHD and the Morford and MacFarlane corpus. Signs which occurred in both the database and the corpus were considered two tokens of the same sign and therefore counted as one type.

Of the signs listed in the Morford and MacFarlane corpus, four of the six types were likely examples of eased articulations of other handshapes, including one token of BORROW which is canonically articulated with a K handshape, one token of BUILDING, canonically articulated with an extended-H handshape, one token of MEAN "meaning" and two tokens of SEE which are canonically articulated with a V handshape. For example, SEE occurs in the database with HS:V a total of 12 times but only two times with HS:3. MEAN "meaning" occurs eight times in the corpus with HS:V but only once with HS:3. Figure 37 shows the articulatory cline between a HS:3 with extended thumb and a fully retracted thumb, non-spread HS:H.

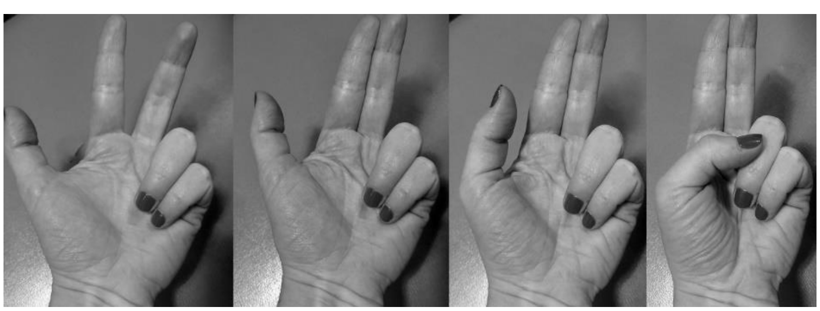

Figure 37) Articulatory cline between HS:3 and HS:H

Thus we can here reiterate that articulatory factors do play an important role in handshape organization insomuch as tokens naturally occur which deviate from the prototype. Lane, Boyes-Braem, and Bellugi (1976) completed a multi-dimensional scaling study of 20 ASL handshapes in a variable primes study which investigated degree of feature overlap between handshapes. Participants were asked to identify which handshape was seen when viewed in the context of heavy visual noise (static).

Figure 38 shows a 2-D representation of distinctive

feature overlap by handshape, based on normalized confusion frequencies across handshape.

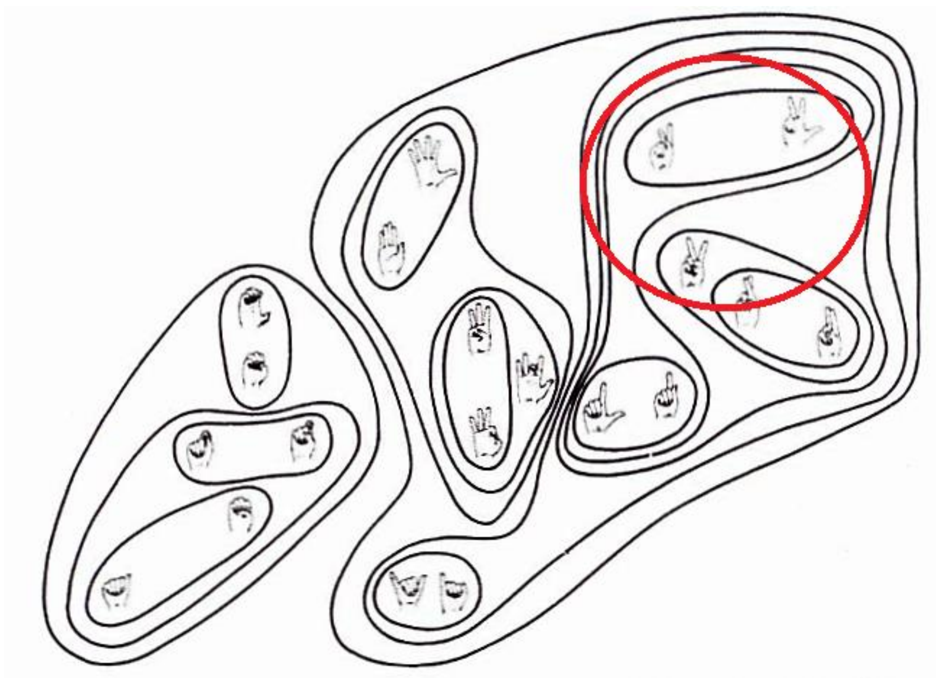

Figure 38) Lane et al. 1976 (p.280) figure depicting multi-dimensional modeling of 20 ASL handshapes. Figure has been altered to show clustering of V, K, and 3 handshapes

The upper-right corner of the figure highlights the close relationship between HS:3 and HS:V and HS:K. Thus we might come to expect that due to the closeness of their articulatory features V and K might have allophonic variations that are articulatorily closer to handshape 3 and thus perceived as such.

Returning to the corpus data, after collapsing the signs into types and removing the signs which were simple articulatory variants, a total of 21 signs were extracted which utilized the 3-handshape. Listed in Table 1, the signs are separated by handedness and symmetry and the greyed cells represent the signs which exhibit secondary movement, with repeated flexing of the index and middle fingers.

ASL-HS:3	1-handed	2-handed symmetrical	2-handed asymmetrical
	THREE-OF-US	AWKWARD	PARK
	VEHICLE	WALK	GARAGE
	LOUSY	GREEDY	SHIP
	SPIT[57]	MISCHEVIOUS	CHEAT
	ROOSTER	ACCIDENT	
	INSECT	DEVIL	
		RECEPTIVE	

Table 1) List of all HS:3 signs from ASLHD and Morford and MacFarlane corpus (grey =secondary movement)

Within this small number of signs, four major mappings emerge. The formal properties of the extended thumb, index, and middle fingers of HS:3 when no secondary movement is present, occur primarily in constructions which profile the numeral three and vehicles. While the mapping of HS:3 as the numeral three only occurred once in the data in the sign THREE-OF-US, in everyday usage we see that this mapping is quite robust as there are many constructions in which numerals denote number of days, weeks, months, years, age, number-of-times something is done, etc. The cluster of signs around the classifier construction use of HS:3, which is broadly construed as a vehicle-classifier, surfaces in the signs VEHICLE, PARK, and GARAGE. Historically, the extended fingers of this handshape were representative of the masts of a ship, hence the inclusion of the sign SHIP in this category. Later this handshape construal was broadened in scope to include all vehicles. PARK and GARAGE also exemplify another sub-grouping of figure-ground constructions in which the dominant hand profiles the figure and the

[57] Despite its dictionary entry, this sign is becoming seemingly infrequent in actual use, being replaced by a static F-handshape articulation or a dynamic baby-O→1 handshape change.

non-dominant hand profiles the ground.

For signs which contain secondary movement, the HS:3→HS:bent-3 alternation, two distinct patterns emerge, one which profiles the movement as ‘pulling material toward you’ in signs having to do with perception and receptions metaphor, and a pattern which maps the metaphor STRAIGHT IS CORRECT or well-formed and by analogy BENT IS ILL-FORMED. GREEDY and RECEPTIVE both profile ‘pulling material toward you’ though one is in the reception sense and the other in the perception sense. Other signs in this schema, though not occurring in this dataset, are PERCEIVE-BY-EAR and PERCEIVE-BY-EYE.

The metaphorical extension of BENT IS ILL-FORMED, though also not frequent in the corpus, is prevalent in ASL and not only in the HS:3→HS:bent-3 alternation. It also surfaces in HS:1→HS:X alternation as in SUSPICIOUS and in the HS:V→HS:bent-V alternation as in DOUBT. Signs with this formal instantiation of negative connotation of lack of form or lack or correctness associated with bentness was first described by P. Wilcox in her discussion of the metaphor IDEAS NOT FULLY IN EXISTENCE ARE BENT (2000, p. 101). Bent-handshapes in general then seem to have the ability to take on a negative connotation in some constructions, likely due to a higher level of abstraction over multiple form-meaning mappings which have overlapping negative association.

The Libras database contained only four tokens of the 3-handshape, none of which contained any secondary movement. The low type frequency of HS:3 in Libras is likely due to the fact that this handshape does not participate in a numerical construction relating to the number three, nor does it participate in the vehicle-classifier construction as Libras makes use of HS:W and HS:B in these constructions respectively. However, since the Libras database is not based on real usage, the representation of frequency of handshapes is static. Furthermore, though it gives a rough estimate of well-accepted and historically accurate usage, representation of language change and contemporary usage is not always accurately reflected. Observation of contemporary Libras paints a different picture of the current distribution and usage of the 3-handshape which I will briefly discuss below.

It seems that this low-frequency handshape is experiencing a surge in usage. Though likely precipitated by basic articulatory factors, HS:3 provides an interesting example of language users creating an externally motivated construal that is not *historically* motivated but synchronically reanalyzed (personal communication, Elidea Bernardino). Libras signers seem to have started to use the 3-handshape in place of the canonical HS:V for the CL:V-walking-human. As we saw, there are several core signs in Libras which arise from the lexicalization of this CL:V representing legs, as in the signs PASSARELA-PARA-PEDESTRES, 'pedestrian walkway' or ANDAR-A-PÉ 'to go-by-foot' both of which utilize the V-handshape to articulate human legs. However, Libras signers were observed articulating classifier constructions with 'walking-people' utilizing a 3-handshape. While no formal count was taken, the impression left was that the frequency with which the 3-handshape is used may be taking over as compared to its V-handshape counterpart.

While this alternation seems to have arisen out of basic coarticulation processes, signers have begun to re-analyze this phonetic extension of the thumb as having semantic properties. Consequently, several examples arose where signers utilized the extended thumb to represent the arm of a person walking. Below in Figure 39, the first signer represents simple allophonic variation, where canonically we would expect 'walking' to be formally instantiated using HS:V but here we see that a simple thumb-extension changes the articulation to HS:3. In the second example, the signer exhibits semantic reanalysis of a purely phonetic feature, and utilizes the extended thumb as a point of reference, as he uses a deictic to refer to the elbow of the person walking. The third example also shows a semantic reanalysis of this contemporary variation as the signer uses the dominant hand, with the initialized D-handshape for DEUS ‘god’, to grab the extended-thumb, taking the hand of the person walking to lead him.

Figure 39) Libras signers articulating HS:3 in a) allophonic alternation of HS:V; b) reanalysis of thumb as arm; c) reanalysis of thumb as arm/hand capable of being interacted with by an agent

In ASL, while we find similar examples of co-articulation of the thumb in this prototypical V handshape mapping of walking, no externally verifiable example of this allophonic variation were found in which the thumb was reanalyzed by a signer as a meaningful feature. An articulatory variant of the ASL sign PERSON-WALK articulated with the extended thumb can be seen in Figure 40.

Figure 40) ASL PERSON-WALK with allophonic variation, extended thumb (Daily Moth)

This is an excellent example of how construal affects even purely phonetic motivation and in turn suggests that previously held assumptions regarding the tendency of iconic mappings or iconic representation to reduce over time (Frishberg, 1975), are not necessarily true. While articulatory pressures can trump externally motivated mappings, and thus drive iconicity into other parts of the construction, phonetic variation can also create the opportunity for new construals which make use of iconic mappings. Thus, while one could argue that HS:3 arises for phonetically motivated reasons, and is a less iconic representation for profiling a person walking as compared to HS:V, Libras users have re-construed an unmotivated phonetic property as having language external motivation in which case the extended-thumb in HS:3 can represent an arm, while the extended fingers continue to represent legs.

4.4 Study 1: Summary

The purpose of study 1 was to discover whether handshapes, previously posited as phonemes with no-intrinsic meaning, were distributed freely among the lexicon, or if handshapes pattern with consistent semantic mappings. My findings show that the distribution of handshape, rather than being randomly distributed across the lexicon, cluster around schematic semantic categories and that these handshapes adhered to at least two, but in some cases many more form-meaning patterns, the majority of which also exhibit sub-patterns. Results of the data analysis of static handshapes in ASL and Libras support the initial findings from the pilot study in that semantic groupings emerged for each of the handshapes in question.

4.5 Chapter 4 Discussion

When examined from a cognitive phonology approach, it is quite clear that these groupings arise from the abstraction of similarities across recurrent form-meaning mappings of usage-events. Importantly, we have seen that mappings between form and meaning are not just one-to-one mappings of an iconic form to a referent. Instead, formal properties of handshape can be construed as many-to-one mappings between semantic schemas and form schemas. Study 1 also suggests that these many-to-one mappings often profile different construals of the formal properties of a handshape which in turn maps to language external construals. Additionally, the mappings do not always rely on concrete, visible properties which are objectively observed by the user. Instead, due to the nature of construal, form-meaning mappings can cover a range of abstractness from concrete to metaphorical, and can profile any feature of the articulation to establish these mappings as seen in the *hand-as-hand* schema, which includes the metaphorical extension of FEELING IS TOUCHING.

In our small sample of static handshapes, it was perhaps no surprise that HS:claw:5, as a member of the highest frequency category of handshapes, exhibited the highest number of stable form-meaning mappings in ASL. Handshape-3 represented the lowest frequency quartile in ASL, but its participation in the Vehicle-classifier-construction and the Numerical-construction greatly increased its number of mappings. As Libras does not make use of HS:3 for numerical constructions or for vehicle-classifier constructions, it exhibited a much lower frequency, and a fewer number of form-meaning mappings. While one could posit that more frequent handshapes participate in a greater number of form-meaning mappings, this remains to be tested in a larger data sample. But as seen with HS:3, its token frequency was greatly increased by just a few types which were representative of frequent constructions. Thus, like spoken language, it seems that individual languages may have higher token frequency of ‘phonemes’ which are typologically infrequent, due to their appearance in frequent words. Such is the case with / ð /, which is comparatively rare across the world’s languages, but because of several function words which utilize this sound, has a high token frequency in English.

There is also likely an interaction between simplicity of the handshape and the number of construals in which it participates. The more complex a handshape, the fewer the number of ways that handshape can be construed as profiling semantic properties; however more simple handshapes, such as HS:claw-5 are free to participate in many form-meaning mappings because there are several ways in which the aspects of the handshape are profiled and several construals which can attribute semantic prototypes to those features. Thus, the more complex a handshape, for example HS:R, which is articulated with the index and middle fingers twisted as in the American gesture ‘to hope’, the less available it’s features are for a variety of construals. Case in point, HS:R seems to only participate in the ‘R-construction’ and the ‘braided-thing-construction’ in which case it is either initialized as in ROPE, or indexing the twisted nature of a braided thing, in the ASL sign BRAID (Lepic, 2015). I suggest that this is due to the complexity of its form, as it does not lend itself to a host of other construals.

If we extend our analysis beyond handshape to include location and movement parameters, we can easily see tendencies toward one-to-many form-meaning mappings and therefore can predict that the same holds for all parameters. For example, circular movements can map to circular movements as in HOUR, which profiles the hands of the clock, it can also map to delineation of inclusion of participants as in THREE-OF-US versus THREE-OF-YOU, and again as a marker of continuous aspect as in LOOK-AT.DURATIVE. That is, the nature of construal of the articulators facilitates and encourages many-to-one form-meaning mappings. There is nothing about a given form that forces or necessitates any given mapping, each form is subject to identification of several possible patterns based on visual characteristics, including shape, movement, etc. For example, the temple can be itself, it can be metonymically extended to profile the brain, or metaphorically extended as the center of consciousness and thought, as in THINK and KNOW. The forehead can also be extended from profiling the seat of thought to the seat of government, as in CAPITAL and POLITICAL. In this way, the location parameter 'forehead' has several stable meaning-mappings associated with the single form.

While it is not necessary for every instance of a handshape in a given construction to pattern with an identifiable semantic schema in order for cognitive phonology to be a useful explanatory tool, it seems to be the case that these patterns are indeed robust and account for the vast majority of forms. Figure 41 demonstrates how individual usage-events form low-level schemas.

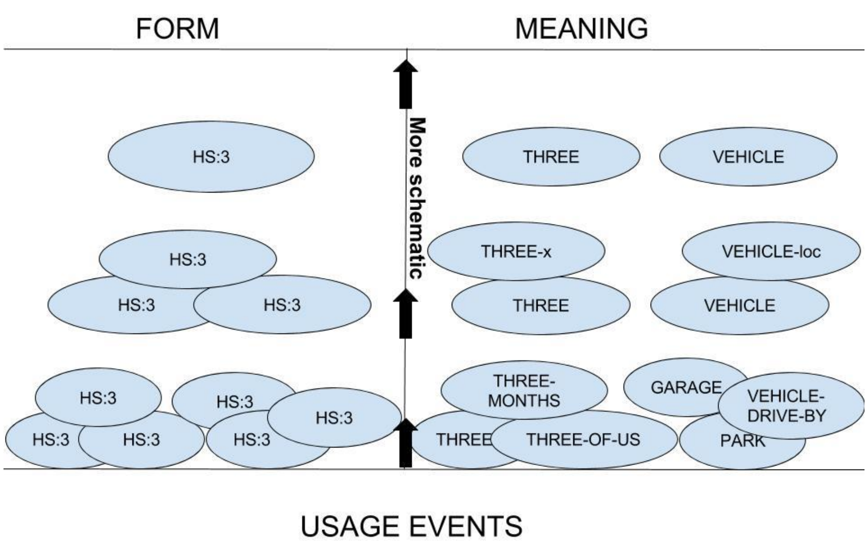

Figure 41) Schematization of symbolic units with HS:3

Through repetition of individual instantiations of these sign constructions, schematic similarities begin to emerge across constructions, begin to cluster into sub-schemas, and eventually become more abstract schemas with broader generalizations across a wider array of constructional events. This abstraction process is at the heart of understanding a usage-based approach to both the emergence and schematization of such mappings.

Armed with the knowledge that distribution of static handshapes seems to be influenced by recurrent form-meaning mappings arising from usage-events across sign constructions, I extend this analysis to investigate signs with dynamic handshape. In chapter 5, I explore whether the distribution of sign-internal handshape change is influenced by similar schematization of form-meaning mappings or whether the distribution of sign-internal handshape change is randomly distributed and governed by phonotactic and well-formedness constraints which make no appeal to semantics.

Chapter 5

5 Sign-Internal Handshape Change

The second study focuses on what signed language linguists often refer to as sign-internal handshape change; I will simply call this handshape change. Handshape change by definition occurs within the articulation of a single sign when the articulation begins with one specified handshape and subsequently changes to a second handshape. There are several possibilities for the combination of initial and final handshapes; however, the combinations do seem to be restricted in some ways. Battison (1978, p. 52) reported that for ASL 87.7 percent of signs with handshape change contain at least one unmarked handshape (HS:B, A, S, O, C, 1, 5), and in 63.2 percent of the cases contained two unmarked handshapes.

Handshape change is generally broken into two types: handshape contours and handshape contrasts. For the purposes of this dissertation I focus on the former, which are defined as open/closed variants of the “same underlying handshape” (Sandler, 1989). That is, selected fingers are only specified once per sign, and as such the initial handshape is underlyingly “the same” as the final handshape except that they are open and closed variants of the handshape. For example, ASL STUBBORN (Figure 42), articulated with a closing HS:open-B → HS:open-A, one needs only to close the aperture of the extended fingers to arrive at the second handshape.

Figure 42) ASL STUBBORN, HS:open-B --> open-A

Handshape change is generally described as being governed by well-formedness conditions of syllable structure. For example, it is said to be ungrammatical for a sign to change handshape from an open-to-open articulation or closed-to-closed articulation, or to change sets of selected fingers. These kinds of handshape change are said to violate both phonotactic constraints and well-formedness constraints. In contrast, I propose that well-formedness conditions of syllable formation and phonotactic constraints are simply descriptions of frequently occurring patterns; they do not drive the emergence of the patterns themselves. I suggest that these patterns arise as a side-effect of recurrent motivated mappings between formal properties of the handshape change and image schemas. This fact is fundamental to understanding why some patterns of handshape change occur, while others do not.

If current models are correct, then we would expect no semantic correlations between signs which happen to share the same open-closed or closed-open handshape change. If, however, these patterns emerge based on motivated mappings such as formal instantiation of image schemas, then we can argue instead that these changes in handshape are rooted in semantic mappings, rather than in well-formedness or phonotactic constraints. Using such an analysis allows us to gain insight into the organizational underpinnings of signed language formal structure, and makes for important generalizations concerning the patterning of form and meaning.

To investigate these claims I focus on pervasive patterns of handshape change involving the opening or closing of the hand, each with two patterns. I examine two closed-to-open handshape changes[58], in which the sign begins with one of two closed handshapes HS:flat-O and HS:S and end in HS:5, as well as two open-to-closed handshape changes, in signs which are

[58] To indicate change in handshape, the notation HS:(x)→ HS:(y) will be used where the arrow represents change in handshape.

formed with the primary articulation beginning with HS:5 and closing in the secondary handshape into one of two handshapes, HS:flat-O or HS:S (Figure 43).

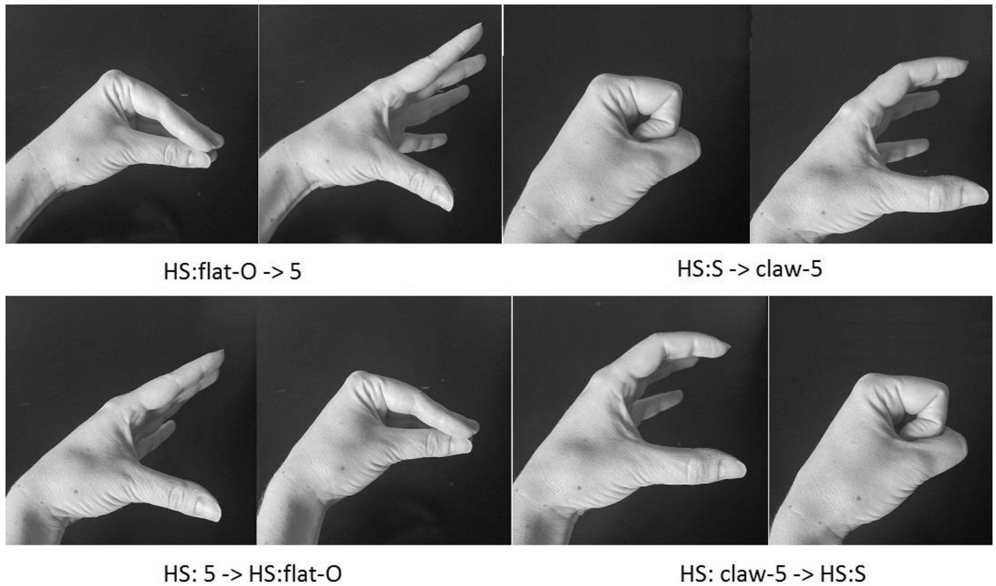

Figure 43) Open to closed and closed to open handshape articulations

5.1 Study 2: Handshape change in ASL

Tokens for sign-internal handshape change were again extracted from both the ASL corpus and Libras database.[59] Tokens of these four handshape changes were extracted from the Morford & MacFarlane (2003) ASL Corpus including tokens of core frozen lexical items, classifier constructions, and lexicalized fingerspelling, excluding fingerspelling and name signs. A total of 475 signs were extracted having been coded for a differing initial and final handshape, making up 12% percent of the corpus. This selection of signs takes a broad definition of phonological handshape change broadly, ignoring previously defined divisions of secondary movement versus sign-internal handshape change proper. However, since this analysis includes only a sub-set of opening/closing patterns, such divisions have no bearing on the data analysis.

[59] See chapter 4 (4.1.1 & 4.1.2) for Corpus information and Coding conventions

Suffice it to say, from a cognitive phonology perspective, it is likely that all types of sign-internal handshape change, including secondary movements such as trills, carry some functional semantic load.

Due to variation in the usage data, some signs appeared multiple times in the corpus with slightly different annotated forms. Thus, signs such as SEND alternated between articulations which began with HS:flat-O→5 and HS:O→5. In these cases, I returned to the data to extract additional tokens with these potential allophonic variations, bringing the total number of signs extracted to 94 tokens which reduced to 52 types. Due to the variation in articulation some allophonic variations caused a doubling of type entry for signs. As these entries were represented twice in the phonetic data but occurred as tokens of a single open-closed or closed-open pattern, I then removed these doubles from the list. This decision was made after the coding process was complete, as it became clear that they were still representative of a single semantic mapping. Additionally, HS:A→5 and HS:5→A were also originally extracted as closed-open and open-closed articulations, but due to low token count across both ASL and Libras datasets these alternations were excluded.

ASL tokens extracted from the Morford & MacFarlane corpus were coded for recurrent semantic mappings by two independent coders. Inter-coder reliability was calculated using Cohen's Kappa which reached 0.89 (95% CI: [0.79, 0.99]). The data was then analyzed according to the semantic mappings identified by the coders. Clear patterns emerged from the data which suggested that the phonological alternation of handshape change was indeed motivated by conceptual categories represented at the phonological level.

Extracting the same four alternations from the Libras corpus resulted in 61 overall tokens, 38 tokens of open→closed and 23 tokens of closed→open. There was also at least one sign, BONITO ‘beautiful’, which seemed to be variable between HS:5 → (A or flat-O). As in the ASL data, because the alternation still adhered to a single schematic articulation of open-closed, only one was counted in the overall type frequency. Access to multiple coders was not available for the Libras data, therefore a single signer provided coding for the dynamic handshape change; no inter-coder reliability measure was completed.

5.1.1 Emergence: Closed-Open articulation patterns

Beginning with the closed-open articulations, ASL data had a fairly equal distribution of S→5 and Flat-O→5 handshape changes with 31 signs articulated with a closed-open pattern, 18 flat-O→5 articulations and 13 of which were articulated with the S→5 change. An overwhelming 20/31 signs grouped under a single mapping, which I call *emergence,* a conceptualization I will expand upon below. The *emergence* schema also contained salient sub-schemas which cluster around certain prototypes. Examples such as GROW and SWEAT embody the mapping of *physical emergence* in that a physical entity emerges from containment. LIGHT, while more abstract, still profiles emergence of a physical release of matter, though not a manipulable one. Metaphorical extensions of this mapping includes the emergence of non-physical entities but emotional or mental ‘objects’. Signs such as INSPIRE and POETRY profile the emergence of a contained substance which is of the expressive, emotional sense. The ASL sign OBVIOUS exemplifies a metonymic extension, in that the emergence schema in this sign maps the emergence of light, which in turn ‘makes clear’ the issue at hand.

Another schema that participates in the closed-open mapping is the *hand-as-hand* schema, which we have seen above in the static handshape data. In this sub-schema, which I refer to as *grasping as possession,* the closed hand maps to the containment of an object and by extension the possession of that object. In this sub-schema, the opening of the handshape profiles the release of possession, as seen in SEND. This physical release can then be metaphorically extended as seen in INFORMATION and LET-ME-KNOW, which profile the hand as holding metaphorical information or knowledge contained in the head, which is let go of once the handshape changes from closed to open. The remaining closed-open articulations in the ASL data mapped to the basic *grasping* schema which simply profiles the manual movement of objects but does not profile the possession or the emergence of entities as in MOVE, MOVE-PERSON, and USE-ASL.[60] Finally, six signs were coded as 'no', meaning that handshape did not contribute to the meaning of the sign.

Libras exhibited similar constructions within the closed-open handshape change data, including the *physical emergence* schema, in signs such as VOMITAR 'vomit' and BALEIA 'whale', which is articulated at the top of the head with a flat-O handshape which opens to a claw-5 handshape – profiling the water spout emerging from the blowhole when the whale exhales[61]. *Hand-as-hand* schematic mapping which extended to *grasping as possession* schema, profiles opening of the hand as release of control were seen in the Libras data in DADOS 'dice', which is also metonymic in that the act of releasing the dice stands for the dice. The metaphorical extension of physical emergence of an entity to an emotional release also occurs in signs such as POEMA 'poem' and EXPRESSAR 'to express'.

Table 2 shows the overall distribution of both closed→open handshape alternations for ASL and Libras. While ASL displayed an even number of tokens for both patterns, Libras exhibited almost three times as many instances of S→5 as Flat-O→5 handshape change. It is unclear what drives this phenomenon. Perhaps, it is the simple robustness of one schema over the another, as it seems that only one of the six tokens of flat-O→5 in Libras mapped to 'hands' and

[60] It is possible that USE-ASL can be construed as also belonging to the 'emergence' schema if one construes the opening and closing of the hands in the sign as 'releasing language' or 'releasing information'.
[61] The selection of what is profiled is a complex issue beyond the scope of this chapter however it entails selection from a domain, or semantic frame that is highly salient as an aspect of its domain either culturally or that it highlights contrastive elements as related to other frames and is thus highly representative of the meaning.

as such may be less accepted as a prototypical instantiation of the *hand as hand* schema. Of the 17 tokens of S→5 in Libras 13 of the 17 (76%) patterned with the *emergence* schema. Three types patterned with the *shape* schema which maps the shape of the path movement drawn as the handshape opens to the shape of the objects, in this case all fruits and vegetables, as in the signs PERA 'pear' COUVE-FLOR 'cauliflower', and PIMENTAO 'pepper'.[62]

HS Change	**ASL**	**Libras**
S → 5	13	17
Flat-O → 5	18	6
TOTAL	31	23

Table 2) Total occurrences of closed to open handshape change alternations across ASL and Libras

Containment is a common image schema (Johnson, 1987). *Containment* necessarily includes the structural elements of INTERIOR, BOUNDARY, EXTERIOR, and is so pervasive that it structures many of the ways in which we conceptualize our world. We view our bodies, our relationships, our minds, even our existence in the world as containment (Lakoff, 1990). Image schemas are structured wholes; their gestalt structure makes them more of the sum of their parts, much like linguistic constructions. It makes sense then that if we are to view signs as constructions, whose form-meaning mappings are more than the sum of their parts, that signs, like constructions in spoken languages, are able to encode complex image schematic properties of the world. This allows linguists to use tools such as image schemas or force dynamics (Talmy, 1988) not just to describe how humans encode physical, social, and psychological interactions

[62] One type was not identifiable as participating in a semantically motivated schema by the informant.

within the semantics of a language, but to describe formal patterns which diagrammatically map these conceptual structures. The formal properties of signed languages allow language users to encode image schematic mapping, handshape change to construals of conceptual structures.

Returning now to the proposed e*mergence* schema, we can see that it uses the basic image schemas of CONTAINMENT, PATH, AND ENTITY, and is therefore a type of complex image schema. Only something that is first contained can emerge from its container. This 'emergence' thus profiles the path of an entity from inside a container to outside of that container. Interestingly, this schema is instantiated in many constructions, which are beyond the scope of this chapter; however, *emergence* as an image schema, like *containment,* necessarily implies two entities — a container and a contained thing. It is interesting then to note that several of the formal properties which encode the *emergence* schema involve either two articulatory operators, such as dominant and non-dominant hand, or dominant hand and body. It seems that the dominant hand in both instances profiles the figure, while the non-dominant hand or the body profiles the ground. Thus the articulator with the most degrees of freedom is free to change its shape against the background of the less dynamic articulator. The profile of both *emergence* and *containment* in many cases is essentially a conceptual 'change of state', which we see reflected in a change in the formal properties as in the sign-internal handshape change.[63]

This observation is not unlike the previously mentioned example from Lepic, Börstell, Belsitzman, & Sandler (2016) who observed that two-handed signs cross-linguistically pattern with concepts for which two entities are profiled, such as verbs with multiple participants, or figure-ground relationships. As we saw in the static handshape analysis, HS:3 had several tokens of two-handed signs which profiled a figure-ground relationship between the *vehicle* construal of

[63] Brennan (1990) has referred to grouping of signs with handshape change as having shared underlying "metaphors".

HS:3 and a backgrounded entity. Signs such as GARAGE or PARK, in which the non-dominant hand articulates a flat HS:open-B, profile the ground as related to the figure (the vehicle) as the flat-B-handshape profiles the roof of the garage and the ground of the lot respectively. Correspondingly, signs with handshape-change also participate in figure-ground mapping in signs such as GROW, which profiles the figure on the dominant hand and the ground on the non-dominant hand, and in signs such as POERTY in which the dominant and non-dominant hands together profile the emergence of substance (the figure) from the body (the ground), both through the path motion away from the body and in the opening of the hands.

If we return to the ASL example GROW, we can observe the coordination of constructions in the figure-ground construction instantiated by the dominant hand as the figure as it emerges from the non-dominant hand (the ground) by breaking the imaginary plane of containment. As the dominant hand rises, the handshape opens and the fingers spread, mapping a secondary *emergence* schema as the fingers go from closed (contained) to open (emerged). This coordination of multiple constructions coming together in a single sign has been noted for spoken language by Goldberg who suggests that, "An actual expression typically includes the combination of at least half a dozen different constructions," (2013, p. 28).

When considering signs as constructions, we realize that rather than static one-to-one iconic mappings, several schematic form-meaning mappings are simultaneously evoked to create complex motivated constructions. Constructional analyses lay bare the complex interplay of form-meaning mappings both in highly conventionalized signs, as well as in creative language use. Language users are well aware of what combinations of constructions are compatible, and in this way signers can make use of several schematic mappings in order to construct new signs, or use language creatively.

Recently, similar hand-opening patterns have been described by Cabeza-Pereiro (2014) for Spanish Sign Language (*Lengua de Signos Españoles* or LSE). Cabeza-Pereiro identified two schematic form-meaning mappings which profile the "appearance or creation of something" and "getting rid of something." Looking at seven instances of closed-open articulations, she found that two handshapes (roughly equivalent to ASL flat-O and baby-O articulated with index and middle finger) did not show evidence of either identified schema; the remaining five handshapes (roughly equivalent to ASL HS:F, HS:O, HS:baby-O, HS:E, and HS:precision-grip' (Figure 44), adhered to the schematic meaning of *creation* or *appearance*. Signs which exhibited characteristics of this form-meaning mapping from the LSE database were signs such as IDEA, NEWS, CREATE, EXPRESS and LIGHT. The opening of the handshape is schematically associated with emergence, or appearance of some entity or element, i.e. ideas or news emerge or are released from a source, something emerges from a source as it is created or expressed, light is emitted from a source.

SEA Notation	Glossed LSE Example	Handshape
iä	IDEA	
oä	LECTURE	
äe	PILL	
ö	RESIGN	
aë	WASTE	
äei	WALK	
ô	GOOD	

Figure 44) Closed-open handshapes investigated in LSE (Cabeza-Pereiro, 2014, p.321)

Cabeza-Pereriro then compared this data with the BSL data from Brennan (1990) who suggested that these opening handshapes pattern with the metaphor of *emission* or *emanation* and can be seen in signs such as MAGIC, SPEND, and DISCHARGE. Though the labels given to the schemas are not the same as the schema labels used here, the data from LSE and BSL have a large degree of overlap with the proposed schema of *emergence* presented in this chapter. As such, this should be taken as evidence that this schema has been shown to exist in four different signed languages. This cross-linguistic similarity suggests that signers exploit similar image schematic mappings as they construe events in the world and map them to construals of articulatory scores. Influence from embodied interactions with the world in which things emerge from containers, and where closed hands grasp objects and then open to release them, allows for functional articulatory scores to be co-opted for linguistic articulations which schematically map similar semantic construals.

5.1.2 Containment: Open-closed articulatory pattern

Turning now to the open-closed alternation, 51 signs were extracted with this articulatory pattern for ASL, and 38 signs from the Libras database. The open-closed articulation showed more articulatory variation than the closed-open alternation; as a result, four separate articulatory patterns were extracted, rather than two. This was done so as not to collapse articulatory patterns that may have participated in different schematic mappings.

Overall, the most frequent open-closed pattern for ASL was for HS:claw-5→S; however, Libras only contained two examples of this articulatory pattern. Distribution, of HS:5→flat-O and HS:5→S seems to have a fairly equal distribution across both languages, with the ending handshape-flat-O being slightly more frequent in both ASL and Libras. The HS:claw-5→flat-O articulation only occurred three times in ASL and had zero occurrences in Libras, this may reflect that this articulation is a simple allophonic variation.[64]

39/57 ASL signs (68%) instantiated a single schematic mapping, relating to the concept of *containment*. The Libras database yielded 71% adherence to the *containment* schema, while only 7 tokens of ‘other’, including PIMENTÃO ‘pepper’, which patterns under the *shape* mapping, where the closing of the articulation maps the tapered shape of a pepper. Table 3 compares the totals for each open-closed articulatory pattern examined across ASL and Libras.

HS Change	ASL	Libras
5→flat-O	16	20
5→S	14	16
Claw-5→flat-O	3	0
Claw-5→S	18	2
TOTAL	51	38

Table 3) Total occurrences of open to closed handshape change alternations across ASL and Libras

Like *emergence, containment* is a complex conceptual structure composed of several structural elements which are themselves image schemas. There is a sense of uncontained entity which is gathered/contained, which allows for the conceptualization of the closure of hands as the movement of an entity from an uncontained state to a contained state. The *containment* schema can also be broken down into sub-schemas of *accumulation* (15 types) and *grasping* (24 types), although it is likely that the *accumulation* schema is actually a sub-schema of grasping. What is important for our purposes is that both *accumulation* and *grasping* schematically map

[64] This articulation requires the change of bent carpal and metacarpal joints to straight metacarpal joints during the closing articulation, and as such may be less articulatorily preferred to the other open-closed articulations.

the closure of the handshape to the containment of an entity, whether it is a person, emotion, thought, or other abstract entity. Only 11/57 (19%) of the open-closed articulations mapped construals other than *containment*. Five signs mapped closure of handshape to *simple closure* and six tokens mapped to *shape*. Six signs were not sanctioned by a schema (Figure 45).

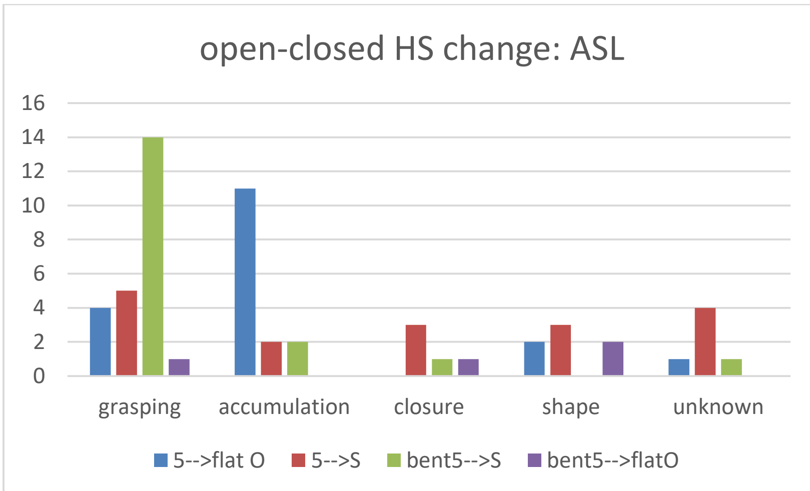

Figure 45) open-closed HS change in ASL

I propose that the prototype for the open-to-closed schema lies in the *hand as hand* mapping in which the articulatory closure of the hand maps to the actual closure of the hand, as seen in USE-ASL in which multiple closing and opening of the hands reflects the actual opening and closing of the hands; however, this very broadly construed schema is then extended in multiple ways, including *grasping* (24 tokens) and *simple closure* (5 tokens). While this basic schema did not exhibit as many tokens as were seen in the closed-open mapping, the extension of ‘closing hand as grasping’ was very frequent. The prototype of this schema, GRAB/GRASP, gives rise to metonymic extensions of this mapping. In tokens such as DRAWER, the motor action closing the hand to grasping the drawer is extended to the nominal representative of the action.

A slightly more abstract notion of grasping can be seen in the ASL signs GET, ACCEPT and ADOPT in which case rather than simply profiling the act of closing the hand to grip an object, the metaphorical extension GRASPING IS POSSESSING profiles the act of holding something physically as having possession of that object. This is interestingly, a common grammaticalization pathway in spoken language as well, languages often begin with ‘hand’, and grammaticalize into a marker of possession (Hopper & Traugott, 2003, pp. 166–67). Further, the possession construal is also extended to POSSESSING IS CONTROLLING in signs such as CATCH-A-PERSON and ARREST in which case the closure of the hand represents the capture or ‘gained control’ over a person. In this sense that which we physically hold becomes that which we control or hold dominion over. In Egyptian, ‘in the hand’ is extended to mean ‘in possession of’ and ‘in charge of’(2003, p. 167). The mapping of *grasping* can also be extended to refer to some sort of *gain* where possession of an object is likened to an increased benefit. In signs such as WIN we can construe the grasping as grabbing the victory, or more concretely a trophy, and in CHERISH the grasping can be construed as holding on to what is dear or precious.

Libras seems to have a similar set of extensions, at least in the sense that there is an extension from the physical act of grasping to the mental act of controlling. Noticeably absent are signs which have to do with physical control over other entities. In this data set, nine tokens of *grasping* schema were extracted. As can be seen in signs ALCANCSAR ‘to grab’ and AGARRAR ‘to catch’ (Figure 46) the closing of the handshape change does indeed get instantiated in the *grasping* schema, and the mental extension of ‘control’ can be seen in signs such as HIPNOTIZAR ‘hypnotize’.

Figure 46) Libras AGARRAR 'to catch' utilizing the grasping schema

A second sub-schema of the *containment* schema is the *accumulation* mapping, which construes the closure of the hand as gathering or accumulating previously disparate matter or autonomous entities into a managed or centralized state of being. As mentioned above, it is possible that this schema is actually a sub-schema of *grasping* in that the extension of gathering of objects can be construed as being executed with the hands, although it seems for most instantiations of this schema, the notion of 'hands' is no longer profiled. Fifteen ASL and 16 Libras signs exhibited this pattern. Signs such as ACCEPT, ADD, INVOLVE, TOTAL, and SUM (Figure 47) exemplify this sub-schema. Libras ABSORVER 'absorb' which profiles the containment of the liquid from an uncontained state and DESAPARACER 'disappear' also profile the accumulation/containment of a substance.

Figure 47) ASL SUM

Interestingly in the ASL data, only five tokens represented extensions of the mapping of *simple closure*, by extending the prototype ‘articulatory hand closure as semantic closure’ to represent the closing of other entities. This *closure* mapping can be seen in the tokens SLEEP, which maps the closure of the hand to the closure of the eyes, and GULP, which represents the closure of the throat or the constriction one feels when they experience a sense of strong emotion such as fear or shock. The ASLHD provides other examples of this *closure* extension, in the example SHUT-MOUTH, where the closing of the hand profiles the closing of the mouth.[65] The Libras example FOTOGRAFAR-ME ‘photograph-me’ profiles the shutter of a camera.

The *shape* schema maps the closure of the hand to tracing of the shape of an object, and profiles the tapering of an object. The ASLHD provided six tokens of this schema[66], including WOLF which profiles the shape of a wolf’s snout, PEAR which profiles the tapered shape of the fruit, and AFRICA which profiles the outline of the continent. In the Libras database seven tokens were representative of the *shape* schema including CASTELO ‘castle’ which profiles the towers of a castle, and MAMAO ‘papaya’ which profiles the shape of the fruit. One sign which was coded as participating in this mapping is perhaps more peripheral to the schema in that the movement is also mapping *movement.* The sign LULA ‘octopus’ profiles both the shape and the movement of the animal. Both OCTOPUS/LULA and WOLF/LOBO use the same open-closed handshape in ASL and Libras but neither language contained tokens of both signs in their respective databases (Figure 48).

[65] Several signers also commented that this mapping could be construed as ‘containment of speech’.
[66] Only one token of the shape-schema occurred in the Morford and MacFarlane corpus, however in the sense that while WHITE diachronically belongs to the shape-schema, synchronically is likely not a central member as the original motivation of a front-shirt-ruffle on a white dress shirt, is no longer salient nor culturally relevant.

Figure 48) Top: Libras LOBO 'wolf'. BOTTOM: ASL WOLF; both utilize HS:5→HS:flat-O articulation

HS:claw-5→S overwhelmingly maps to the concept of grasping, while HS:5→flat-O primarily maps to the concept of containment. While the mappings between HS:5→S are less robust, there is a slight preference for the use of this articulation for both the closure and shape mappings. Perhaps more importantly, this handshape is not well represented in open-closed mappings which profile containment or grasping. This seems to suggest that form-meaning mappings are highly specified. However, there is some conceptual overlap between extensions in that the *grasping as possession* schema and the *closure* schema arise from the mapping of closure of the articulator to closure of the hand, but the *closure* schema also maps onto the semantics of closure that is not related to the hand, which is also the extension of the *shape* schema, in which closure of the hand profiles the tapering of an outlined shape. Figure 49 captures the overlap in semantic extension within this larger mapping of open-closed articulations. Thus, the *shape* and *grasping as possession* schemas do not share the same underlying mappings.

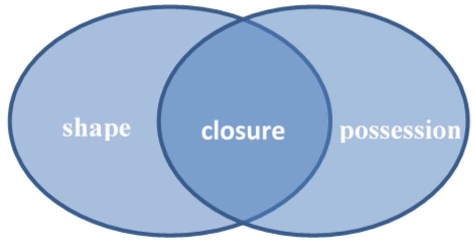

Figure 49) Semantic overlap of shape, closure, and possession schemas for open-closed articulatory variations

5.1.3 Study 2 Summary

In study two, I have aimed to show that open-closed and closed-open articulatory patterns emerge based on motivated mappings of form and meaning. Signs across a variety of lexical meanings, which at first glance may seem to be semantically unrelated, formally instantiate image schemas. Thus while the ASL signs POETRY and INFORM and the Libras signs AGARRAR ‘to catch’ and ABSORVER ‘absorb’ have little to do with one another, they schematically pattern together as signs which make use of the *emergence* and *containment* schemas respectively. Image schemas such play a central role in the structuring of concepts (M. Johnson, 1987) which are in turn encoded in the linguistic form of signs. Thus rather than ascribing distributional patterns to purely phonological well-formedness rules, we can argue instead that these formal changes in handshape are rooted in semantic mappings. Study 2 supports the findings from the static handshape distribution data in Study 1 (4.3). Both studies suggest that formal properties of signs schematize from usage events with their associated meanings, forming several many-to-one construals, motivated by language internal and language external patterning.

I have shown that a usage-based approach allows linguists to explain how specific form-meaning mappings arise in a given context, that is, it is the construction which allows for a given form-meaning mapping to be referenced. I have also endeavored to show that the way in which signed linguists have sometimes construed iconic mappings, as an isomorphic relationship between a form and a meaning, is not the case in any of the contexts examined. Instead, it seems that for any given parameter, a many-to-one relationship emerges depending on the profile of the semantic frame. Thus, it is not the case that parameters such as handshape are devoid of meaning, on the contrary, sign parameters are extrapolated from meaningful content and retain meaningful associations as they are extracted and abstracted. This point is made clear by the numerous complex clusters of form-meaning mappings which I have shown to be present in the distributional patterns of the handshape parameter in ASL and Libras.

5.2 Discussion

While not comprehensive, these studies give us a preliminary look into the ways in which construal of form and meaning contributes to the structure of the lexicon in language. The studies presented in chapters 4 and 5 investigated whether articulatory forms are randomly distributed across semantic space or whether the semantic associations play a role in the lexical organization of sign languages. If meaning had no role in the formation and organization of lexical units, then we would not expect to find the robust form-meaning patterns these studies discovered, in which the majority of signs examined clustered around schematic semantic prototypes. Findings from the investigation of the distribution of both static and dynamic handshapes have produced promising results, which suggest that meaning, and more specifically image schemas, contribute to the articulatory patterns of sign-internal handshape change.

Image schemas arise from our perception of the world, through our experiences with how our bodies move through three-dimensional space and interact with objects (Johnson, 1987; Lakoff & Johnson, 1980; Talmy, 2000). They provide us with pre-linguistic conceptual structures, which are then co-opted by language users and used to structure the linguistic system. Signed language articulators play a dual role, both as functional appendages which manipulate objects in the real world, and as linguistic articulators which produce language. There are marked differences between the overlap in shared functional and linguistic motor routines of the hands versus the vocal tract. Hands can grasp, pull, carry, hold, and manipulate objects, creating a myriad of functional motor routines which exist outside of language. Signed language articulators can also themselves be objects moving through three-dimensional space, interacting with other parts of the body as objects. Patterns of sign-internal handshape change which utilize open-closed and closed-open articulations take advantage of these motor routines in many ways.[67]

As we extend this analysis beyond the scope of these four static handshapes, and two articulatory patterns of sign-internal handshape change to other handshapes and even to locations and movement, we must consider how the general organization of conceptual material might impact the aggregation of form-meaning mappings. While it remains to be seen whether other phonological parameters will be more heterogeneous, so that there are fewer tokens for many more types of meaning schemas, or more homogeneous so that there are a greater number of tokens with fewer meaning schemas, multifaceted construals of form paired with metaphoric and metonymic extensions makes it seem unlikely that formal parameters of signs will have one-to-one mappings. Many handshapes participate minimally in both classificatory and depictive mappings, while others tend to pattern with initialization-constructions and classificatory mappings. It seems that rather than a single one-to-one mapping, two is the minimum number of mappings for any given handshape.

Keeping a cognitively oriented phonological analysis in mind, we must not ignore the

[67] Stokoe first made allusions to this view, describing the structure in signed languages in his treatise on Semantic Phonology noting, “one needs only to think of a sign as something that acts together with its action,” (2001, p. 438). Though Stokoe did not have the well-defined frameworks of cognitive linguistics to help structure the details of his approach, the conceptual groundwork was laid for a new way of thinking about signs.

role that articulation plays in the development and maintenance of the system; however, I believe I have given reason to caution a reliance on articulatory restrictions as the primary motivation for the organization of phonological systems. Of course, entrenchment of motor schemas and entrainment of motoric constituents exerts pressure on the formal parameters; however, these do not operate in a vacuum. While the description of formal patterns is an important endeavor, descriptions must not be taken as explanatory. Tendencies tell us about the current state of a system, but do not tell us why or how the system functions in its current state. Cognitively oriented approaches help us to understand how the system functions and why the patterns and current organization of the system are structured as such. For example, a purely formal description of handshape change which invokes well-formedness conditions and hierarchical feature organization tells us about the tendencies of what occurs in the system, but these formal approaches miss the relations between signs in the lexicon and cross-linguistically which make use of domain general mechanisms contributing to lexical organization. Likewise, language internal and language external motivations are rampant across languages and are encoded through diagrammatic and imagistic structures; however, for signed languages, the majority of attention has been paid to the imagistic phenomenon, likely because the visual properties of signs distract from the relationships between signs that are important in diagrammatic mappings.

It must also be said that the description of these form-meaning mappings are descriptions of tendencies and robust patterns, but I do not suggest that every sign can be accounted for through this analysis. Clearly there are several cases where other pressures on the linguistic system ‘beat-out’ the pull of language internal or language external form-meaning mappings. This emancipation is not only normal but is the source of new schemas and contributes to phonogenesis (P. J. Hopper, 1994). The loss of motivation, whether internal or external, is influenced by several factors including: frequency of occurrence in a given collocation, productivity of the pattern, cultural connotations/contemporary relevancy, number of competing mappings, and strength of phonological competitors.

Finally, as for markedness as the main driver of distributional characteristics of handshape, I believe this question is still open for debate. As previously suggested in this chapter, markedness, or more precisely frequency of occurrence, likely has a complicated relationship with simplicity or complexity of the articulatory form. Frequency of less complex handshapes such as HS:B and HS:V may be driven in part by the large number of construals associated with their formal properties. Conversely, more complex handshapes such as HS:open-8 may have lower frequencies by virtue of the fact that the complexity of the articulation discourages a large number construals. However, participation across a variety of constructions, not just core lexical items, raises the type and token frequency. As we saw with HS:3, which is considered a difficult to articulate handshape (Ann, 2005), and which represented the least frequent quartile of handshapes in the ASLHD data, an increased number of mappings was observed due to the participation of this handshape across a variety of frequently used constructions such as numeric-constructions and classifier-constructions. Further investigation cross-linguistically but also across constructions will help to clarify the relationship between markedness/frequency and individual handshape distribution.

Chapter 6

6 Conclusions and Additional Considerations

In this dissertation I have attempted to lay out a phonological framework that addresses the occurrence of motivation versus arbitrariness in sign language lexicons. Cognitive phonology brings together the theoretical tenets of usage-based phonology and Cognitive Grammar, focusing on how embodiment and construal contribute to the organization of language structure. I have suggested that by utilizing an approach grounded in cognitively oriented frameworks, we gain the ability to account for the emergence of phonemes from repeated usage-events. I have argued that cognitive phonology, as it has been described here, allows for more direct comparisons between signed and spoken language phonology, in that it can account for the prevalence of motivated mappings in signed languages, and the prevalence of 'arbitrary' mappings in spoken languages. Importantly, these differences are a matter of ratios of kind on a single continuum, from arbitrary to motivated, rather than a matter of different types of mechanisms at work across modalities.

I maintain as Bybee and others have that phonological structure, be it the syllabic, the phonemic, or the featural level, is emergent. Phonological content schematizes from usage-events in which form and meaning are encountered simultaneously, in the same way that other levels of linguistic structure emerge. Thus, the contextualization of phonemic content within meaningful utterances allows for traces of meaning to be schematized along with the phonetic content. This means that a cognitive framework includes not only truth-conditional semantics, but encyclopedic knowledge of the world, semantic domains, metaphorical cross-domain relations, and metonymic intra-domain relations. Additionally, this model stresses the importance of procedural articulatory knowledge, allowing for the construal of tactile and kinetic motor routines, and perceptual knowledge of how a form is visually and auditorily encountered, perceived, or articulated. These form-meaning relations are then schematized across all occurrences of a given form, which may lead to highly abstract form-meaning associations.

Meaning associated with highly schematized phonetic content has the potential to become so attenuated that it no longer appears to be meaningful at all. This is one possible outcome of the process of formal schematization in phonology however, it is also possible that language-external motivations ground a form in one or many of its meaningful associations, therefore maintaining a stronger connection between form and meaning. In these cases, though a formal property may continue to schematize at the phonological pole, the semantic pole maintains associations across these forms which do not become schematized to an unrecognizable extent. As I have argued, for signed languages, due to the three-dimensional visual properties of the articulators, the frequency of occurrence of this second possibility in the process of phonologization is higher and thus, signed languages seem to have more motivated form-meaning pairings.

In addition to proposing a framework for a cognitive approach to phonology, I have provided two case studies in which I investigate the implications of a phonological model which considers form and meaning together, as emergent properties of usage-events. First, I investigated the distribution of static handshapes in ASL and Libras and challenged whether traditional approaches, which privilege articulatory factors as the primary drivers of phonological organization, best account for the distribution of phonemes. All tokens of HS:claw-5, HS:V, HS:open-8, and HS:3 were collected from the Morford and MacFarlane ASL corpus (2003), the ASL Handshape Dictionary, (Tennant & Gluszak Brown, 1998), and the Xavier database of Libras (Xavier, 2006). Signs were coded for phonological features, and semantic domains.

The majority of tokens extracted for each handshape were found to belong to shared semantic domains, while very few tokens were not found to participate in such mappings. Additionally, these mappings suggest that different articulatory features are highlighted to profile different language external construals. For example, in the data on HS:claw-5, no fewer than six separate construals of the form were found to exist in ASL. The same phonemic handshape participated in six different mappings of form-meaning construals. Labeled for their featural profiles, these mappings are as follows: *curved palm* in which the palm of the hand is profiled as a convex/concave surface, *fingers* in which the fingers of the hand are profiled as straight elements which belong to a larger grouping i.e.) singularity, the *whole hand***,** in which the entire hand is profiled as a hand, either human or primate, *gaps between fingers*, in which the gaps between the fingers are profiled as non-compact, not-solid, or uncontained matter, and finally *gaps plus fingers*, in which the fingers interlock with each other, profiling interlocking components of objects such as gears, and by extension tight fit of adjoined objects.

However, while multiple construals of a single articulation are available, the selection of featural profiles for different semantic domains are not predetermined and thus may vary by language. While shared cultural conventions, and similar interactions with objects may lead signers in different languages to select the same profile from a given semantic domain[68], form-meaning mappings are not preexisting and only arise from construal of the articulators and construal of semantic content.

While the role of articulatory factors cannot be completely disregarded, the data presented here makes clear that the distribution and organization of sign forms is influenced by more than phonetic factors. Organizational patterns of robust form-meaning mappings were

[68] This may lead to the prevalence of similar form-meaning mappings across unrelated languages. For instance, many similar form mappings exist for the concept of woman and man across signed languages, where the signs for woman profile breasts while the signs for man profile facial hair.

discovered for each handshape studied in Study 1. The fact that handshapes are shown here to participate in many-to-one mappings between meaning and form demonstrates language-users' ability to construe articulatory features in various ways. Though handshape is traditionally determined based on contrastive phonemic properties, featural properties of signs can be selected to profile language external associations which once established, then pattern according to language internal associations. The semantic features that phonetic features profile seem to be those which are in some way prototypical with respect to a specific category or semantically contrastive domain features, in other words domain features with high cue validity (Rosch, 1978). This process creates clusters of meaning within a given phonemic handshape, imbuing signed languages with their characteristic motivated grammars.

In the second study, tokens for four different articulatory patterns of sign-internal handshape change were collected, including HS:5→HS:flat-O, HS:claw-5→S and HS:S→claw-5, HS:flat-O→5. Signs were coded for phonological features, and general semantic domains. The distribution of dynamic handshape change reflected the findings from Study 1 on static handshape distribution. The majority of tokens collected for each of the articulatory patterns of dynamic handshape change clustered around semantic prototypes. Like the static handshape data, handshape change data exhibited many-to-one mappings between several semantic mappings and a given articulatory pattern. Data from Study 2 supports the initial finding that articulatory factors, though likely to play some role in the organization of structure, may not be the determining factor for the distribution of handshape. Articulatory patterns for both static handshape and dynamic handshape change showed strong clustering tendencies around robust form-meaning mappings. Very few tokens from the sign-internal handshape change data resisted falling into an identifiable form-meaning mapping.

6.1 Motivation and the structure of the lexicon

Studies on static and dynamic handshape in the lexicon show that language-internal and language-external mappings play a role in structuring the lexicon. Language-external mappings, which are motivated by construal of conceptual archetypes characteristic of relations and properties of objects in the real world, interact in meaningful ways with language-internal motivations. The result is the ability of form-meaning exemplars to pull other forms toward them in conceptual space. While it is an empirical question as to whether overlap in form and meaning across constructions influences the semantic relatedness of concepts or their closeness in conceptual space, anecdotal evidence seems to suggest that at least for signers this may indeed be the case. For native English speakers, the concepts ‘fence’ and ‘prison’ may be only marginally semantically related, perhaps peripherally noting that prisons often have fences.

In ASL, the formational properties of FENCE and PRISON,[69] which are externally motivated by the construal of ‘bars or slats creating a physical barrier’, seem to strengthen the semantic association between these concepts, bringing them together in conceptual space. It seems that if the conceptualization allows for a motivated association, the formal overlap will strengthen or enhance this tendency. In spoken languages, this process may be stifled by orthographic convention which blocks these associations; however, children who are pre-literate often make such cross-domain connections. In one example, a child who drew a picture of a ‘Beluga whale’ attempted to label it ‘*blue*ga’ and colored the whale blue. If you have ever experienced viewing a beluga whale through the glass of an aquarium, you might note that they often appear blue from the reflection of the water. In another example, a young boy imagined that there were two types of ‘b’ in the English alphabet, a ‘regular b’ and an ‘elemeno b’ (P.C. S. Wilcox, 2014). In this construal, the phonological string of the pronunciation of the letters ‘l’ ‘m’

[69] Both signs are articulated in neutral space with two hands in the HS:4.

‘n’ and ‘o’ when said in fast speech /ɛɫəmˈənoʊˌbi/, amounted to a modifier describing the second type of ‘b’ in the alphabet, but most importantly, the phonology and semantics, i.e. the perceived construction of Adj-Noun, allowed for such an association to arise.

However, this phenomenon is not only restricted to language acquisition contexts. More than fifty years ago, Bolinger (1965b) had already identified this phenomenon in natural adult language. Applying the label “morphosemantic constellations” Bolinger pointed out that in the context of two or more forms in which the forms, “coincidentally resemble one another in both form and meaning,” that the overlap results in the two forms, “drawing closer together and pulling other forms into their orbit” (1965b, p. 59) . Bolinger gives examples from English, suggesting that *bulge* has had an influence on *divulge* and *indulge* imparting a sense of “expansiveness” where there formerly was none. Additionally, he cites morphosemantic constellations in Spanish where we find clusters such as *derrabar, derramar, derrenegar, derrengar, derretir, derribar, derrisión, derrocar, derrochar, derrotar, derrubiar, derruir,* all of which participate in the meaning of “bring-down”, “mistreat”, or “destroy”, all cases of negative affect.

These claims are supported by the work by Bybee and Eddington (2006) who utilized a multi-dimensional scaling model to show that Spanish the adjectives used with different verbs of becoming cluster in predictable ways around shared semantic properties which are likely reinforced and molded according to other frequent members of the category.

The strength of association between the grounding element of the language-external mapping and the formal phonetic properties of a sign also influences language-internal associations. The continuous reinforcement from language-external mappings may infuse signed languages with recognizable iconic mappings, allowing for schematization of constructions while maintaining anchors to semantic content. This in turn grounds the articulatory properties of the language in schematic construals of external mappings, such as "flat hands map to flat surfaces" or "closed tight fists map to solid, objects". One such example of this language-external reinforcement of language-internal associations can be seen in the family of signs which share the construal of HS:V with inverted and extended pointer and middle fingers as two-leggedness. This family of signs, which includes STAND, JUMP, DANCE, and FALL, are internally motivated by associations shared across form-meaning mappings, but are externally grounded in the construal of two-fingers as representing a construal of two-leggedness. As suggested by Anible (2016), the sign STAND acts as a “phono-semantic anchor” for this group of signs. The extension of two-fingers is a good way to formally represent two-legs (and likely always will be), thus this remains a robust mapping despite frequent usage. In 4.3.3 we saw that this mapping of two-fingers to two-leggedness withstands the loss of iconic mapping even in the face of articulatory pressures which result in thumb-extension, thereby creating an alternation between the HS:V and the HS:3. In this case we see that the robustness of the mapping persists, rather than a loss of iconicity in the face of articulatory variation, the thumb is re-analyzed in the Libras examples in (chapter 4, Figure 39) as an arm. Thus, the form-meaning mapping is simultaneously internally reinforced, through the reoccurrence of mappings across forms which have the shared form-meaning mapping of two extended fingers and two legs, but also externally ‘re-motivated’ by reconstruing the variable articulation with the HS:3 as a representation of three, rather than two, limbs.

6.2 Sign vs Spoken languages: Iconic motivations

Why might there be discrepancies between how signed and spoken languages encode these externally anchored iconic motivations? The simplest answer is, because humans are visual beings navigating our way through our visual world and we understand our relationship with the world through our interactions with visible matter. Since we rely mostly on sight to make sense of this relationship, our ability to iconically represent these relationships is much richer in the visual modality. Sound makes a poor medium for iconic mappings (though this is not the only type of iconic mapping available to spoken language users)[70] and thus for spoken languages, the productive use of iconic sound-meaning mappings is relatively limited as compared with the visual modality. Though there are some languages that are quite creative in this respect (cf. Dingemanse on ideophones in Siwu (2011b), inter alia), this mismatch in our ability to iconically represent our interactions in space and time, through sound, is compounded by the fact that the oral channel is much more restricted in terms of articulatory degree of freedom and visual saliency.

The vocal tract is not able to represent visually iconic aspects of the world in part because the articulators are mostly hidden, other than the lips and some degree of tongue and jaw movement. Some have argued that there is a propensity for languages, cross-linguistically, to encode largeness or smallness through low and high vowels respectively (Ultan, 1978). This iconic relationship is grounded in the perception that large animals tend to have lower sounding vocalizations while smaller animals tend to have higher pitched vocalizations, but also in the fact that by lowering the jaw and producing a low-vowel makes a ‘bigger’ noise, thus we are in essence making ourselves appear bigger in the process. Likewise, high-front vowels have less sonority and therefore are associated with smaller noises and therefore smaller creatures. This in addition to perceptual phenomena such as the McGurk effect (McGurk & MacDonald, 1976), suggests that despite the limited degree of visual articulation input in the spoken modality,

[70] For an in depth discussion of possible sound-meaning mappings in spoken language sound symbolism see Hinton, Nichols, & Ohala, 1994.

speakers and hearers capitalize on the additional information provided in this channel.

As previously discussed, signed languages, on the other hand, have at their disposal a medium in which representing our construal of the world and its events has many more degrees of freedom. This is because there are more options for visually representing the world than auditorily representing the world, although the degree to which spoken languages are able to iconically represent the world via sound is much vaster and creative than they are often given credit for. Hands make good ‘things’ and movements make good ‘processes’ in the Langackerian sense, and as Stokoe’s Semantic Phonology demonstrated, signs seem to consist of things and processes, which are carried out by hands moving.

The second, perhaps less obvious reason why signed languages seem to exhibit more iconicity than spoken languages is not unrelated to the first point; we represent spatial relationships and motion at the grammatical level in spoken languages, but spatial relationships and motion are encoded directly in the phonology of signed languages. It stands to reason that the morphosyntactic level is where we find the most external-motivation in spoken language. Iconicity at the syntactic level has been well documented in the literature on spoken language (Haiman, 1985, 2003). Much of Lakoff and Johnson’s earlier work has shown that English has a pattern of encoding space, time and movement through conceptually grounded metaphor (1980).[71] Where signed languages are concerned, entities can be represented by objects (hands), space can be represented by space, and movement by movement, and this all happens at the ‘phonological level’. Despite suggestions that signed language iconicity is primarily imagistic, I argue that these are classic examples of diagrammatic iconicity, in which grammatical structure reflects conceptual relations. Formal properties of language are reflections of conceptual

---

[71] Importantly, metaphoric relationships do not involve direct resemblance between sign and referent, but rather it involves association between symbols.

structure; this is at the heart of cognitive approaches to language; function often mediates form. This is the primary evidence for treating signs as constructions.

Signed languages are not forced outside of the visual modality in order to construct visual representations of movement, location or space; it is this one-to-one mapping that gives signed languages an articulatory and perhaps conceptual 'advantage' over spoken languages. This is no doubt one of the reasons signed languages 'feel more iconic': the iconicity is salient in the formal properties of the language. That iconicity seems more pervasive in signed languages is not surprising, as others have observed there are many things in our world that have shape properties but no sound associated with them. A colleague of mine formulated it thus: phonemes in visual languages are "semantically rich and phonologically cheap…you get a lot of semantic information in a very small amount of articulation," (L. Gorbet, personal communication, February 12, 2014).

Should it be the case then that spoken languages are condemned to be unable to encode iconic properties at the phonological level? The answer to this question is simply, no. In my description of cognitive phonology, it is apparent that semantic content is still associated with the phonological pole in spoken languages. As I have argued, all levels of emergent formal content come-with a semantic pole; the meaningless phoneme arises only when a phoneme has been schematized to such a level that the semantic pole becomes too diluted for there to be any recognizable semantic content left. It is only under these circumstances of extreme abatement of the semantic pole that we are left with 'meaningless phonemes'. From a cognitive perspective of language storage, the degree to which phonemes' semantic poles are attenuated, or not, should be expected to vary with age and experience in any given speaker over his/her lifetime, but also should be expected to vary from speaker to speaker within a given linguistic community.

Within spoken languages, one can easily conceive of this high level of schematization. Phonemes are frequently reused and recurrent in varying positions; however, language users can also resurrect these highly abstracted semantic meanings, even from ‘meaningless phonemes’. For example, in poetry, lyrics, neologisms, advertising, and other realms of language use, ‘professional language users’ are able to evoke schematic semantic associations. In this way they tap into these highly abstract semantic relationships, and awaken intuitions held by communities of speakers. This professional language usage is studied extensively in research and development of new products (Stolarski, 2012), but also in poetry and literature (A. Fischer, 1999). Unfortunately, though vast amounts of research are conducted on the ways in which language users process and react to these mappings, the data and findings produced from this research is often out of the purview of linguists. For example, when given drawings of abstract shapes, English language users are sensitive to the relationship between vowel height and front or backness and object names for these abstract shapes. Features of vowel height and frontness were overwhelmingly equated with physical properties of sharpness or jagged shapes. On the contrary, rounded, bulbous shapes were significantly correlated with low and or back vowels (Maurer, Pathman, & Mondloch, 2006)

Similar form-meaning mappings have been found for natural classes of consonants. In one such study on the effectiveness of a cancer drug, participants perceived drug names which contained voiceless stops as faster acting, less invasive and therefore more effective when compared to hypothetical drug names which contained voiced stops, which were judged to be slow and ineffective (Abel & Glinert, 2008). Moreover, studies which look at phonological iconicity and its role in language have found similar evidence suggesting that iconicity plays an important role in the acquisition and structure of language. This includes work on the evolution of language (Perlman & Cain, 2014; Perlman, Dale, & Lupyan, 2015), first language acquisition (Monaghan, Shillcock, Christiansen, & Kirby, 2014) and language processing (Maglio, Rabaglia, Feder, Krehm, & Trope, 2014).

And these phenomena are not reserved for spoken languages alone. Signed language users are also able to resurrect highly schematized form-meaning relationships as evidenced by language usage events from story-tellers, poets and language purity activists. It is not uncommon to witness an ASL user proclaim a word such as HEAR, when used in an evidential context as in "Oh, I heard some news," as an inappropriate use of the sign (which is articulated by pointing to the ear). HEAR, in this sense, does not *iconically* represent how the language user came about the piece of knowledge, as they clearly *saw* but did not *hear* the gossip. In another example, Deaf linguist Patrick Boudreault addresses how Deaf people dream in a VLOG post. Boudreault signs the words TALK and SIGN, with the place of articulation at his forehead, rather than at the canonical places of articulation, at the lips and in neutral space, respectively. By creatively using language, Boudreault adapts the meaning of these signs to show that he signs/talks in his mind (Boudreault, 2013). This creative use of language shows that users are at least sub-consciously, and often overtly consciously aware, that handshapes, movements, and places of articulation exhibit regular patterns of form-meaning mapping.

As humans, we have access to a host of basic representations of the world. Whether we call these representations *conceptual archetypes* in the style of Langacker (2008) or *cognitive metaphors* in the style of Lakoff and Johnson (1980), we have access to these understandings about how the world works and how we move and interact with our environments. What I have proposed, in the true vein of cognitive approaches to language, is that we make use of these conceptual archetypes as ways of organizing the world, and that we take advantage of this general cognitive ability when constructing linguistic systems. In essence, we want to construe the word in a way which is as true to our archetypal understanding as we possibly can, therefore the semantic and phonological poles often reflect these basic understandings. As Haiman has suggested, "linguistic forms are frequently the way they are because, like diagrams, they resemble the conceptual structures they are used to convey," (1985, p. 1). Do languages need to be told to encode transitivity? Or the self-versus other? It seems that though there is no rule that dictates these conceptualizations should be encoded, inevitably they are. Moreover, how the grammar encodes these concepts in often iconic both in spoken and signed languages.

6.3 Duality of Patterning

Several logical questions fall out of the above discussion: what about duality of patterning? Is it not a pre-requisite for human language? And if so, are signed languages somehow less good human languages because they seem to exhibit less duality of patterning? These questions can easily be answered within the framework of cognitive phonology. First, I am neither suggesting that duality of patterning is unimportant, nor am I suggesting it does not exist to the same extent in signed languages as it does in spoken language. I am suggesting that duality of patterning arises through the process of schematization of form-meaning patterns, but is only one possible result of the process. The primacy of duality of patterning is predicated on the fact that phonemes are first and foremost meaningless atomic units which combine to produce meaningful utterances. Even at first glance we can see that these assumptions associated with a building-block approach to language structure are not consistent with cognitive models.

This first point is not unrelated to the second answer as to whether duality of patterning is a basic requirement of human language. Previous research has shown that duality of patterning is an emergent feature of a dynamic system (Blevins, 2012), as are phonemes, morphemes, etc.; arising from the same domain general processes that give rise to other schematic structures. I suggest that the phenomenon which we label ‘duality of patterning’ simply refers to the degree to which a phoneme has been schematized, and the degree to which the articulatory feature in question has been emancipated from its grounded form. Cognitive phonology predicts that this high level of schematization of ‘form without meaning’ which is seen in ‘arbitrary mappings’ is only one possible outcome of the process of extracting patterns across usage-events.

Still, in regards to the relationship between signed languages and duality of patterning, one might conclude from the evidence presented in this dissertation that duality of patterning does not exist in ASL or Libras. Or perhaps, if this extreme stance is not taken, one might still assume that the phonology of signed languages does not resemble spoken phonology in any way with which they are familiar. This is a common reaction to the ideas I have advanced here. Interestingly, work by deBoer, Sandler and Kirby (2012) has recently suggested that there is no duality of patterning in Israeli Sign Language, attributing this to the young age of the language. These types of indictment have kept studies of motivation in signed language in the dark for decades, for fear that signed languages would not be considered real languages. But this is wrongheaded in several ways. While it may well be the case that young signed languages, within three or four generations of their advent, may not have had sufficient time to schematize form-meaning mappings enough that they reach a perceived threshold of arbitrariness; however, even for ‘old’ signed languages, such as French Sign language FSL, the degree to which the language maintains motivation is quite robust.

Primarily, age of the language is actually an ancillary measure for frequency. The more frequent the usage, the more occasions for variable articulation, implicature, and emancipation. I argue, in the same way that highly schematized ‘meaningless’ phones can arise in an emergent model, so too can schematizations remain grounded in their external motivation. So while time may be a factor, some grounded externally motivated mappings may never lose their transparency. Emancipation in this sense is not a predetermined result of language use.

6.4 Coordination with other models of phonology

In proposing a new phonological framework, it is important to describe what the model does and does not do. Questions may be raised regarding the role of articulatory factors in the organization and description of language structure, such as: how does the cognitive phonology framework handle phonological processes such as assimilation or lenition. The answer is that it doesn't, at least not on its own. Usage-based and articulatory models already do exactly this. The model of phonology proposed here is completely compatible with usage-based and articulatory/gestural approaches to phonology, and in fact should be used in conjunction with these models. When taken together with usage-based and articulatory/gestural models, cognitive phonology is complimentary, and addresses specific concerns relating to motivation and the role of language internal versus language external effects on the system. Cognitive phonology as a model is not necessarily concerned with articulatorily motivated phonological processes; though these kinds of processes are recognized as important to the organization, storage, and ultimately change of the structure of language.

Articulatory Phonology is largely complimentary to usage-based approaches.[72] Articulatory Phonology, as pioneered by Browman and Goldstein (1986), suggests that speech is a motor activity that constrains and shapes the organization of phonological systems. In this model, coordinated articulatory movements, or *gestures*, combine into complex motor routines in which multiple articulators are simultaneously and sequentially active. Stretches of coordinated articulatory gestures combine in larger or smaller chunks to achieve an articulatory goal.

[72] Advances since its advent have taken Articulatory Phonology away from some of its more important initial propositions. Nevertheless, the foundational work from the late 1980s has proven very useful for understanding purely phonetic effects of language organization and change.

Gestures are considered the primary representations of linguistic units which includes articulatory motor routines, as well as perceptual information such as acoustic or visual properties. While this theory was not designed to handle signed languages, attempts have been made to extend this model across the modal divide (Easterday & Occhino-Kehoe, 2015; Keane, 2014; S. Wilcox, 1988). Articulatory Phonology is well suited for describing spoken and signed languages because the domain-general pressures relevant to vocal articulations are in many ways similar to the articulatory pressures exerted on manual-corporal systems. Thus legs learn to run, mouths learn to speak, and hands learn to sign, in similarly embodied ways.

Cognitive phonology is concerned with the fact that both language-internal and language-external factors influence the structure of language, for phonological structure as is the case for any other emergent linguistic unit. Sub-morphemic units then can still retain schematic associations from their position in a word, the word in which they occur, and even the construal of the articulation itself, including visual, tactile, or in the case of spoken languages auditory sensations. Phonology is viewed not as a separate system, but as a type of emergent language structure, in the same vein as morphosyntactic or prosodic constructions.

6.5 Simulation Semantics and Cognitive Phonology

Finally, it is necessary to point out the obvious relationship between proposals regarding the role of mental simulation in spoken language processing and the way in which signed languages encode semantics in their formal representations. The motivation it seems is the same and thus the outcome is uncannily similar. Simulation, as it has been defined, concerns the way in which humans process the semantics of (spoken) language by invoking simulations or enactments of motoric routines or visual displays. In other words, when we encounter written or spoken stimuli, in order to comprehend the content, we engage the parts of our brain which are wired to perform or perceive the action or object in question.

What is important here is that though these regions of the brain are stimulated, they are not activated to the level that the action or event is actually performed. Zwaan and Madden point out that "simulation is always attenuated relative to engaged experience. Because it is not driven by immediate perceptual input, or harnessed to actual motor activity, it lacks the intensity or "vividness" of such experience," (2005, p. 536). In other words, simulation of semantics is an attenuated version of real life experiences, because they are an amalgamation of our construals of these experiences over time.

Likewise, in production, we engage the parts of the brain which connect the linguistic meaning to the physical action or visual referent; however, in production there is the possibility that the activation reaches a threshold which allows for gestures which encode some of this visual, embodied information to become enacted via the motor system in the form of 'gesture,' (Hostetter & Alibali, 2008). Thus situated embodied language comprehension and production has at least two facets in which the body plays a major role: situated embodied simulation, and gestural enactment of experience. The former occurs in the minds of language users, and can in many ways be conflated with the cognitive linguistic definition of *construal*, while the latter occurs in the semantically rich medium of three-dimensional space. As Marghetis and Bergen suggest with regard to the second type of bodily involvement, "The body proper…is perfectly suited for representing *itself*, without recourse to internal representations of its physiology; manual gestures afford rich representations of manual actions," (2015, p. 2005). It is precisely at this juncture of language and cognition that signed languages make the most of the affordances provided manual-visual language. Signed languages do not have to reach outside of the rich three-dimensional space in which the language, and more importantly the grammar, are produced. Hence, the same types of embodied manual articulatory gestures, which occur in conjunction with vocal articulations to create rich multi-modal constructions in spoken language, occur instead as the primary linguistic signal in signed languages.

Evidence from spoken language research suggests the areas of the brain associated with physical motor routines and sensory experiences are activated to even greater degree when the motor system has already been engaged in the task in question (Hostetter & Alibali, 2010; Sassenberg & van der Meer, 2010). To date, no experimental work has been conducted to test the ways in which simulation interacts with perception or production of signs, but forays into multi-modal construction grammar as a new approach to spoken language analysis has already hinted at complex multi-dimensional interactions. Signed languages, of course, provide a unique opportunity by which to study how the implementation of physical motor routines for action profiles, construals of force dynamic interactions of participants, and metaphorical extensions of physical force can be encoded directly into the formal properties of language. As we proceed and refine our investigations within the realm of experimental semantics, it is very possible that signed languages can take a more central role in the investigation of humans' ability to conceptualize and encode information in their linguistic structure.

6.6 Conclusions regarding Cognitive Phonology

The framework of cognitive phonology is not categorically new; though it naturally arises when the basic tenets of cognitive and usage-based models are brought into conversation with each other and are applied to reach a common goal. The need to develop such a model of phonology has emerged as a response to accounting for the role of motivation in the formational units of signed languages. Traditionally, models of signed language phonology have been based on generative paradigms which disallow the consideration of motivation because phonological content by definition is devoid of meaning. Believing morphemes to be the minimal units of meaning, and phonemes to be necessarily arbitrary, minimally contrastive units, has perpetuated the acceptance of duality of patterning and recursion without earnest consideration. In many ways, phonology has remained the last frontier among traditional topics of linguistic analysis to have been explored from a cognitive perspective.

This primacy of arbitrary form-meaning relationships has been accepted largely for over 100 years, even perseverating into the analyses of functional/cognitive linguists. Within a cognitive phonology model, the traditional conceptualization of the phoneme as a meaningless unit is challenged. By stepping back from preconceived notions regarding the conditions necessary for human language, and by faithfully implementing the analytical tools put forth by functional/cognitive perspectives, many of the issues which are not answered using formal approaches, can be dealt with in a concise, cognitively realistic and widely applicable manner.

Of course, any model of phonology must have the explanatory power to account for both arbitrariness and motivation, and ideally such a model would work equally well for both spoken and signed languages. It is clear that while motivated form-meaning mappings have continued to be problematic for signed language phonology, motivation at the phonological level has also persisted as a problem for spoken languages description as well. Regardless of modality, motivated phonological patterns have often been marginalized, ignored and deemed to be deviant exceptions to the rule of arbitrariness.

It should not be overlooked that attempts at marrying semantics and phonology in a single field have been made before. In the early twentieth century, Bolinger wrote on the importance of such considerations, within the framework of ‘phonosemantics’. Bolinger’s (1965b), *The Sign is Not Arbitrary*, challenged the notion that phonemes and morphemes should be considered related to their meanings solely on the basis of convention. Instead, he suggested that the assumption of the arbitrariness of the sign was a comparativist relic. During this time, Bolinger also lamented the trend of retreating from semantic analysis, jovially suggesting this practice, "had bred a generation of linguists who display acute symptoms of fright and its accompanying compensations when meaning is mentioned, who have elaborated subtle techniques for circumventing it in their analyses, and who have left the investigation of meaning adrift and at the mercy of a few competent semanticists among a legion of charlatans," (1949, p. 52).

I must agree with Bolinger, that by adhering to these preconceptions and ignoring the role of meaning, linguists have created an unnatural approach to linguistic analysis. From an Emergentist perspective, language form and meaning interact on various levels as they are always encountered together, perceived through the sensory apparatuses within a grounded context, given the interaction of the body in its environment. Cognitive phonology provides several practical explanations for the differing levels of arbitrariness and iconicity between spoken and signed languages. Specifically it explains how language-external conceptual archetypes (Langacker, 1991) and image schemas (M. Johnson, 1987; Lakoff, 1990) are encoded and schematized in language structure, while offering a rationale for the influence of language-internal mappings, also known as analogical iconicity. Both language internal and language external semantic mappings contribute directly to our schematization of the semantic pole of phonemes.

Ample evidence from psycholinguistic studies on acquisition, processing, and perception, as well as data from more disparate areas of research such as poetry, marketing, medical research, support the presence of phoneme level (or smaller) form-meaning mappings. However, these findings have often been trivialized by the lack of interest from linguists as to semantic influence on the organization of formal parameters. Researchers studying these semantic effects of form have not been successful in unifying their findings under a single framework, and in many cases have not linked their results to any particular linguistic framework at all;[73] nonetheless their findings build a strong case for cognitive phonology.

Perhaps what has been missing from the previous attempts at building an integrated model of cognitive phonology has been the ability to isolate the connections between phonemic content and semantic associations. Viewing these phenomena through the lens of a different modality, namely signed language linguistics, in which form-meaning mappings afford easier access to the complex interactions of language-internal and language-external factor, may provide linguists with a catalyst for reconsidering formal associations.

The major contribution of this dissertation has been to focus on developing a theoretical framework which will account for the types of motivated mappings shown to be prevalent in signed language phonology. At the same time, I have shown such a model can also account for the prevalence of arbitrariness in spoken language, though I have also challenged the idea that arbitrariness should be privileged in language, in general. Through the marriage of several viewpoints from usage-based phonology and construction grammar approaches, I have shown how such a framework both predicts and accounts for the kinds of motivations seen in signed language structure. I have suggested that contrary to current theories of signed language phonology, factors other than articulatory ease and well-formedness constraints affect the distribution of handshape. Instead, I suggest that construal of form ultimately allows for language users to map both language externally motivated conceptual structures and language internal patterns onto the 'features' or 'phonemes' identified in traditional theories of signed language phonology.

As de Matteo pointed out nearly forty years ago, "It seems fairly clear that any proper

[73] This is often the case in marketing and medical research

understanding of grammatical/semantic relationships among signs in ASL will necessarily incorporate the notion of visual imagery or some similar notion," (1977, p. 116). What de Matteo did not recognize at the time was that at some point, linguistic theory would propose similar theoretical constraints for spoken language. Simulation semantics and studies on embodied cognition have recently advocated for a view that acknowledges that our visual experience in the world constrains our conceptualization of spoken language.

In signed languages, space is grammar, and grammar is spatial. In this visual realm of language production and processing our conceptualizations of recurrent gestalt experiences such as interactions of two participants in a predication or figure ground relationships, can be encoded by the articulators. Two-hands can represent two entities, or a figure and a ground. Moreover, the use of three-dimensional space for articulation provides affordances for encoding the relative relations between these entities or figure-ground configurations. If those entities are semantically coming together, the hands converge; if those entities are semantically moving away from one another, the hands diverge. As we have seen, utilizing a cognitively oriented approach to language analysis, such language-external construals of the world are active in the construction and organization of both signed and spoken languages, it is just in the internal simulation versus the external 'gesture' or in better terms, articulation that these modalities differ.

Signed languages provide an interesting point of departure from which to study language emergence and structure. By adopting usage-based/cognitive approaches I have shown that more direct comparisons can be made between structures in spoken and signed languages. It should come as no surprise then that domain general factors shape language organization, construals of real world experience influence grammatical form, and embodied simulations are active in our construction of form-meaning patterning in both modalities.

Bibliography

Abel, G. A., & Glinert, L. H. (2008). Chemotherapy as language: Sound symbolism in cancer medication names. *Social Science & Medicine*, *66*(8), 1863–1869. https://doi.org/http://dx.doi.org/10.1016/j.socscimed.2007.12.016

Abelin, Å. (1999). *Studies in Sound Symbolism* (Dissertation). Göteborg University, Göteborg, Sweden.

Abelin, Å. (2015). Phonaesthemes and sound symbolism in Swedish brand names. *Ampersand*, *2*, 19–29. https://doi.org/10.1016/j.amper.2014.12.001

Anible, B. (2016). *Iconicity effects in translation direction: bimodal bilingual language processing* (Dissertation). University of New Mexico, Albuquerque, NM.

Ann, J. (1996). On the relation between ease of articulation and frequency of occurrence of handshapes in two sign languages. Lingua, 98, 19–41.

Ann, J. (2005). A Functional Explanation of Taiwan Sign Language Handshape Frequency. *Language and Linguistics*, *6*(2), 217–246.

Armstrong, D., Stokoe, W. C., & Wilcox, S. (1995). Gesture and the nature of language. Cambridge; New York NY USA: Cambridge University Press.

ASL sign for THROW | HandSpeak. (n.d.). Retrieved March 24, 2016, from http://www.handspeak.com/word/search/index.php?id=2211

Battison, R. (1974). Phonological deletion in American Sign Language. *Sign Language Studies*, *5*, 1–19.

Battison, R. (1978). Lexical Borrowing in American Sign Language. Silver Spring, MD: Linstok Press.

Baus, C., Carreiras, M., & Emmorey, K. (2013). When does Iconicity in Sign Language Matter?

Language and Cognitive Processes, *28*(3), 261–271. https://doi.org/10.1080/01690965.2011.620374

Beckner, C., Blythe, R., Bybee, J., Christiansen, M. H., Croft, W., Ellis, N. C., Schoenemann, T. (2009). Language is a complex adaptive system: Position paper. Language Learning, 59, 1–26.

Bergen, B., & Chang, N. (2005). Embodied construction grammar in simulation-based language understanding. *Construction Grammars: Cognitive Grounding and Theoretical Extensions*, *3*, 147–190.

Bergen, B. K. (2004). The Psychological Reality of Phonaesthemes. *Language*, *80*, 290–311.

Beuls, K., & Steels, L. (2013). Agent-Based Models of Strategies for the Emergence and Evolution of Grammatical Agreement. *PLoS ONE*, *8*(3), e58960. https://doi.org/10.1371/journal.pone.0058960

Blevins, J. (2012). Duality of patterning: Absolute universal or statistical tendency? *Language and Cognition*, *4*, 275–296. https://doi.org/10.1515/langcog-2012-0016

Bolinger, D. (1965a). *Forms of English: accent, morpheme, order*. (I. Abe & T. Kanekiyo, Eds.). Cambridge, MA: Harvard University Press.

Bolinger, D. (1965b). The Sign Is Not Arbitrary. In I. Abe & T. Kanekiyo (Eds.), *Forms of English: Accent, Morpheme, Order*. Cambridge, MA: Harvard University Press.

Bolinger, D. L. (1949). The sign is not arbitrary. *Thesaurus*, *1*(1), 52–62.

Boudreault, P. (2013). The Universal language is in our minds. UC Berkeley.

Boyes Braem, P. (1990). A Preliminary Analysis of the Child's Acquisition of the Handshape in American Sign Language. In V. Volterra & C. Erting (Eds.), *From Gesture to Language in Hearing and Deaf Children*. Heidelberg: Springer Verlag.

Brennan, M. (1990). Productive morphology in British Sign Language. *Proceedings of the International Congress on Sign Language Research and Application, Hamburg*, *90*, 205–228.

Brentari, D. (1998). *A prosodic model of sign language phonology*. Cambridge, MA: MIT Press.

Brentari, D. (2001). *Foreign vocabulary in sign languages : a cross-linguistic investigation of word formation*. Mahwah, N.J: Lawrence Erlbaum Associates.

Brentari, D. (2012). Phonology. In R. Pfau, M. Steinbach, & B. Woll (Eds.), *Sign language an international handbook* (pp. 21–54). Berlin; Boston: De Gruyter Mouton. Retrieved from http://www.myilibrary.com?id=393999

Brentari, D., Coppola, M., Mazzoni, L., & Goldin-Meadow, S. (2012). When does a system become phonological? *Natural Language and Linguistic Theory*, *30*(1), 1–31.

Brentari, D., & Padden, C. (2001). A language with multiple origins: Native and foreign vocabulary in American Sign Language. In *Foreign Vocabulary in Sign Language: A Crosslinguistic Investigation of Word Formation* (pp. 87–119). Mahwah, N.J: Lawrence Erlbaum Associates.

Browman, C. P., & Goldstein, L. (1986). Towards an articulatory phonology. In C. Ewen & J. Anderson (Eds.), *Phonology Yearbook* (Vol. 3, pp. 219–252). Cambridge, MA: Cambridge University Press.

Browman, C. P., & Goldstein, L. (1989). Articulatory gestures as phonological units. *Phonology*, *6*(2), 201. https://doi.org/10.1017/S0952675700001019

Browman, C. P., & Goldstein, L. (1992). Articulatory phonology: An overview. *Phonetica*, *49*(3–4), 155–180.

Bybee, J. L. (1985). Diagrammatic iconicity in stem inflection relations. In J. Haiman (Ed.), Iconicity in Syntax (pp. 11–48). Stanford, June 24-26, 1983: John Benjamins Publishing Company.

Bybee, J. L. (1994). A View of Phonology from a Cognitive and Functional Perspective. *Cognitive Linguistics*, *5*(4), 285–305.

Bybee, J. L. (1999). Usage-based phonology. In B. Hayes, M. Darnell, E. A. Moravcsik, M. Noonan, F. J. Newmeyer, & K. Wheatley (Eds.), *Functionalism and formalism in linguistics* (pp. 211–242). Amsterdam: John Benjamins.

Bybee, J. L. (2000). The Phonology of the Lexicon: Evidence from Lexical Diffusion. In M. Barlow & S. Kemmer (Eds.), Usage-based models of language. Stanford, Calif: CSLI Publications, Center for the Study of Language and Information.

Bybee, J. L. (2001). *Phonology and language use*. Cambridge, [England] ; New York: Cambridge University Press.

Bybee, J. L. (2006). From Usage to Grammar: The Mind's Response to Repetition. *Language*, *82*(4), 711–733.

Bybee, J. L. (2007). *Frequency of use and the organization of language*. Oxford ; New York: Oxford University Press.

Bybee, J. L. (2010). *Language, usage and cognition*. Cambridge; New York: Cambridge University Press.

Bybee, J. L., & Eddington, D. (2006). A Usage-Based Approach to Spanish Verbs of "Becoming." *Language*, *82*(2), 323–355. https://doi.org/10.2307/4490159

Bybee, J. L., & Hopper, P. J. (Eds.). (2001). *Frequency and the emergence of linguistic structure*. Amsterdam: Benjamins.

Cabeza-Pereiro, C. (2014). Metaphor and Lexicon in Sign Languages: Analysis of the Hand-

Opening Articulation in LSE and BSL. *Sign Language Studies*, *14*(3), 302–332. https://doi.org/10.1353/sls.2014.0009

Canadian Cultural Society of the Deaf, & Bailey, C. (2002). *The Canadian dictionary of ASL*. Edmonton, AB: University of Alberta Press.

Capovilla, F. C., & Raphael, W. D. (2001). Dicionário Enciclopédico Ilustrado Trilíngüe da língua de sinais brasileira (Vol. 1: Sinais de A a L). São Paulo: Edusp, Fapesp, Fundação Vitae, Feneis: Brasil Telecom.

Cates, D., Gutiérrez, E., Hafer, S., Barrett, R., & Corina, D. (2013). Location, Location, Location. *Sign Language Studies*, *13*(4), 433–461. https://doi.org/10.1353/sls.2013.0014

Chomsky, N. (1986). *Knowledge of language: Its nature, origin, and use*. Greenwood Publishing Group.

Chomsky, N., & Halle, M. (1997). The sound patterns of English. Cambridge, Mass.: MIT Press.

CHS ASL. (n.d.). *# HASHTAG | ASL - American Sign Language*. Retrieved from https://www.youtube.com/watch?v=_5fJwBXCs4I

Coltheart, M. (1981). The MRC psycholinguistic database. *The Quarterly Journal of Experimental Psychology Section A*, *33*(4), 497–505.

Connine, C. M., Ranbom, L. J., & Patterson, D. J. (2008). Processing variant forms in spoken word recognition: The role of variant frequency. *Perception & Psychophysics*, *70*(3), 403–411. https://doi.org/10.3758/PP.70.3.403

Cooper, R. P., & Aslin, R. N. (1989). The language environment of the young infant: Implications for early perceptual development. *Canadian Journal of Psychology/Revue Canadienne de Psychologie*, *43*(2), 247–265. https://doi.org/10.1037/h0084216

Corina, D., & Sandler, W. (1993). On the Nature of Phonological Structure in Sign Language.

Phonology, *10*(2), 165–207.

Coulter, G. R. (1982). *On the nature of ASL as a monosyllabic language*. Paper presented at the Annual Meeting of the Linguistic Society of America, San Diego, CA.

Crasborn, O., & van der Kooij, E. (2003). Base joint configuration in Sign Language of the Netherlands. In J. V. D. Weijer, V. J. V. Heuven, & H. van der Hulst (Eds.), The phonological spectrum (Vol. 1, pp. 257–287). Philadelphia, PA: John Benjamins Publishing Company.

Croft, W. (2001). *Radical construction grammar: syntactic theory in typological perspective*. Oxford ; New York: Oxford University Press.

de Boer, B., Sandler, W., & Kirby, S. (2012). New perspectives on duality of patterning: Introduction to the special issue. *Language and Cognition*, *4*(4), 251–259. https://doi.org/10.1515/langcog-2012-0014

de Casper, A. J., & Fifer, W. P. (1980). Of human bonding: Newborns prefer their mothers' voices. *Science*, *208*, 1174–76.

DeMatteo, A. (1977). Visual imagery and visual analogues in American Sign Language. *On the Other Hand: New Perspectives on American Sign Language*, 109–136.

Dingemanse, M. (2011a). Ezra Pound among the Mawu: Ideophones and iconicity in Siwu. In P. Michelucci, O. Fischer, & C. Ljungberg (Eds.), *Semblance and Signification* (pp. 39–54). Amsterdam: John Benjamins.

Dingemanse, M. (2011b). *The Meaning and Use of Ideophones in Siwu* (PhD Dissertation). Radboud University, Nijmegen, Netherlands.

Dingemanse, M. (2013). Ideophones and gesture in everyday speech. *Gesture*, *13*(2), 143–165.

Dingemanse, M., Blasi, D. E., Lupyan, G., Christiansen, M. H., & Monaghan, P. (2015).

Arbitrariness, Iconicity, and Systematicity in Language. *Trends in Cognitive Sciences*, *19*(10), 603–615. https://doi.org/10.1016/j.tics.2015.07.013

Easterday, S., & Occhino-Kehoe, C. (2015). *Articulatory retiming: investigations from cross-modal linguistic evidence*. Poster presented at the Annual Meeting on Phonology (AMP), University of British Columbia.

Eccarius, P. (2008). *A constraint-based account of handshape contrast in sign languages*. Purdue University, West Lafayette, IN.

Eccarius, P., & Brentari, D. (2010). A formal analysis of phonological contrast and iconicity in sign language handshapes. *Sign Language & Linguistics*, *13*(2), 156–181. https://doi.org/10.1075/sll.13.2.02ecc

Elman, J. L. (1995). Language as a dynamical system. In R. F. Port & T. Van Gelder (Eds.), *Mind as motion: explorations in the dynamics of cognition*. Cambridge, Mass.: MIT Press.

Elman, J. L. (1998). Connectionism, artificial life, and dynamical systems: New approaches to old questions. In W. Bechtel & G. Graham (Eds.), *A Companion to Cognitive Science*. Oxford: Basil Blackwood.

Fernald, T. B., & Napoli, D. J. (2000). Exploitation of Morphological Possibilities in Signed Languages Comparison of American Sign Language with English. *Sign Language & Linguistics*, *3*(1), 3–58.

Fischer, A. (1999). What, if Anything, is Phonological Iconicity? In M. Nänny & O. Fischer (Eds.), *Form miming meaning* (pp. 123–134). Amsterdam: John Benjamins.

Fischer, S., & Gough, B. (1978). Verbs in American Sign Language. *Sign Language Studies*, *18*, 17–48.

Fowler, C. A. (1996). Listeners do hear sounds, not tongues. *J. Acoustical Society of America*, *99*(3), 1730–41.

Fowler, C. A. (2010). Embodied, Embedded Language Use. *Ecological Psychology*, *22*(4), 286–303. https://doi.org/10.1080/10407413.2010.517115

Friedman, L. A. (1977). Formational Properties of American Sign Language. In *On the other hand: New perspectives on American Sign Language* (pp. 13–56). London: Academic Press.

Frishberg, N. (1975). Arbitrariness and Iconicity: Historical Change in American Sign Language. *Language*, *51*(3), 696–719.

Fuks, O., & Tobin, Y. (2008). The signs B and B-bent in Israeli sign language according to the theory of Phonology as Human Behavior. *Clinical Linguistics & Phonetics*, *22*(4–5), 391–400. https://doi.org/10.1080/02699200801916808

Gee, J., & Kegl, J. (1982). Semantic perspicuity and the locative hypothesis: Implications for acquisition. *Journal of Education*, *164*, 185–209.

Geeraerts, D. (1997). *Diachronic prototype semantics: A Contribution to Historical Lexicology*. Claredon Press.

Gentner, D., & Colhoun, J. (2010). Analogical Processes in Human Thinking and Learning. In B. Glatzeder, V. Goel, & A. Müller (Eds.), *Towards a Theory of Thinking* (pp. 35–48). Berlin, Heidelberg: Springer Berlin Heidelberg. Retrieved from http://link.springer.com/10.1007/978-3-642-03129-8_3

Gibbs, R. W. (2012). The social nature of embodied cognition: A view from the world of metaphor. *Intellectica*, *56*, 81–98.

Gibbs, R. W., Jr. (2005). The Psychological Status of Image Schemas. In B. Hampe (Ed.), *From*

Perception to Meaning: Image Schemas in Cognitive Linguistics (pp. 113–135). Berlin: Mouton de Gruyter. Retrieved from http://libproxy.unm.edu/login?url=http://search.proquest.com/docview/85644405?accountid=14613

Gibbs, R. W., & Matlock, T. (2008). Metaphor, imagination, and simulation: Psycholinguistic evidence. In *Cambridge handbook of metaphor and thought* (pp. 161–176). New York: Cambridge University Press.

Givón, T. (1985). Iconicity, isomorphism, and non-arbitrary coding in syntax. In J. Haiman (Ed.), *Iconicity in Syntax*. Stanford, June 24-26, 1983: John Benjamins Publishing Company.

Givón, T. (2015). Beyond Structuralism: Exorcising Saussure's Ghost. Presented at the 11th Conference of the Association for Linguistic Typology, University of New Mexico, Albuquerque, NM.

Glenberg, A. M., & Kaschak, M. P. (2002). Grounding language in action. *Psychonomic Bulletin & Review*.

Goldberg, A. (2006). *Constructions at Work; The nature of generalisations in language*. Oxford: Oxford University Press.

Goldberg, A. (2013). Constructionist Approaches. In T. Hoffmann & G. Trousdale (Eds.), *The Oxford handbook of construction grammar* (pp. 15–31). Oxford ; New York: Oxford University Press.

Goldsmith, J. A. (1976). *Autosegmental Phonology* (Dissertation). MIT, Cambridge, MA.

Haiman, J. (1980). The Iconicity of Grammar: Isomorphism and Motivation. *Language*, *56*(3), 515–540. https://doi.org/10.2307/414448

Haiman, J. (1983). Iconic and Economic Motivation. *Language*, *59*, 781–819.

Haiman, J. (Ed.). (1985). *Iconicity in Syntax*. Stanford, June 24-26, 1983: John Benjamins Publishing Company.

Haiman, J. (2003). Iconicity. In L. Nadel (Ed.), *Encyclopedia of Cognitive Science*. London: Nature Publishing Group.

Henner, J., Geer, L. C., & Lillo-Martin, D. (2013). Calculating Frequency of Occurrence of ASL handshapes. *LSA Annual Meeting Extended Abstracts*, *4*, 16. https://doi.org/10.3765/exabs.v0i0.764

Hinton, L., Nichols, J., & Ohala, J. (1994). *Sound symbolism*. Cambridge: Cambridge University Press.

Hollmann, W. B. (2013). Nouns and verbs in Cognitive Grammar: Where is the "sound" evidence? *Cognitive Linguistics*, *24*(2). https://doi.org/10.1515/cog-2013-0009

Holzrichter, A. S., & Meier, R. P. (2000). Child-directed signing in American Sign Language. In C. Chamberlain, J. P. Morford, & R. I. Mayberry (Eds.), *Language acquisition by eye* (pp. 25–40). Mahwah, N.J.: Lawrence Erlbaum Associates.

Hopper, P. (1987). Emergent grammar (Vol. 13, pp. 139–157). Presented at the Annual Meeting of the Berkeley Linguistics Society.

Hopper, P. J. (1994). Phonogenesis. In W. Pagliuca (Ed.), *Current Issues in Linguistic Theory* (Vol. 109, pp. 29–45). Amsterdam: John Benjamins Publishing Company. Retrieved from https://benjamins.com/catalog/cilt.109.09hop

Hopper, P. J., & Traugott, E. C. (2003). *Grammaticalization*. Cambridge University Press.

Hostetter, A. B., & Alibali, M. W. (2008). Visible embodiment: Gestures as simulated action. *Psychonomic Bulletin & Review*.

Hostetter, A. B., & Alibali, M. W. (2010). Language, gesture, action! A test of the Gesture as Simulated Action framework. *Journal of Memory and Language*, *63*(2), 245–257.

Hulst, H. van der. (1993). Units in the analysis of signs. *Phonology*, *10*, 209–241.

Hulst, H. G. van der. (2003). Cognitive Phonology. In H. den Besten, J. Koster & H. van Riemsdijk (Eds.), *Germania et alia a linguistic webschrift for Hans den Besten*. Groningen: Rijksuniversiteit Groningen [Host].

Itô, J., & Mester, A. (1993). Japanese phonology: constraint domains and structure preservation. *The Handbook of Phonological Theory*, 817–838.

Jantunen, T., & Takkinen, R. (2010). Syllable structure in sign language phonology. In D. Brentari (Ed.), *Sign languages* (pp. 312–331). Cambridge: Cambridge University Press.

Johnson, K. (1997). Speech perception without speaker normalization: An exemplar model. In K. Johnson & J. W. Mullennix (Eds.), *Talker Variability in Speech Processing* (p. 145–165.). San Diego, CA: Academic Press.

Johnson, M. (1987). *The Body in the Mind : The Bodily Basis of Meaning, Imagination, and Reason*. Chicago: University of Chicago Press. Retrieved from http://libproxy.unm.edu/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=e000xna&AN=778108&site=eds-live&scope=site

Kaye, J. (1989). *Phonology: a cognitive view*. Hillsdale, N.J: L. Erlbaum Associates.

Keane, J. (2014). *Towards an articulatory model of handshape* (Dissertation). University of Chicago, Chicago, IL.

Kegl, J. A., & Wilbur, R. B. (1976). When Does Structure Stop and Style Begin? Syntax, Morphology, and Phonology v.s. Stylistic Variation in American Sign Language. In *In Papers from the... Regional Meeting* (Vol. 12, pp. 376–396). Chicago, Ill.

Kemmerer, D. L. (2015). *Cognitive neuroscience of language*. New York: Psychology Press.

Kip Fletcher | Riverlight Studios http://kipfletcher.photoshelter.com/. (n.d.). Retrieved November 17, 2016, from http://kipfletcher.photoshelter.com/

Klima, E. S., & Bellugi, U. (1979). *The signs of language*. Cambridge, Mass.: Harvard University Press.

Kosslyn, S. M., Ganis, G., & Thompson, W. L. (2001). Neural foundations of imagery. *Nature Reviews Neuroscience*, *2*, 635–642.

Kristiansen, G. (2006). Towards a Usage-Based Cognitive Phonology. *International Journal of English Studies*, *6*(2), 107–140.

Ladd, D. R. (2012). What is duality of patterning, anyway? *Language and Cognition*, *4*(4), 261–273. https://doi.org/10.1515/langcog-2012-0015

Lakoff, G. (1990). *Women, fire, and dangerous things: What categories reveal about the mind*. Chicago, IL: University of Chicago Press.

Lakoff, G. (1993a). Cognitive Phonology. In J. A. Goldsmith (Ed.), *The Last phonological rule: reflections on constraints and derivations* (pp. 117–145). Chicago: University of Chicago Press.

Lakoff, G. (1993b). Cognitive Phonology. In J. Goldsmith (Ed.), *The Last Phonological Rule: Reflections on Constraints and Derivations* (pp. 117–145). Chicago: University of Chicago Press.

Lakoff, G., & Johnson, M. (1980). *Metaphors we live by*. Chicago, Ill.: The University of Chicago Press.

Lane, H. L., Boyes Braem, P., & Bellugi, U. (1976). Preliminaries to a Distinctive Feature Analysis of Handshapes in American Sign Language. *Cognitive Psychology*, *8*(1).

Langacker, R. W. (1987). *Foundations of Cognitive Grammar: Theoretical Prerequisites* (Vol. 1). Stanford, Calif.: Stanford University Press.

Langacker, R. W. (1991). *Foundations of Cognitive Grammar: Descriptive Application* (Vol. 2). Stanford, Calif.: Stanford University Press.

Langacker, R. W. (2008). *Cognitive Grammar: A Basic Introduction*. Oxford ; New York: Oxford University Press.

Lepic, R. (2015). *Motivation in Morphology: Lexical Patterns in ASL and English* (Dissertation). University of California, San Diego, San Diego, CA.

Lepic, R. (2016). The great ASL compound hoax. In *Proceedings of the 11th High Desert Linguistics Society Conference* (pp. 227–250). Albuquerque, NM. Retrieved from http://linggraduate.unm.edu/HDLS11Proceedings.html

Lepic, R., Börstell, C., Belsitzman, G., & Sandler, W. (2016). Taking meaning in hand: Iconic motivations in two-handed signs. *Sign Language and Linguistics, 19*(1), 37–81.

Liddell, S. (1984). THINK and BELIEVE: Sequentiality in American Sign Language. *Language*, *60*, 372–399.

Liddell, S. (2003). *Grammar, gesture, and meaning in American Sign Language*. Cambridge ; New York: Cambridge University Press.

Liddell, S., & Johnson, R. (1989a). American Sign Language: the phonological base. *Sign Language Studies*, *64*, 195–277.

Liddell, S., & Johnson, R. (1989b). American Sign Language: The Phonological Base. *Sign Language Studies*, *64*(1), 195–277. https://doi.org/10.1353/sls.1989.0027

MacWhinney, B. (2005). The emergence of linguistic form in time. *Connection Science*, *17*(3–4), 191–211.

Maglio, S. J., Rabaglia, C. D., Feder, M. A., Krehm, M., & Trope, Y. (2014). Vowel sounds in words affect mental construal and shift preferences for targets. *Journal of Experimental Psychology: General*, *143*(3), 1082–1096. https://doi.org/10.1037/a0035543

Malaia, E., & Wilbur, R. B. (2012). Kinematic signatures of telic and atelic events in ASL predicates. *Language and Speech*, *55*(Pt 3), 407–421.

Malaia, E., Wilbur, R. B., & Milkovic, M. (2013). Kinematic Parameters of Signed Verbs. *Journal of Speech Language and Hearing Research*, *56*(5), 1677. https://doi.org/10.1044/1092-4388(2013/12-0257)

Mandel, M. (1977). Iconic Devices in American Sign Language. In L. Friedman (Ed.), *On the other hand: New perspectives on American Sign Language* (pp. 57–107). London: Academic Press.

Marghetis, T., & Bergen, B. (2015). Embodied meaning, inside and out: The coupling of gesture and mental simulation. In C. Mueller, A. Cienki, E. Fricke, S. H. Ladewig, D. McNeill, & S. Tessendorf (Eds.), *Body-Language-Communication*. New York: Mouton de Gruyter.

Massaro, D. W., & Cohen, M. M. (1983). Evaluation and integration of visual and auditory information in speech perception. *Journal of Experimental Psychology: Human Perception and Performance*, *9*(5), 753–771. https://doi.org/10.1037/0096-1523.9.5.753

Matlock, T. (2010). Abstract motion is no longer abstract. *Language and Cognition*, *2*, 243–260.

Matlock, T. (2011). The conceptual motivation of aspect. In K. Panther & G. Radden (Eds.), *Motivation in Grammar and the Lexicon* (pp. 133–147). Amsterdam ; Philadelphia: John Benjamins.

Mattes, V. (2014). *Types of reduplication: a case study of Bikol*. Berlin: De Gruyter Mouton.

Mattiello, E. (2013). *Extra-grammatical morphology in English: abbreviations, blends,* *reduplicatives, and related phenomena*. Berlin: De Gruyter Mouton.

Mauk, C. E., & Tyrone, M. E. (2012). Location in ASL: Insights from phonetic variation. *Sign Language & Linguistics*, *15*(1), 128–146. https://doi.org/10.1075/sll.15.1.06mau

Maurer, D., Pathman, T., & Mondloch, C. J. (2006). The shape of boubas: sound–shape correspondences in toddlers and adults. *Developmental Science*, *9*(3), 316–322. https://doi.org/10.1111/j.1467-7687.2006.00495.x

McGurk, H., & MacDonald, J. (1976). Hearing lips and seeing voices. *Nature*, *264*, 746–48.

Meier, R. P., Mauk, C. E., Mirus, G. R., & Conlin, K. E. (1998). Motoric constraints on early sign acquisition. *In Proceedings of the Child Language Research Forum*, *29*, 63–72.

Mines, M. A., Hanson, B. F., & Shoup, J. E. (1978). Frequency of Occurrence of Phonemes in Conversational English. *Language and Speech*, *21*(3), 221–241. https://doi.org/10.1177/002383097802100302

Monaghan, P., Shillcock, R. C., Christiansen, M. H., & Kirby, S. (2014). How arbitrary is language? *Philosophical Transactions of the Royal Society B: Biological Sciences*, *369*(1651), 20130299–20130299. https://doi.org/10.1098/rstb.2013.0299

Morais, J., Cary, L., Alegria, J., & Bertelson, P. (1979). Does awareness of speech as a sequence of phones arise spontaneously? *Cognition*, *7*.

Morford, J. P., & MacFarlane, J. (2003). Frequency Characteristics of American Sign Language. *Sign Language Studies*, *3*(2), 213–225.

Nathan, G. S. (2008). *Phonology: a cognitive grammar introduction* (Vol. 3). Amsterdam ; Philadelphia: John Benjamins Pub. Co.

Nathan, G. S. (2009). Is the Phoneme Usage-Based? -Some Issues. *International Journal of English Studies; Vol 6, No 2 (2006): Cognitive Phonology*. Retrieved from http://revistas.um.es/ijes/article/view/48921

Nobile, L. (2015). Phonemes as images: An experimental inquiry into shape-sound symbolism applied to the distinctive features of French. In M. K. Hiraga, W. J. Herlofsky, K. Shinohara, & K. Akita (Eds.), *Iconicity in Language and Literature* (Vol. 14, pp. 71–91). Amsterdam: John Benjamins Publishing Company. Retrieved from https://benjamins.com/catalog/ill.14.04nob

Nyle Dimarco's ASL Survival Guide. (2015, November 16). Retrieved March 21, 2016, from https://video.nylon.com/embed/390

Occhino, C., Anible, B., Morford, J. P., & Wilkinson, E. (in press). Iconicity is in the eye of the beholder: How language experience affects perceived iconicity. *Gesture*.

Ortega, G., & Morgan, G. (2014). The effect of iconicity in the mental lexicon of hearing non-signers and proficient signers: evidence of cross-modal priming. *Language, Cognition and Neuroscience*, *30*(5), 574–585. https://doi.org/10.1080/23273798.2014.959533

Padden, C., & Gunsauls, D. C. (2003). How the Alphabet Came to Be Used in a Sign Language. *Sign Language Studies*, *4*(1), 10–33. https://doi.org/10.1353/sls.2003.0026

Padden, C., & Perlmutter, D. M. (1987). American Sign Language and the Architecture of Phonological Theory. *Natural Language & Linguistic Theory*, *5*(3), 335–375.

Pagliuca, W., & Mowrey, R. (1987). Articulatory evolution. In A. G. Ramat, O. Carruba, & G. Bernini (Eds.), *Papers from the 7th International Conference on Historical Linguistics* (pp. 459–72). Amsterdam: Benjamins.

Panther, K.-U., & Thornburg, L. L. (2010). Metonymy. In D. Geeraerts & H. Cuyckens (Eds.), *The Oxford handbook of cognitive linguistics* (pp. 236–263). Oxford: Oxford Univ. Press.

Perlman, M., & Cain, A. A. (2014). Iconicity in vocalization, comparisons with gesture, and implications for theories on the evolution of language. *Gesture*, *14*(3), 320–350.

Perlman, M., Dale, R., & Lupyan, G. (2015). Iconicity can ground the creation of vocal symbols. *Royal Society Open Science*, *2*(8), 150152. https://doi.org/10.1098/rsos.150152

Perlmutter, D. M. (1989). The moraic theory and the typology of American Sign Language syllable structure. In G. Coulter (Ed.), *Phonetics and phonology* (Vol. 3, pp. 227–261). New York: Academic Press.

Perniss, P., Thompson, R. L., & Vigliocco, G. (2010). Iconicity as a General Property of Language: Evidence from Spoken and Signed Languages. *Frontiers in Psychology*, *1*(227). https://doi.org/10.3389/fpsyg.2010.00227

Petitto, L.-A. (2013). *How the Human Child Discovers Language: New Insights from the Neural Foundations of Language, The Bilingual Brain, and the Visual Phonological Mind*. Presentation presented at the 14th Annual Early Hearing Detection & Intervention Meeting, Glendale, AZ.

Pierrehumbert, J. B. (2001). Exemplar dynamics: Word frequency, lenition and contrast. In J. Bybee & P. Hopper (Eds.), *Frequency and the Emergence of Linguistic Structure,* (pp. 137–157).

Pizzuto, E., Cameracanna, E., Corazza, S., & Volterra, V. (1995). Terms for Spatio-Temporal Relations in Italian Sign Language. In R. Simone (Ed.), *Iconicity in Language* (pp. 237–256). Amsterdam/Philadelphia: John Benjamins Publishing.

Poizner, H., Bellugi, U., & Tweney, R. D. (1981). Processing of formational, semantic, and iconic information in American Sign Language. *Journal of Experimental Psychology: Human Perception and Performance*, *7*(5), 1146–1159. https://doi.org/10.1037/0096-1523.7.5.1146

Ramus, F. (2002). Language discrimination by newborns: Teasing apart phonotactic, rhythmic, and intonational cues. *Annual Review of Language Acquisition*, *2*, 8–115.

Rosch, E. (1978). Principles of categorization. In E. Rosch & B. B. Lloyd (Eds.), *Cognition and Categorization* (pp. 27–47). Hillsdale, NJ: Erlbaum.

Rouw, R., & Scholte, H. S. (2007). Increased structural connectivity in grapheme-color synesthesia. *Nature Neuroscience*, *10*(6), 792–797. https://doi.org/10.1038/nn1906

Russell, K., Wilkinson, E., & Janzen, T. (2011). ASL sign lowering as undershoot: A corpus study. *Laboratory Phonology*, *2*(2), 403–422. https://doi.org/10.1515/LABPHON.2011.015

San Roque, L., Kendrick, K. H., Norcliffe, E., Brown, P., Defina, R., Dingemanse, M., … Majid, A. (2015). Vision verbs dominate in conversation across cultures, but the ranking of non-visual verbs varies. *Cognitive Linguistics*, *26*(1). https://doi.org/10.1515/cog-2014-0089

Sandler, W. (1986). The Spreading Hand Autosegment of American Sign Language. *Sign Language Studies*, *1050*(1), 1–28. https://doi.org/10.1353/sls.1986.0006

Sandler, W. (1989). *Phonological representation of the sign : linearity and nonlinearity in American Sign Language*. Dordrecht, Holland; Providence, RI, U.S.A.: Foris Publications.

Sandler, W. (1993). A Sonority Cycle in American Sign Language. *Phonology*, *10*(2), 243–279. https://doi.org/10.2307/4615437

Sandler, W. (2006). Phonology, phonetics and the nondominant hand. In *Papers in Laboratory Phonology: Varieties of Phonological Competence* (pp. 185–212). Mouton de Gruyter.

Sandler, W., & Lillo-Martin, D. (2006). *Sign language and linguistic universals*. Cambridge UK ;;New York: Cambridge University Press.

Sassenberg, U., & van der Meer, E. (2010). Do we really gesture more when it is more difficult? *Cognitive Science*, *34*(4), 643–664.

Shaw, E., & Delaporte, Y. (2014). *A historical and etymological dictionary of American Sign Language: the origin and evolution of more than 500 signs*. Washington, DC: Gallaudet University Press.

Sign language dictionary - SPREADTHESIGN. (n.d.). Retrieved November 17, 2016, from https://www.spreadthesign.com/us/

SLTD.tv. (n.d.). *ASL: Decide להחליט*. Retrieved from https://www.youtube.com/watch?v=gMFIxs3YERI

Spranger, M., & Steels, L. (2014). Discovering communication through ontogenetic ritualisation (pp. 14–19). IEEE. https://doi.org/10.1109/DEVLRN.2014.6982948

Stokoe, W. C. (1960). *Sign Language Structure*. Silver Spring, MD: Linstok Press.

Stokoe, W. C. (2001). Semantic Phonology. *Sign Language Studies*, *1*, 434–441. https://doi.org/10.1353/sls.2001.0019

Stokoe, W. C., Casterline, D. C., & Croneberg, C. G. (1965). *A dictionary of American Sign Language on Linguistic Principles*. [Silver Spring, Md.]: Linstok Press.

Stolarski, Ł. (2012). Size-sound symbolism in the names of cars. *Token: A Journal of English Linguistics*, *1*.

Studdert-Kennedy, M. (1981). Perceiving Phonetic Segments. In T. Myers, J. Laver, & J. M. Anderson (Eds.), *The Cognitive representation of speech* (pp. 3–10). Amsterdam ; New York : New York: North-Holland Pub. Co. ; Sole distributors for the U.S.A. and Canada, Elsevier North-Holland.

Talmy, L. (1988). Force Dynamics in language and cognition. *Cognitive Science*, *12*(1), 49–100.

Talmy, L. (2000). *Toward a Cognitive Semantics* (Vol. 1 & 2). Cambridge MA: MIT Press.

Tennant, R., & Gluszak Brown, M. (1998). *The American Sign Language Handshape Dictionary* (4th ed.). Washington, D.C.: Clerc Books; Gallaudet University Press.

Thelen, E., & Smith, L. B. (1996). *A dynamic systems approach to the development of cognition and action*. Cambridge, Mass.: MIT Press. Retrieved from http://search.ebscohost.com/login.aspx?direct=true&scope=site&db=nlebk&db=nlabk&AN=1712

Thompson, R. L. (2011). Iconicity in Language Processing and Acquisition: What Signed Languages Reveal: Iconicity in Sign Language. *Language and Linguistics Compass*, *5*(9), 603–616. https://doi.org/10.1111/j.1749-818X.2011.00301.x

Thompson, R. L., Vinson, D. P., & Vigliocco, G. (2009). The link between form and meaning in American Sign Language: Lexical processing effects. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *35*, 550–557. https://doi.org/10.1037/a0014547

Thompson, R., Vinson, D., & Vigliocco, G. (2010). The Link between Form and Meaning in British Sign Language: Effects of Iconicity for Phonological Decisions. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *36*(4), 1017–1027. https://doi.org/10.1037/a0019339

Tuggy, D. (2005). Cognitive approach to word-formation. In P. Štekauer & R. Lieber (Eds.), *Handbook of Word-Formation* (pp. 233–265). Dordrecht: Springer.

Tuggy, D. (2007). Schematicity. In D. Geeraerts & H. Cuyckens (Eds.), *Oxford Handbook of Cognitive Linguistics* (pp. 82–115). Oxford: Oxford University Press.

Tyrone, M. E., & Mauk, C. E. (2012). Phonetic reduction and variation in American Sign

Language: A quantitative study of sign lowering. *Laboratory Phonology*, *3*(2), 425–453. https://doi.org/10.1515/lp-2012-0019

Ultan, R. (1978). Size-sound symbolism. In J. H. Greenberg (Ed.), *Universals of Human Language* (Vol. 2). Stanford, CA: Stanford University Press.

Uyechi, L. (1996). *The geometry of visual phonology*. Stanford, CA: CSLI Publications.

Välimaa-Blum, R. (2005). *Cognitive phonology in construction grammar: analytic tools for students of English*. Berlin ; New York: Mouton de Gruyter.

Välimaa-Blum, R. (2009). The phonemes in cognitive phonology: episodic memories of both meaningful and meaningless units? *Cognitextes*, *2*. Retrieved from http://cognitextes.revues.org/211

Wescott, R. W. (1971). Labio-Velarity and Derogation in English: a Study in Phonosemic Correlation. *American Speech*, *46*(1/2), 123.

Wilbur, R. B. (2003). Representation of telicity in ASL. *Chicago Linguistic Society*, *39*, 354–368.

Wilbur, R. B. (2004). Complex predicates involving events, time and aspect: is this why sign languages look so similar? Presented at the 8th International Conference on Theoretical Issues in Sign Language Research (TISLR8), Barcelona, Spain.

Wilcox, P. (2000). *Metaphor in American Sign Language*. Washington, D.C.: Gallaudet University Press.

Wilcox, S. (1988, May). *The Phonetics of Fingerspelling: Kinematic, Temporal, and Dynamic Aspects of Fingerspelling Production*. University of New Mexico, Albuquerque, NM.

Wilcox, S. (2004). Conceptual spaces and embodied actions: Cognitive iconicity and signed languages. *Cognitive Linguistics*, *15*(2), 119–147.

Wilcox, S., & Occhino, C. (2016). Constructing signs: Place as a symbolic structure in signed languages. *Cognitive Linguistics*, *27*(3). https://doi.org/10.1515/cog-2016-0003

Wilcox, S., & Wilcox, P. P. (2013). Cognitive Linguistics and Signed Languages. *International Journal of Cognitive Linguistics*, *3*(2), 127–151.

Winter, B., & Bergen, B. (2012). Language comprehenders represent object distance both visually and auditorily. *Language and Cognition*, *4*(1), 1–16. https://doi.org/10.1515/langcog-2012-0001

Xavier, A. N. (2006). *Descrição fonético-fonológica dos sinais da língua de sinais brasileira (LSB/LIBRAS).* . (Dissertação de Mestrado). Universidade de São Paulo, São Paulo, Brazil.

Zwaan, R. A., & Madden, C. J. (2005). Embodied Sentence Comprehension. In D. Pecher & R. A. Zwaan (Eds.), *The grounding of cognition: The role of perception and action in memory, language, and thinking* (pp. 224–245). Cambridge, UK: Cambridge University Press.