Motivating Morphological Constituents: A Learning-Based Analysis of Hebrew, Navajo, and Spanish

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MOTIVATING MORPHOLOGICAL CONSTITUENTS:
A LEARNING-BASED ANALYSIS OF HEBREW, NAVAJO, AND SPANISH

by

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ABSTRACT

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In both description and theory, a variety of linguistic structures have been posited to account for a multitude of linguistic patterns. In the sub-field of morphology, such units include roots, stems, and morphemes. Previous research that has explored the motivation for linguistic structures and constructs in phonology and syntax has raised questions about the nature of these linguistic structures and constructs. Such work, however, has not focused on morphological constituent structure, a gap which the present dissertation addresses through a focused examination of the evidence motivating morphological constituents in Hebrew, Navajo, and Spanish.

The theoretical framework of this dissertation follows a learning-based approach, in which linguistic structure emerges from the application of domain-general learning mechanisms to linguistic data. Under this approach, a constituent is posited when a language exhibits generalizations that are more effectively expressed with it than without it. Therefore, morphological constituents for a given language are motivated through a convergence of linguistic patterns that rely on that constituent for description.

In all three languages, the grammatical word and word-internal constituents are motivated. In Hebrew, the word-internal constituents are the root and the stem; in Navajo, they are the stem, the conjunct, and the disjunct; and in Spanish, the word-internal constituent is the
stem. A lack of uniformity can be found within each language, such that verbs exhibit more complex constituent structure than other classes of words. In addition, despite the commonality in terminology conventionally employed for word-internal constituents in Hebrew, Navajo, and Spanish, the criteria motivating each of the word-internal constituents are distinct across the three languages, such that, for instance, a stem in one language is not the same entity as a stem in another.

A comparison of the findings for the three languages offers implications for linguistic theory. Given that the grammatical word is motivated for all three languages, the present study supports other work in morphology that claims the primacy of the word as a basic morphological constituent. In addition, the distinct criteria that identify each word-internal constituent in the different languages indicate that the word-internal constituents motivated by the learning-based approach cannot be thought of as universal, supporting the theoretical claim that linguistic elements, including morphological categories and domains, should be approached on a language-specific basis.
Acknowledgments

Over the years, I’ve known many people who have run marathons, and I’ve always been impressed by the commitment, hard work, and persistence that they put into training for and completing a 26.2-mile race. After feeling settled and established as an elementary and middle school teacher after several years working in a variety of classrooms, I had decided that I wanted to run my own marathon as a way of enriching my life. However, given that I have little inclination for running but great inclination for linguistics, I ultimately resolved that my version of a marathon would involve earning a Ph.D. in linguistics.

If my completion of a dissertation can indeed be likened to running a marathon, then I can say that my accomplishment would not have been possible without the dedicated guidance of a team of trainers, the warm companionship of fellow marathoners, and the loving support of cheerleaders who believed in me.

My team of trainers – a.k.a., my dissertation committee – consisted of individuals who have helped shape and sharpen my thinking about questions of language throughout my time in graduate school. From Juliette Blevins, my lead trainer and the chair of my committee, I learned the importance of comprehensive and deep knowledge and the value of an open mind in the pursuit of knowledge. She has set an excellent example of what an exemplary scholar is like. In addition, her passion for learning is contagious and I hope that I can continue to honor her great contribution to my intellectual life by continually seeking to learn. From Ricardo Otheguy, I learned that questioning received wisdom is not only allowed but also encouraged in one’s development as a scholar. Moreover, I will seek to use his gentle yet rigorous manner of guiding students as a model for my interacting with my future students. Through Jim Blevins, I discovered my love of morphology. His perspectives on the structures of words resonated with
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Though the participants in a marathon must ultimately do the work of running themselves, I am deeply grateful that in my Ph.D. marathon I have had a wonderful cadre of
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Chapter 1: Background

1. Overview of the Dissertation

This dissertation motivates the morphological constituents of three distinct languages: Hebrew, Navajo, and Spanish\(^1\). The theoretical framework adopted for this analysis is what will be referred to as a learning-based approach. The tenets of this approach and the methodology derived from it are introduced and elaborated upon in the present chapter, Chapter 1, and the application of that methodology to each of the three languages is detailed in the following chapters: Chapter 2 focuses on Hebrew, Chapter 3 on Navajo, and Chapter 4 on Spanish. The final chapter of the dissertation, Chapter 5, concludes with a synthesis of the analyses of the three languages and a discussion of the implications for linguistic theory.

The present chapter introduces the dissertation by presenting background information on the analysis applied to the linguistic patterns of Hebrew, Navajo, and Spanish. Section 1 of this chapter outlines an overview of the dissertation, including the context in which the present work is situated. The important ideas introduced in the overview are discussed in greater depth throughout the rest of the chapter. Section 2 is an exposition of the theoretical framework, the learning-based approach, on which the analysis is built. Section 3 presents previous research on motivating linguistic constituents. The methodology adopted by this dissertation for motivating morphological constituents is based on the principles of the learning-based approach and on previous work motivating other linguistic constituents. This methodology is elaborated upon in Section 4.

\(^1\) As discussed in greater detail in the chapters focusing on each of the languages, Hebrew generally refers to Modern Hebrew and Spanish to the variety spoken in Northern Mexico and along the United States/Mexico border.
1.1. Context. The present work is situated in the larger context of other work that examines the motivation for different linguistic structures and constructs. In both description and theory, a variety of linguistic units have been posited to account for a multitude of linguistic patterns. Such units include segments and syllables in the domain of phonology, roots and stems in the domain of morphology, and different types of phrases in the domain of syntax. Previous research that has explored the motivation for these types of linguistic structures and constructs has raised questions about the nature of certain linguistic elements. Such work, however, has not focused on morphological constituent structure, a gap which the present dissertation addresses.

Many of the assumptions that have been made about the universality and range of characteristics of certain linguistic structures and constructs have been questioned through this kind of work. To illustrate, if we consider the syllable as a phonological constituent, we can observe that it is indeed motivated by many different kinds of patterns cross-linguistically (J. Blevins 1995), as is discussed in greater depth in Section 3. In other words, many patterns exist across the world’s languages that make use of the construct of the syllable, indicating that it is indeed a useful theoretical and descriptive linguistic unit. However, syllables also have to be described in language-specific terms. For instance, what was once thought to be a universal sub-syllabic structure, the rhyme (i.e., nucleus and coda together as a constituent), which is relevant for describing the patterns of English, may not be relevant for describing the patterns of other languages, such as Korean, where the body (i.e., onset and nucleus together as a constituent), is motivated as a sub-syllabic structure (Yoon & Derwing 2001). Moreover, this kind of cross-linguistic exploration also reveals that the syllable as a constituent plays a minimal role, if any, in describing the patterns of certain languages, such as Gokana (Hyman 2011).
This kind of examination has been done for other linguistic structures and constructs, with similar results to those described for the syllable. Among the linguistic structures and constructs whose motivation as cross-linguistic linguistic units has been explored are the prosodic word (Bickel, Hildebrandt & Schiering 2009), distinctive features (Mielke 2000), and grammatical relations (Dryer 1997), all of which are discussed further in Section 3. In all these cases, similar conclusions have been reached: Such structures are indeed motivated cross-linguistically by the patterns of many distinct languages; however, these structures are not necessarily universal and they can have different properties across the languages for which they are motivated.

1.2. Research questions. Given the results of other work motivating linguistic constituents and the fact that such work has not yet been undertaken in morphology, a similar re-evaluation of morphological constituents is appropriate. The aim of this dissertation is to consider the nature of morphological constituents across different languages. Since the research summarized in Section 1.1 and elaborated upon in Section 3 indicates that linguistic structures and constructs cannot be assumed to be universal even if they are motivated for some languages, morphological constituency is approached on a language-specific basis in the present study. By considering three languages that are distinctive typologically, that have relatively complex morphological patterns, and that are unrelated genetically, we can begin to see the extent to which morphological constituents, such as roots and stems, can vary cross-linguistically.

The primary research question of this dissertation is as follows: What types of morphological constituents are motivated for Hebrew, Navajo, and Spanish? Within this general, overarching question, other questions are addressed. One such question builds upon an ongoing debate in the field of morphology: Is the basic unit of the morphological system a word or a morpheme? Other questions involve the word-internal units, such as words and stems: What word-
internal structures are motivated for each of the three languages? To what extent is the word-
internal structure for one class of words the same as the word-internal structure of another class of
words? For example, is a unit such as a root motivated for all content words in a given language?
If so, is a root in a noun, for instance, the same as a root in verb? Once the morphological
constituents of each of the three languages is determined, we can then make cross-linguistic
comparisons: What morphological constituents are common across the three different languages?
With regard to constituents that are shared by two or more languages, to what extent do they have
shared properties? What other similarities and differences can be found with regard to cross-
linguistic morphological structure?

The focus of the dissertation is on morphological constituents, that is, units that stand in
relation to one another (e.g., in a hierarchical arrangement) and that can be said to constitute a part
of the morphological architecture of the words in a language. A focus on morphological
constituents defined in this way is not meant to suggest that constituents are the only elements that
are relevant morphologically. Certain morphological elements may not be part of the basic
architecture of words but may nevertheless be motivated by the linguistic patterns of a given
language. For instance, a unit such as a morpheme\(^2\), a form-meaning pairing distinct from and
smaller than a word, may either be part of the basic constituent structure of words in that it can be
identified as the building block out of which words are formed, in which case it is a constituent,

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\(^2\) The term *morpheme* will be used in this dissertation to refer to a unit of form within a word that is reliably
linked to a meaning or grammatical function. Though the term *morpheme* has also been used to signify any
unit that is the minimal sign pairing, thereby allowing a word to also be a morpheme, in the present study
the morpheme is distinguished from a word. Rather than *morpheme*, the term *linguistic sign* (de Saussure,
Baskin, & Meisel 2011) will be used for a unit with a “constant form with a constant meaning” (Bybee
2010, p. 2), irrespective of whether it is a word or a sub-word element.

The term *morph* will be used for a unit of form that is not necessarily linked to a meaning or grammatical
function.
or it may be motivated only in certain limited cases, in which case it is not a constituent but is
nevertheless a motivated morphological unit for the language. If it is the former, then it would
form a principal part of the analysis of this dissertation. If, on the other hand, it is the latter, then
it would not be discussed as extensively, though it would be briefly addressed. Therefore, other
research questions of this dissertation are as follows: What other morphological elements are
motivated for each of the three languages? To what extent are such elements similar and different
cross-linguistically?

In addition, given that these three languages have been discussed in previous research and
that there are open questions regarding each one, other questions that are addressed are specific to
each of the three languages. For instance, how does the analysis adopted in this dissertation inform
questions regarding the status of the root in Hebrew, the role of the template in Navajo, and the
characterization of theme vowels in Spanish? Thus, the findings of this dissertation bear upon both
general questions regarding cross-linguistic morphological structure and specific questions
relevant to each of the three languages explored.

1.3. Theoretical approach. To address the research questions presented above, a learning-
based approach will be adopted for analyzing the linguistic patterns that motivate morphological
constituents in Hebrew, Navajo, and Spanish, an approach that has not previously been applied to
the research questions in Section 1.2. Some of the major tenets of the approach are briefly
introduced in the present section and are elaborated upon in greater detail in Section 2.

Under a learning-based approach, linguistic structures are viewed as learned entities. As
such, they are considered to be constructed based on domain-general learning mechanisms, such
as pattern-finding, generalization, and analogical reasoning (e.g., Blevins & Blevins 2009; Bybee
2010; Ramscar, Yarlett, Dye, Denny, & Thorpe 2010; Clark and Lappin 2011; Ramscar, Dye, &
McCaulay 2013). This view stands in contrast to one in which the source of most linguistic structures is a language-specific genetic endowment, such as Universal Grammar (e.g., Chomsky 1965). In other words, under a learning-based approach, children acquire language not through a language-specific learning faculty, but rather through general learning mechanisms they use to develop other cognitive systems (Tomasello 2003). As a result, linguistic structures resemble other types of cognitive categories, and findings from cognition on the nature of cognitive categories bear on the properties of linguistic structures. For instance, linguistic structures are expected to exhibit prototype effects, family resemblance relationships, and fuzzy boundaries between categories (Taylor 2003; Ramscar & Port 2015). Thus, a learning-based approach is closely linked to empirically-based research that explores mechanisms outside of the formal linguistic system, such as acquisition and processing.

Therefore, in a learning-based approach, linguistic structures and constructs are not posited in advance of analysis. Instead, they must be motivated by the data that an analyst encounters. Thus, linguistic analysis is not approached deductively. In other words, in analyzing the patterns of a language, we do not start with a set of theoretical constructs that have been decided upon a priori. Instead, linguistic analysis is approached inductively. It is from the attempt to organize the patterns of a language that particular structures and constructs emerge from the patterns themselves. To illustrate, a deductive approach to patterns in English might take as a given that a morpheme is a constituent in the language. An analyst working under this approach would then set about to determine which elements constitute the morphemes of the language. In contrast, in an inductive approach, the linguistic patterns are primary. An element such as a morpheme, a form-meaning pairing smaller than and distinct from a word, is posited only if one sees that an element that can be called a morpheme is useful in making generalizations that capture observations about
the patterns of a language that a speaker can be shown to be sensitive to. If such a construct does not emerge from the patterns, then it is not motivated for the language. Thus, the test of whether a constituent is motivated or not is primarily whether it emerges from the patterns of the language\(^3\), not whether an analysis can be formulated that uses that constituent. Thus, another way of characterizing units in a learning-based approach is as emergent.

The reason for referring to such an approach as learning-based is to emphasize the assumption that the source of linguistic structures and constructs is general learning mechanisms acting on linguistic patterns in the input. However, the basic assumptions of this approach have been characterized by others using different names and the assumptions of a learning-based approach are consistent with linguistic frameworks that have been referred to as, among terms, usage-based (Bybee 2006), constructionist (Goldberg 2013), emergentist (MacWhinney 2001), and data-driven (Clark and Lappin 2011). All these approaches stand in contrast to a innatist approach, in which the primary source of linguistic structures and constructs is an innate language faculty, such as Universal Grammar.

1.4. Methodology. In a learning-based approach, a constituent is motivated by generalizations that are more effectively stated with that constituent than without it (J. Blevins 1995). In other words, a constituent is motivated for a particular language only if we need it to describe patterns in that language. Therefore, the method for determining what morphological constituents are motivated for a particular language is by identifying linguistic patterns whose description calls for that constituent. The kinds of linguistic patterns that will be explored include distributions, processes, and constraints in morphology, phonology, syntax, and semantics.

\(^3\) The emergence referred to in this section can in be discussed in from a variety of perspectives. For example, an element can emerge in a computational learning model that is implementing a particular learning model, or an element can be said to emerge as an optimized descriptive tool in the process of an analyst attempting to describe the patterns of a language.
Patterns that can or must be described with a particular constituent serve as evidence for that constituent. In addition, though the focus of the dissertation is evidence that is internal to the linguistic system, external support will also be marshalled in certain cases. Thus, if a given constituent is utilized in processing, acquisition, or other linguistic behavior, that too serves as evidence motivating the positing of that constituent. The details of this methodology, including the rationale for the three languages chosen for analysis, are elaborated upon further in Section 4.

1.5. Major claims. A summary of the major findings for each of the languages whose morphological constituents are motivated in the dissertation can be found in Section 5 of the chapter dedicated to that language (Hebrew in Chapter 2, Navajo in Chapter 3, and Spanish in Chapter 4). In addition, a comparison of the morphological constituents of the three languages are offered in Chapter 5, whose focus is on synthesizing the findings for each language and presenting broader implications of the work. The present section, therefore, presents a preview of the major claims that are advanced in the dissertation.

For all three languages, the grammatical word is motivated as a primary morphological constituent. Though the factors that motivate the word are not identical in each language, there is considerable overlap. Among the characteristics of the word that support positing it as the basis of the morphological system in these languages is the fact that in all three cases it serves as the primary locus of semantic and grammatical features. In addition, for all three languages, word-internal constituent structure is also motivated, a finding that is not surprising given that each of the languages was selected in part because of its morphological complexity. Though certain similarities exist among the word-internal constituent structure of each of the three languages, each language should be considered on its own terms, a finding consistent with other work on motivating linguistic constituents.
In Hebrew, an asymmetry exists between verbs on the one hand and nominals (i.e., nouns and adjectives) on the other. For verbs, two word-internal constituents are motivated: the root and the stem, arranged hierarchically with the root below the level of the stem. The primary role of the root is as the anchor to the paradigms of a verbal lexeme. For nominals, only the stem is motivated as a consistent constituent. Though elements such as nominal roots and other morphemes are motivated by certain patterns of the language, they are not motivated as consistent parts of the constituent structure of Hebrew.

In Navajo, the marked difference between verbs and other lexical classes results in constituent structure that is reliably applicable only to verbs. Navajo verbs exhibit the most complex constituent structure of the languages studied in the dissertation. They consist of three constituents – the disjunct, conjunct, and stem – which are in a non-hierarchical relationship (i.e., they occur at the same level of hierarchy), below the level of the word. Of the three constituents, only the conjunct and the stem are obligatory components of the word. The analysis of this dissertation does not posit a traditional Athabaskan slot-and-filler template as part of the synchronic morphological system of the language.

In Spanish, only one word-internal constituent is reliably motivated by the patterns of the language, an element which will be referred to as the stem. This stands in contrast to the conventional view of languages such as Spanish as having a root-stem-word structure for all content words in the language. Though theme vowels and other word markers do complicate the morphological system, they do not motivate additional levels of hierarchy. The notion of complexity is introduced to account for different types of stems and words, for which additional constituent-internal structure can be identified without motivating additional constituents.
A comparison of the findings for the three languages offers implications for linguistic theory. Given that the grammatical word is motivated for all three languages and that grammatical words across the three languages are more similar than are other constituents, the present study supports other work in morphology that claims the primacy of the word as a basic morphological constituent. The morpheme, which is the basic morphological unit in other approaches, has the status of a reliable unit in each of the languages only in limited cases. It is therefore treated as a relevant morphological unit in the learning-based approach, but not as the basis of the morphological system. Word-internal constituents, such as stems and roots, are motivated for each of the languages studied. However, though some similarities do exist across the three languages, the distinct criteria that identify each word-internal constituent in the different languages indicate that they should not be considered the same type of unit cross-linguistically. In other words, what is called a Spanish stem is not the same as what is called a Navajo stem or a Hebrew stem. Therefore, the word-internal constituents motivated by the learning-based approach cannot be thought of as universal, supporting the theoretical claim that linguistic elements should be approached on a language-specific basis.

2. Theoretical Background

The theoretical approach that serves as the basis of the analyses of morphological constituents in Hebrew, Navajo, and Spanish is what will be referred to as a learning-based approach. This characterization is intended to emphasize the idea that linguistic structures are considered learned entities, constructed by learners via domain-general mechanisms during the acquisition process as they attempt to make sense of the linguistic patterns they encounter. This idea is elaborated upon in greater detail in Section 2.1. Because linguistic structures and constructs arise from general cognitive mechanisms under this theoretical approach, they are expected to have
the properties of other cognitive categories, a notion that will be discussed further in Section 2.2. Such an approach to linguistic analysis aligns well with several theoretical frameworks whose ideas overlap with each other. Such frameworks can be characterized as usage-based approach, constructionist, emergentist, and data-driven, all of which stand in contrast to the innatist approach in which linguistic structures are not learned entities but rather part of the innate endowment of the language faculty. The assumptions shared by the learning-based approach and other empiricist approaches to analysis are discussed in Section 2.3. The implications for analysis of adopting a learning-based framework are explored further in Section 2.4.

2.1. Linguistic structures as learned entities. In a learning-based approach, linguistic structures such as units, expressions, and dependencies are constructed by learners in their attempt to make sense of the linguistic input they encounter. Driven in large part by the desire to communicate with others around them, learners aim to understand the linguistic system of the speakers in their environment (i.e., the grammar of the target language). Learners are aided in this process by the kinds of learning mechanisms that help them make sense of other information they encounter, mechanisms such as pattern-finding, categorization, and analogical reasoning (Bybee 2010). Though the ability to acquire language is based on certain innate abilities of humans related to general cognition and learning, no language-specific knowledge is assumed at birth. Indeed, research on first language acquisition shows that such specialized knowledge is not necessary. Tomasello (2003) claims, for example, that the acquisition of language can be accounted for through two powerful sets of skills, neither of which is specific to language: those related to intention-reading (e.g., theory of mind) and those related to pattern-finding (e.g., categorization).

The first set of skills is related to the developing communicative needs of the child. In a learning-based framework, language is conceptualized primarily as a system of communication,
and the goal of communication is to influence someone else’s intentional or mental states (Tomasello 2003). Out of this communicative drive arises the acquisition of linguistic symbols, which are “social conventions by means of which one individual attempts to share attention with another individual by directing the other’s attentional or mental state to something in the outside world” (p. 8). In his synthesis of work in developmental psychology, Tomasello describes steps in the development of intention-reading skills that have implications for linguistic communication (e.g., use of words to refer to entities in immediate and distal environments), other kinds of communication (e.g., the ability to direct others’ attention through gestures such as pointing), and other cultural skills (e.g., the ability to participate in rituals). Thus, not only do intention-reading skills underlie important aspects of language acquisition, they also must be considered domain-general in that they influence other aspects of the development of the child’s cognitive and social skills. In addition, the level of sophistication of human symbolic thinking, critical for linguistic communication, appears to be unique to the species, which helps account for why language is a human-specific behavior (Tomasello 1998). Linguistic structure in a learning-based framework, therefore, would be expected to be shaped in large part by communicative imperatives.

The second set of skills that Tomasello claims is key to understanding the acquisition process – those related to pattern-finding – accounts for the development of grammatical structures. In contrast to intention-reading, these skills are not unique to humans (Tomasello & Call 1997). As with intention-reading skills, pattern-finding skills are not specific to language learning. Indeed, categorization, a key component of pattern-finding, is particularly adaptive to most sentient organisms. Taken together with symbolic thinking, pattern-finding skills of the kind that children have been shown to possess can lead children to find linguistic patterns in the input they receive. This process of organizing the linguistic input serves as the basis of the grammar.
Thus, a given linguistic constituent is part of the grammar because the learner discovered patterns related to that structure. In other words, if the construct *root* or *stem* characterizes certain elements in the morphological system of a given language, this is because that construct can be used to describe certain patterns of that language and plays a role in learning the language. In addition, by considering the role of categorization in the acquisition of linguistic patterns, we can also see how language develops over time. If the proximal source of, for example, roots in the grammar of a particular language is the application of an individual’s categorization skills to the patterns in that language, then the historical source of the structure is related to the process of grammaticalization, which results from new patterns that emerge from language use that lead to the development of new structures over time (Tomasello 2003). As learners encounter new forms or usages, former linguistic categories shift to accommodate the new information. The forces that shape grammaticalization, therefore, are based on both cognition and usage. Thus, in addition to being influenced by communicative imperatives, linguistic structures are also shaped by cognitive processes.

Therefore, any structure, such as a morphological constituent, that is in the grammar of the linguistically mature individual is there because the structure was useful in organizing the linguistic input and, since it was constructed using mechanisms such as pattern-finding and generalization, it would be expected to have properties associated with those mechanisms associated with it. Thus, analysts working under a learning-based approach must keep in mind notions of learnability when positing grammatical structures. Given that acquisition is assumed to proceed via domain-general learning mechanisms, linguistic structures in a learning-based approach are shaped by our knowledge of cognition and learning and of processes such as pattern-finding, generalizing, analogical reasoning, statistical reasoning, and long- and short-term memory
storage (Bybee 2010). In addition, other processes that might be expected to potentially play a role in the properties of linguistic structures would be auditory perception (or visual perception in the case of signed languages), articulation, and social factors. All these processes would be expected to shape the kinds of structures that are constructed by learners as they attempt to make sense of the linguistic input they encounter. Thus, the properties of linguistic structures should be consistent with those processes, and therefore consistent with approaches that take functionalist explanations into account.

2.2. **Linguistic structures as cognitive categories.** Given that in a learning-based approach linguistic structures are constructed from general learning mechanisms, linguistic structures are expected to have the same kinds of properties as other cognitive categories. Thus, linguistic structures can be thought of as cognitive categories, rather than as classical categories, which is how they are often conceptualized in the field of linguistics.

A classical category is determined by a set of necessary and sufficient features (Taylor 2003, p. 20). For example, ‘bachelor’ may be defined as an entity with the properties of being human, male, unmarried, and adult. Classical categories are based on the law of contradiction and the law of the excluded middle, which together assert that an entity cannot both be and not be and that it must either be or not be. An entity, therefore, cannot both possess a particular feature and not possess it. From this it follows that features are binary (Taylor 2003, p. 21). In this view, only two options exist for categorizing in terms of a given feature: either married or unmarried, either adult or not adult, etc.

Classical categories therefore have clear boundaries; if a necessary feature is absent, then the entity is not a member of the category. Someone who is not an adult cannot be a bachelor. Consequently, there are no hierarchies within a category and all members have the status within a
given category (Taylor 2003, p. 21). It is not possible, therefore, for one unmarried, single, adult human to be more of a bachelor than another unmarried, single, adult human; after all, both possess all of the necessary features to qualify as bachelors, even if one has possessed them for longer or if he also possesses other features that may be informally associated with a bachelor (e.g., living in a home that others would characterize as a so-called bachelor pad). These logic-based views of categories have been adopted by many models of language (Taylor 2003, p. 22). They stand in contrast, though, with a conceptualization of linguistic structures as cognitive categories, which is the conceptualization that is adopted in this dissertation, consistent with the learning-based framework.

Cognitive categories, in contrast, are based on experimental findings on cognition. Rather than being described using principles of formal logic, they are shaped by observations about how the mind works. As a result, rather than being defined in terms of a set of shared features, cognitive categories are characterized by a “criss-crossing network of similarities” (Taylor 2003, p. 42). Cognitive categories, therefore, exhibit family resemblance relationships, as described by Wittgenstein (as cited in Taylor 2003). With regard to the category of ‘game’, for instance, entities as diverse as baseball, chess, solitaire, and peek-a-boo all constitute games, despite the fact that no set of defining properties can characterize them. Thus, in a learning-based approach, it would not be problematic for a constituent to be defined using a convergence of various criteria, none of which on its own necessarily define the constituent.

Categories based on family resemblance relationships can also exhibit prototype effects, meaning that members of a given category can potentially be viewed along a continuum of more central to more peripheral members. With a concept such as ‘furniture’, for instance, psychologists have conducted experiments in which participants are asked to judge the extent to which items
such as dressers, desks, and shelves are examples of furniture. The results indicate that people consider chairs and tables as more prototypical examples of furniture relative to the more marginal mirrors and magazine racks, which tend to be judged as members of the category based on their similarity to the more prototypical members (Rosch 1975). As this example demonstrates, it is noteworthy that categories can exhibit prototype effects even without a single explicit prototype. With regard to linguistic categories, therefore, we would not be surprised if some members of the category are considered better examples of that category than other members.

Another way in which entities can be connected through family resemblance relationships is through what are referred to as meaning chains (Taylor 2003, p. 117). This would involve an instance where entity A is closely related to B, which is related to C, which is related to D, but where A and D do not resemble each other. Taylor, for instance, describes the various senses of over in this way, such that its occurrence in sentences such as *The lamp hangs over the table*, *Come over here*, *He got over his parents’ death*, and *It isn’t over till it’s over* can be related in terms of related meanings where every usage can be related to at least another usage even if not all usages can be related to each other (2003, p. 112-116). Thus, family resemblance relationships can be exhibited without identifiable prototypes.

A result of categories that are organized around a prototype or whose members exhibit meaning chains is that category boundaries can be fuzzy, that is, difficult to determine precisely. In other words, for some entities it can be difficult to ascertain whether it belongs to a given category or not, especially with regard to cases that are considered more marginal. Moreover, categories can merge into one another, whereby a marginal member of one category may also be a marginal member of a different category. This can be seen in the domain of colors, where, for instance, maroon can potentially be seen as a member of either the category ‘red’ or the category
‘purple’. Another result of categories defined by family resemblance relationships is that not all members of a category have equal status. We would therefore expect to see what are referred to as degree of membership effects, which involves speakers judging one entity a better member of a category than another (e.g., a chair being judged a better representative of the category furniture than a mirror). Both fuzzy boundaries and degree of category effects are explicitly ruled out when dealing with classical categories. Constituents motivated under a usage-based approach, therefore, would be expected to exhibit properties such as fuzzy boundaries, degree of category effects, and prototype effects.

2.3. Alignment with other orientations. As with all theoretical approaches, the learning-based approach makes certain assumptions about the nature of linguistic structures and how they should be represented. The assumptions of the learning-based approach align well with theoretical orientations that have been called usage-based, constructionist, emergentist, and data-driven. The primary reason that the theoretical approach of this dissertation is not characterized by one of these orientations is because these frameworks all have theoretical mechanisms that are further developed than is necessary for answering the research questions of this dissertation. In other words, the assumptions of the methodological approach of this dissertation are consistent with usage-based, constructionist, emergentist, and data-driven orientations, but since the aim of the dissertation is to motivate morphological structures through surface patterns of the language the linguistic structures of these models will not be taken as a priori structures. A linguist operating under the assumptions of one of these frameworks should be able to make connections among the structures posited in the present work and those of models working under another related framework, but those connections are beyond the scope of the present study. All the aforementioned frameworks can be categorized under the umbrella term empiricist since linguistic
structure is said to come from individual’s experience with the world. They stand in contrast to frameworks that can be called *innatist*, which posit that linguistic structure is available at birth through an innate language faculty. The assumptions of each of these are discussed in turn.

2.3.1. Alignment with empiricist orientations. In a usage-based framework, grammar is defined as “the cognitive organization of one’s experience with language” in which “specific usage events affect representation” (Bybee 2006, p. 11). In a usage-based approach, grammar derives from general cognitive processes such as categorization and memory. As a result, findings from other fields, such as cognitive science, bear on linguistic theory. Thus, related to the claim of a learning-based approach that linguistic structures constitute cognitive categories rather than classical categories, one of the properties of the usage-based framework is that gradience and variation are incorporated into linguistic structures, which stands in contrast to frameworks, such as the generative framework, that seek to describe an idealized version of the structure by abstracting away from variability in usage. Another characteristic of the usage-based framework is that grammar is also shaped by usage, which aligns with the learning-based principle that linguistic structure emerges from learners’ experiences with the linguistic input they encounter in the process of acquisition. With regard to morphological structure, Bybee writes that “even though words entered in the lexicon are not broken up into their constituent morphemes, their morphological structure emerges from the connections they make with other words in the lexicon” (Bybee 1995, p. 429). Thus, linguistic structures are emergent in a usage-based approach, and this emergence arises from connections among surface forms. Grammar is a result of the network of interconnections among lexical items. An important idea of the usage-based approach is that the basis of the lexicon is words themselves, since the words are what the user experiences directly.
Though the word is the primary morphological unit, this framework also allows for word-internal constituents as emergent units that arise from general cognitive processes.

Linguistic frameworks that are constructionist in orientation are based on a variety of assumptions that are characteristic of a learning-based approach. Under a constructionist orientation, the primary linguistic elements are constructions, that is, pairings of form and function that are learned directly from surface patterns (Croft 2007; Goldberg 2013; also see Langacker 2007 for the same notion in Cognitive Grammar). Constructions, therefore, are learned entities, and they are learned via general cognitive mechanisms. The representation of constructions in the mind is posited to be via a network of interrelations (Goldberg 1995), a characteristic that is also part of a learning-based orientation (Bybee 2006), and that connects well with the idea that linguistic categories arise as generalizations over patterns observed in the input and thus are shaped by experiences of the learner. Constructionist approaches recognize that languages can vary widely, and broader generalizations that can be made about language as a whole can be linked to domain-general cognitive processes (Goldberg 2013, p. 16). Thus, constructionist approaches are also informed by work in fields such as cognitive science, which is one of the several reasons it is consistent with the learning-based approach adopted by this dissertation.

Another characteristic of the learning-based approach is that linguistic structure is considered emergent. In an emergentist perspective, language is viewed as a self-organizing system of human behavior (MacWhinney 2001). Therefore, any linguistic structures that can be said to characterize language develop as a result of cognitive processes acting upon linguistic patterns. Under an emergentist perspective, an individual’s grammar consists of the generalizations that a learner has drawn to organize the complex input that the individual encounters. Thus, language acquisition is the proximal source of the linguistic structures that characterize a given
language and is driven by general cognitive processes, such as statistical learning (Harrison & Raimy 2007). As with other empiricist approaches, language representation in an emergentist perspective is considered from the point of view of cognitive organization. Neural networks, for example, represent connections between meanings and sounds and the abstractions associated with these (MacWhinney 2001). In an emergentist model, therefore, linguistic constituents would be the abstractions that arise from these types of connections.

In a data-driven orientation, the source of linguistic structure is the learning algorithms that allow learners to draw generalizations from the data in the linguistic input. Clark and Lappin (2011) argue that “the most important evidence available to the child consists of the utterances to which he/she is exposed in the first few years of his/her life” (p. 55). The two key components of the construction of linguistic structure, therefore, are learning algorithms and linguistic patterns. Clark and Lappin model the former via computational paradigms, which are posited to be available to the child learner in the acquisition process. These processes acting on the linguistic input encountered by the child identify patterns that lead to generalizations. Among the generalizations that can arise in a data-driven model are linguistic constituents. The learning algorithms in their models are innate in the sense that they are posited to be available to the child as part of the human genetic endowment. The algorithms, however, reflect domain-general processes that are not specific to language. Representative of general cognitive processes, therefore, the computational learning-models of Clark and Lappin are consistent with the learning-based perspective that linguistic structures are a type of cognitive category. Indeed, the learning-based approach can be said to complement the models of the data-driven framework. Whereas the data-driven framework focuses on the learning algorithms that apply to the linguistic input, the learning-based approach focuses on the patterns that these algorithms are likely to identify. A data-driven approach,
therefore, overlaps significantly with an emergentist perspective, both of which are consistent with a usage-based, constructionist approach to grammar.

2.3.2. Contrast with the innatist approach. The empiricist orientations discussed in the previous section share the assumption that linguistic structure arises from the experiences of learners with the patterns of the language they encounter. As such, they stand in contrast to innatist approaches, such as the generative framework, in which linguistic structures are available at birth as part of the genetic endowment of the child. Thus, the source of linguistic structure in an innatist approach is the innate language faculty. In this view, children are born with an inventory of linguistic structures, what is commonly referred to as Universal Grammar (UG) (Chomsky 1965). Two examples of what might be part of UG are the morphological and prosodic hierarchies, such as those in Table 1 (morphological domains adapted from Bermúdez-Otero 2013 and Lehnmann 2008 and prosodic domains adopted from Schiering, Bickel & Hildebrandt 2010).

Table 1: List of morphological and prosodic hierarchical domains under an innatist approach

<table>
<thead>
<tr>
<th>Morphological hierarchical domains</th>
<th>Prosodic hierarchical domains</th>
</tr>
</thead>
<tbody>
<tr>
<td>phrase, grammatical word, stem, root</td>
<td>phonological phrase, prosodic word, foot, syllable</td>
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</table>

In each of these hierarchies, various levels of structure are proposed for every language. Each domain occurs in a fixed position (e.g., stems dominate roots) and each domain is present in every language (e.g., each language exhibits a prosodic word domain intermediate between the phonological phrase and the foot). The hierarchy is posited to be universal, though specific instantiations of each domain are language-specific. Thus, the task of the learner is to determine what elements in the linguistic input map onto the pre-determined structures of the innate language faculty.
This line of reasoning is well exemplified by the Principles and Parameters (P&P) approach (e.g., Chomsky 1995). In this characterization of the innate language faculty, UG consists of general principles that constrain linguistic structures through positive and negative requirements that dictate what is or is not licit in the grammar of every language. These principles, however, need not be instantiated in the same manner across different languages. The various possibilities for instantiation of these principles are known as parameters. To illustrate using a discussion found in Haegeman (1994), one of the principles proposed in the P&P-based theory of Government and Binding is the Extended Projection Principle (EPP), which states that all sentences must have an element in the structural position of the subject, irrespective of the argument structure of the verb. It is argued that this structural requirement explains why English requires the semantically empty element *it* in a sentence such as *It is raining*. However, not all languages insert such an empty element in that construction. In Spanish, for example, one can simply express the same proposition with a verb that serves as the entire sentence: *Llueve* ‘It is raining’. Furthermore, even in instances where the word in the subject position does have a specific referent, Spanish allows sentences that appear to not have any element in the subject position: e.g., *Bailo* ‘I dance’, which consists of simply an inflected verb and stands in contrast to the English counterpart in which the absence of an element in the subject position is considered ungrammatical. A P&P account of these facts invokes the notion of parameters (in addition to the idea that syntactic structure is represented at multiple levels): All sentences in all languages do in fact adhere to the EPP at the underlying level, but the EPP need not apply at the surface level. For any given language, then, the universal principle of the EPP has at least two parameters associated with it, overt subject or null subject, depending on whether or not the language requires surface expression of the subject. Thus, following the P&P-based Government and Binding account, all children are born with the EPP
and at least two associated parameter settings as part of UG, and Spanish and English adult
grammars differ only with regard to the parameter setting of that principle: English sets the EPP
parameter to overt subject and Spanish to null subject.

One consequence that follows from adopting an innatist versus a learning-based framework
involves the nature of the linguistic structures that one posits in one’s model. Among the properties
of linguistic structures that can be associated with one framework or another include their
complexity, their degree of abstractness, and the kinds of categories they represent. The primary
issue shaping the properties of structures in any approach is that, in order to model natural
language, the structures and mechanisms that are posited must be learnable by the child. Given
the distinct views about language acquisition associated with the two approaches, very different
ideas about learnability arise depending on which perspective one adopts, which in turn shape the
nature of the linguistic structures in models that instantiate these two approaches. Because in an
innatist framework, the child is genetically endowed with linguistic structures at birth, learnability
is less of a constraining factor with regard to how complex structures can be. Indeed, this
framework was designed specifically to deal with what were viewed as linguistic structures that
were believed to be learned naturally (Chomsky 1986). Consequently, structures posited by an
analyst to account for observed linguistic patterns can be relatively complex since their learnability
is not particularly a problem.

One form of complexity available in an innatist framework involves the positing of
relatively abstract elements (i.e., elements removed from the surface expressions they are meant
to represent). In generative approaches, for example, a minimum of two distinct levels of
representation are proposed, with mechanisms, such as the transformational rules of Chomsky
(1965), linking structures in different levels. Given a complex set of such mechanisms, one can
then posit linguistic units whose properties are minimally reflected in actual utterances of speakers. For example, in the generative-oriented Optimality Theory, a principle known as the *richness of the base* states that any phonological representation is available underlingly regardless of whether such a representation is manifested at all in the surface realization (Prince & Smolensky 2008). As with complexity in general, such a level of abstractness is possible because the proposed mechanisms linking underlying and surface structures are presumed to be innate. This stands in contrast with the learning-based approach in which structures posited by the analyst must be linked to surface patterns in the language. This does not mean that abstract elements are not available in a learning-based analysis, but any abstract elements must be supported with evidence from the patterns of the language or speakers’ linguistic behavior. As discussed in Sections 2.1, 2.2, and 2.3.1, linguistic structures in a learning-based approach are emergent. Linguistic units are best treated as abstractions over full surface forms; such abstractions that are relational in nature and are driven by the connections that can be found among surface forms (J.P. Blevins 2006). As a result, their complexity is limited by the learning process, and therefore abstract elements are posited only via direct evidence from the surface patterns of the language.

In addition to views on the nature of linguistic structures in innatist versus empiricist frameworks, these two approaches are also associated with distinct views of how structures compare cross-linguistically, including whether linguistic structures can be thought of as universal. The issue of universality is relatively straightforward for an innatist approach. After all, if UG – the ultimate source of linguistic structure – is part of the genetic endowment, then all humans are born with the same set of grammatical resources. Though the principles and parameters of UG are instantiated differently in different languages, there is a sense in which all languages ultimately exhibit the same linguistic structure (Chomsky 1965). Structures that may at first appear quite
different are actually all manifestations of a common linguistic architecture (Baker 2001). As a result, structures are readily comparable across languages in an innatist framework, which also follows from a perspective in which linguistic units are classical categories with clear boundaries and readily definable through a set of necessary and sufficient features, as discussed in Section 2.2. Once a set of forms in one language is determined to constitute, for example, the instantiation of auxiliaries, then they can be assumed to be the same type of entity as auxiliaries in another language. This is necessarily the case because all linguistic structures are drawn from the same inventory of options offered by UG and they are governed by the same principles.

In a learning-based framework, on the other hand, universality is not a central issue. Though universality is in principle possible under a view that treats structure as emergent via general learning mechanisms, if a given structure is universal, the reason for it would be related to something about cognition, phonetics, or communicative needs. As Tomasello (2003) argues: “Universals are therefore emergent phenomena, based ultimately on universals of human cognition, human communicative needs, and human vocal-auditory processing” (p. 19). Thus, universality in such an approach may also arise from innate mechanisms, but these need not be specifically linguistic mechanisms. Linguistic universals, therefore, are possible in a learning-based approach; however, universality is not an important tenet of the framework. Whether or not universals exist neither strongly supports nor challenges the learning-based framework, in contrast to the innatist framework, which is based on assumptions of and makes predictions about universality of linguistic structure. Universals in a learning-based approach are determined empirically rather than theoretically, which means that structures would have to be identified first in individual languages and only after substantial overlap is found across languages should notions of universality be entertained.
2.4. Implications for analysis. The learning-based approach to analysis can be considered an inductive approach because it involves starting with surface patterns and building linguistic structure from those patterns. In this way, analysis for the analyst mirrors the acquisition process of the learner. The surface linguistic patterns are the point of departure, and linguistic categories are generalized based on whether they are useful for organizing those patterns. This contrasts with a deductive approach, in which one starts with a priori established linguistic categories and then looks for instantiations of those categories in the patterns of the language one is studying.

In an inductive analysis, the analyst begins by searching for patterns in the utterances of the language. Linguistic categories, such as morphological constituents, are posited when certain forms exhibit similar behavior. For example, an analyst approaching a new language without a priori notions of what constituents are relevant for that language might note early on in the process of analysis that only certain types of sequences are uttered in isolation. For instance, in English, one might observe that children hear utterances such as \[\text{wɛizjə-bal}\] (‘Where’s your ball?’), \[\text{ðɪsbælizfɪəmɡɹæm}\] (‘This ball is from Grandma’), and \[\text{ɡɪvmɪðəbælðætsblu}\] (‘Give me the ball that’s blue’). One might note that the sequence \[\text{bəl}\] is repeated in multiple contexts and that in all instances where this expression is found the intended message involves a spherical toy. One might then observe that this sequence can be uttered in isolation. These two properties – a reliable referent in the message and the ability to be uttered in isolation – also converge on other sequences, such as \[\text{ju}\] (‘you’), \[\text{naʊ}\] (‘now’), and \[\text{sit}\] (‘sit’). Given that these properties and others reliably apply to a certain set of forms, it is reasonable to posit a more abstract category that characterizes these forms and others that share the same properties. Constituents, such as word, in a learning-based approach are motivated using this type of procedure.
Constituents within a constituent are motivated in a similar fashion, that is, on the basis of patterns that converge on elements within an established constituent. Thus, word-internal elements, such as roots or stems, are abstractions over words. In other words, the basic units of the system are the surface forms that a learner directly encounters and constituents of those units arise as generalizations drawn by comparing connections among those surface units and identifying recurrent parts of those surface units. In this way, this analytical approach can be considered abstractive, whereby “patterns within a morphological system [are described] in terms of relations abstracted from forms and associated properties” (J.P. Blevins 2016, p. 14). In an abstractive approach to analysis, grammar is viewed as “a set of relations among full surface forms” (Anderson 1992, p. 369). The full surface forms Blevins and Anderson refer to are grammatical words. It is important to note, however, that in such an approach the grammatical words are not taken for granted. Words do not have “a privileged status a priori” (J.P. Blevins 2016, p. 164), and therefore in the present study they are motivated in the same way that word-internal morphological constituents are motivated. However, given how relevant words have been found to be in other descriptive and theoretical work, it is hypothesized that the grammatical word will indeed be motivated for the three languages in focus, an idea that is developed further in Section 4.1.1.

Another characterization of this kind of analysis is that is implicational. Analyses that can be described in this way “adopt a complex system perspective and emphasize patterns of interdependency” (J.P. Blevins, 2016, p. 5). The learning-based approach is consistent with an implicational analysis since it is founded on the view that morphological constituents are based on relations among forms. The interdependent relationships that characterize morphological constituents constitute part of a larger system and therefore we need not limit ourselves to morphological patterns when considering the motivation for morphological constituents. That is,
phonological, syntactic, and semantic patterns can also serve as evidence for morphological constituents. In addition, a key component of the analysis that will be adopted in this dissertation is that patterns will not be analyzed by focusing simply on words in isolation. Motivation for morphological constituents will come about by comparing forms to other forms and determining which of the relationships that emerge from these networks of connections can be characterized as morphological constituents. An implicational analysis of linguistic structure is consistent with the various frameworks discussed in Section 2.3. As J.P. Blevins (2016) observes, “network-based implicational models fall within a cognitive tradition that includes ‘emergentist’ (Bybee 1985, 2010), ‘usage-based’ (Tomasello 2003; Diessel 2015) and ‘construction-based’ branches” (p. 17).

The learning-based approach of this dissertation is built upon the insights of these various characterizations of linguistic structure, and the analysis that is adopted is abstractive and implicational. Morphological constituents for a given language are motivated based on connections that emerge in the linguistic patterns of that language.

3. Motivating linguistic structures

Given that this dissertation is adopting a learning-based framework, the methodology employed for analysis of the morphological constituents of Hebrew, Navajo, and Spanish is informed by previous studies in which linguistic structures are motivated based primarily on surface patterns. A detailed discussion of the syllable in Section 3.1 will serve to illustrate the process of motivating a linguistic structure and the potential results of such an endeavor. It will be followed in Section 3.2 by a briefer discussion of other linguistic structures that have been motivated: the prosodic word, distinctive features, and grammatical relations.

In all cases, the structures discussed are widely used in linguistic description and theory. As such, they have clearly been deemed useful constructs by many analysts in their work.
However, the fact that a particular structure is widely used does not entail that it is in fact sufficiently motivated by observed linguistic patterns. After all, linguistics is not immune from a certain amount of “inertia of ideas” (Matthews 1993, p. 92), whereby weakly supported constructs are perpetuated despite their questionable value simply by virtue of having become familiar to many. Thus, the mere pervasiveness of a linguistic structure should not be reason enough to assume that it is motivated by the evidence at hand. Rather than assuming that a given structure is relevant to a language simply because it has been utilized by multiple researchers, a structure will be motivated in a language when that language exhibits generalizations that are more effectively expressed with that construct than without it (J. Blevins 1995).

In this way, the task of the analyst is similar to the task of the child acquiring a language: Both are attempting to organize the linguistic patterns they encounter. In addition, the factors that motivate a particular structure for an analyst are also those that make it salient in the input for children attempting to create categories to organize the linguistic data they encounter. For example, in a language with fixed stress on the penultimate syllable of the word, such as Nahuatl (Herrera 2004), the stress pattern would draw the learner’s attention to phonological word boundaries, thereby making the category *phonological word* salient to the child and providing at least one criterion for identifying it. The same stress pattern would also serve as motivation for an analyst of that language to posit the construct *phonological word* as necessary for describing the linguistic system of that language. In this way, the process of motivating a linguistic structure is grounded in the idea that what the analyst posits as a theoretical structure reflects what is also salient for the child during the acquisition process.

3.1. **Motivating the syllable.** The syllable – a phonological organizational unit that is longer than a segment and shorter than a prosodic word – has served as a descriptive and theoretical
construct in a wide variety of linguistic approaches (J. Blevins 1995). It has been implicated in a multitude of phonological models: as a vital structure in metrical stress theory (e.g., Hayes 1995); a component of many rules in Generative Phonology (e.g., Kenstowicz 1994); a coupling unit of gestures in Articulatory Phonology (Nam, Goldstein, & Saltzman 2010); and the target of many constraints in Optimality Theory (e.g., Kager 1999). As demonstrated by its widespread adoption, many linguists have clearly deemed it a useful construct in theory-building. Following the research questions of this dissertation (cf. Section 1.2), we can ask similar questions regarding the syllable: Is the syllable motivated by surface linguistic patterns and/or language-external evidence, or has it been motivated for strictly language-internal reasons? Moreover, to what extent can knowing about a syllable in one language tell us about syllables in other languages?

3.1.1. Linguistic patterns that motivate the syllable. The answer to the first question is discussed by J. Blevins (1995), who presents extensive cross-linguistic evidence for the syllable as a phonological constituent. Though syllable structures can vary enormously across languages, Blevins illustrates how a clear set of heuristics converges on syllables and sub-syllabic constituents in individual languages, offering coherent explanations for a wide range of sound patterns. Among the evidence she provides in support of positing a syllable as a constituent are a wide diversity of linguistic processes: those for which the syllable serves as a domain (e.g., stress and tone across many languages, pharyngealization in Cairene Arabic and Berber, ballisticity in certain Otomanguean languages); those which apply at syllable edges (e.g., syllable-initial aspiration in English and Kumjen and syllable-final aspiration in Sierra Popoluca and Yucatec Mayan); and those that target syllables (e.g., language games, morphological reduplication processes). In all these cases, merely describing the linguistic phenomena requires a reference to a syllable. Thus, such phenomena facilitate learners’ positing of a syllable both because the syllable is made salient
by that pattern (whether it be stress assignment, aspiration, reduplication) and because positing a syllable as a constituent allows the child to more readily learn to reproduce that pattern.

3.1.2. Evidence against universality of the syllable. Though the syllable is clearly established as a useful constituent in general linguistic description and theory, it is also important to note that its motivation in some languages does not entail that it is motivated for all languages. In a learning-based framework, it would not necessarily be expected that the need for such a constituent would be equal across languages. In fact, it would not be surprising if some languages offer minimal, if any, motivation for the syllable as a constituent. Gokana, a language of the Niger-Congo family spoken in Nigeria, is an example of such a language. Hyman (2011) argues that Gokana exhibits minimal application of the syllable as a constituent. He presents evidence that many of the linguistic phenomena that often rely on the syllable across other languages (e.g., distributional constraints, phonological rules, allomorphy, stress assignment) can be accounted for in Gokana without the notion of the syllable. Though Hyman notes that the description of a few marginal phenomena (consonant identity asymmetries in prosodic stems) may be served by the construct of the syllable, we can conclude that children building a model of Gokana’s sound system would find little motivation to develop the construct of the syllable as they attempt to organize the phonological patterns of the input around them.

3.1.3. Language-specific properties of the syllable. In addition, even in languages in which an organizing unit that may be referred to as a syllable is motivated, its properties may be language-specific. One characteristic of syllables that has been posited to be universal is the proposition that the sequence CV is a basic syllable structure in all languages, which means that in …VCV… sequences, the consonant is syllabified with the following vowel, V.CV rather than VC,V, a proposition encapsulated in the Maximal Onset Principle (Hayes 2009). Certainly, this seems to
be common cross-linguistically, which can be explained in part phonetically with the observation
that consonantal gestures tend to be coupled articulatorily with the vocalic gestures that follow
them (Nam, Goldstein, & Saltzman 2010). This and other phonetic factors help to account for the
strong typological tendency of languages to adhere to the Maximal Onset Principle; however, this
preference need not constitute part of the pre-existing mental representation of the learner. The
expectation under a learning-based framework would be that consonants syllabify with vowels in
whatever direction is indicated by the data. For many learners, that would indeed lead to CV units.
This, however, would not necessarily be expected to be universal. In fact, for a learner of Arrernte,
a Pama-Nyungan language spoken in the Northern Territory of Australia, the linguistic processes
in the language favor attending to VC units rather than CV units. For example, the reduplicative
processes of the language – involving the frequentative, habitative, and attenuative forms – all
involve a VC stem in conjunction with one or two VC units from the base (e.g., in the pair eN-em
‘is standing’ and eNepeN-em ‘keeps standing’, the latter exhibits reduplication of the stem eN
with insertion of -ep- between the stem and the reduplicant) (Breen & Pensalfini 1999). Children
attempting to make sense of these patterns would have an easier time acquiring the use of
reduplicative forms more effectively if they treat syllabic units as vowel-initial rather than
consonant-initial. Moreover, the stress system of the language does not indicate otherwise, since
the algorithm – stress the first vowel preceded by a consonant (Breen & Pensalfini 1999) – allows
children to learn to stress words without necessitating reference to CV sequences as prosodic units.
In Arrernte, Breen and Pensalfini argue, the syllable template is vowel initial (i.e., there are no
onsets in the syllable template), such that VCV and VCCV sequences are syllabified as VC.V and
VCC.V respectively. The psychological reality of VC sequences as units in Arrernte sequences
can be seen in the language game, Rabbit Talk, which involves transposing what can best be
described as the first syllable, a VC unit (e.g., [itirem] → [iremit] ‘thinking’) (Breen & Pensalfini 1999). As a linguistic unit, both for the linguist and for the child learner, the basic CV syllable is not necessary for describing or using the language, and is therefore not motivated as the basic shape of the syllable in Arrernte.

Another way in which syllables may vary across languages involves their sub-constituents. Yoon and Derwing (2001), for example, discuss how, though syllables may be constituents relevant for analysis of both English and Korean, the structure of the units is distinct in each language: English relies on the rhyme (nucleus-coda, Figure 1a) as a syllabic sub-constituent, whereas Korean relies on the body (onset-nucleus, Figure 1b).

Certainly, the rhyming traditions of a language such as English, both in formal verse and in children’s word play, suggest that the rhyme is, in fact, a robust linguistic constituent. In Korean, though, this does not appear to be the case, something that is hinted at by the orthographic system, which includes syllables as units of letters that when split are divided into body and coda. Just as the psychological reality of the rhyme for English speakers can be seen in the game Pig Latin, wherein the onset is split from the rhyme, Korean speakers have the nosa game, in which the body and the coda are split (e.g., [chəl.su] → [chə.no.sal.su]) (Yoon & Derwing 2001). Yoon and Derwing demonstrate that the body, not the rhyme, is the psychologically real sub-syllabic unit for speakers. In a series of experiments – judging two syllables with regard to their similarity, forming classes of words based on whether they share a rhyme or a body, reduplicating either body or
rhyme, and recalling nonce words – Korean participants consistently give primacy to the body in precisely those situations where English speakers give primacy to the rhyme. Yoon and Derwing offer a glimpse into what the experience of children learning Korean might be: an encounter with an inventory in which contrasts are minimally retained in coda position relative to onset position. Thus, a Korean learner attempting to organize the phonological patterns of the language is better served to focus on the body as a sub-syllabic constituent rather than the coda. Yoon and Derwing’s results indicate that even in two languages that both rely on the syllable as a constituent, the sub-syllabic units are not predetermined. In an innatist approach that treats the syllable as part of the endowment of Universal Grammar, the Korean results would motivate inclusion of yet another parameter in the syllable architecture, whereas in a learning-based approach, no further stipulations are necessary: The sub-syllabic units for which the child learner finds evidence are those that are motivated for both the child and the analyst.

3.1.4. Benefits of motivating the syllable. This collection of studies demonstrates the contribution that the exercise of motivating linguistic constituents using internal and external evidence can offer to linguistic theory. Far from discrediting the value of the syllable, this endeavor confirms the utility of relying on it as a constituent in descriptions of and explanations for linguistic patterns. However, research on the syllable also reveals some of the limitations of the syllable as a construct: It is not necessarily universally applicable and it exhibits notable cross-linguistic variability with regard to its properties. As such, though some generalizations can be made regarding its characteristics, when dealing with the patterns of a specific language, the syllable should be considered on a language-specific basis. An examination of the evidence for the syllable, therefore, illustrates how the enterprise of motivating constituents contributes both to our understanding of linguistic structure in general and to our understanding of specific languages.
3.2. Motivating other structures. Similar enterprises have been embarked upon for other linguistic structures as well. Questions of what motivates a particular construct have been asked of, for example, the prosodic word, distinctive features, and grammatical relations. As with Blevins’ (1995) treatment of the syllable, linguistic and extra-linguistic patterns have been marshalled to motivate these other structures, and similar conclusions have been reached. Though these structures have proven useful for many linguistic patterns, they are most usefully approached in language-specific terms.

3.2.1. The prosodic word. Another longstanding phonological structure whose status has been explored is the prosodic word. A discussion of the extent to which this unit is motivated cross-linguistically can be found in Bickel, Hildebrandt, and Schiering (2009). They contrast two types of approaches to cross-linguistic analysis of phonological domains. The first approach is one in which “prosodic domains are conceived as pre-existing entities which can be discovered by phonological patterns which reference them within or across languages” (p. 72). Consistent with the conceptualization of grammar in an innatist framework, these a priori domains, introduced in Section 2.3.2 in Table 1, adhere to certain logically consistent principles, encapsulated in the Prosodic Hierarchy framework (e.g., Nespor & Vogel 1986). One of the theoretical predictions that follows from this framework is known as the Clustering Hypothesis, which “posits a finite range of possible domains and predicts that phonological patterns universally converge on this range of domains” (Bickel, Hildebrandt & Schiering 2009, p. 47). According to the Clustering Hypothesis, therefore, there is one and only one domain intermediate between the foot and the phrase. This kind of straightforward and clearly defined organization coheres well with the kinds of structures that characterize grammar in an innatist approach. Having one and only one domain
that is hierarchically arranged and readily identifiable relative to other units is ideal as a feature of a formal phonological system that is part of a newborn’s innate language faculty.

The problem with this characterization of prosodic organization, however, is that its predictions are not borne out. For example, a close analysis of the phonological patterns in Limbu, a Sino-Tibetan language of Nepal, reveals that the Clustering Hypothesis is disconfirmed. Instead of only one prosodic domain between the foot and the phrase, Limbu exhibits four distinct domains at the prosodic word level (Schiering, Bickel & Hildebrandt 2010; Bickel, Hildebrandt & Schiering 2009). Limbu, therefore, violates one of the principles of the Prosodic Hierarchy framework by exhibiting too many prosodic domains. As these researchers show, the principles of the Prosodic Hierarchy framework can also be violated by a language not exhibiting enough prosodic domains. Another hypothesis of the Prosodic Hierarchy framework, the Strict Succession Hypothesis, states that the phrase level must dominate a prosodic word level. In other words, a given level in the prosodic hierarchy cannot be skipped. Vietnamese, a Viet-Muong language of Vietnam, however, serves as an example of a language without a convergence of evidence for a domain intermediate between the foot and the phrase. Connected to the isolating nature of the morphological system, many words are mono-syllabic, and, in fact, no prosodic distinction is necessary between the prosodic word and the syllable for such words. The words in the language that are multi-syllabic, on the other hand, are not distinguishable prosodically from phrases. No phonological processes apply to a class that includes only words, whether mono-syllabic or multi-syllabic, to the exclusion of syllables and phrases (Schiering, Bickel & Hildebrandt 2010). Therefore, languages such as Vietnamese and Limbu demonstrate that the Prosodic Hierarchy framework, at least in its strictest formulation, does not work as a universal characterization of phonological structure.
To address the fact that the predictions of the Prosodic Hierarchy framework fail empirically, Bickel, Hildebrandt, and Schiering (2009) offer two different alternatives to address this. One possible solution is to modify the elements of the universal framework. For example, the problems presented by Limbu could be resolved by adding levels of hierarchy, and the issues involved with Vietnamese could lead to an introduction of exceptions. Though doing so would address the empirical problems, it would also lead to a less compact and less elegant representational model. Though allowing for these kinds of adjustments to the model may improve its empirical validity, it also leads to a more stipulative model and makes it more difficult to assess when the data actually call for an abandonment of the basic premises rather than minor alternations to the model. After all, if one’s model can always be adjusted, then one does not have an effective way of determining whether the assumptions were valid to begin with.

The other approach that Bickel, Hildebrandt, and Schiering (2009) offer as a way of addressing the empirical shortcomings of the Prosodic Hierarchy framework is, in fact, to reject the initial assumptions of universality in favor a language-specific orientation. The alternative they offer is referred to as the typological approach: “Instead of assuming a finite and universally fixed set of phonological domains, one may ask what kinds of domains are empirically evidenced by a sample of languages and explore the principles that explain the distribution of the attested domains” (p. 48-9). Thus, the starting point for an examination of phonological domains is an empirical exploration of individual languages; only after a large number of languages have been considered can an analysis about language-general properties of these domains be undertaken. Given the inductive nature of this approach, it aligns well with the learning-based framework.

The methodology presented by Bickel, Hildebrandt, and Schiering (2009) for examining the prosodic word serves as a model that can be applied to other linguistic domains as well. They
begin by defining the object of inquiry, in this case by defining the prosodic word as a domain of sound patterns that excludes feet and syllables on the one hand and phrases and compounds on the other. Since their goal is to make general claims about prosodic structure, they rely on a large database of phonological patterns, one that includes prosodic word patterns such as stress assignment, segmental processes, and phonotactic constraints from 63 distinct languages belonging to a broad range of language families. These patterns were evaluated to determine whether they converged on a single domain smaller than a phrase and larger than a foot. Thus, rather than assuming that one and only one such domain is relevant in these languages, they treated this as a hypothesis to be tested empirically. What Bickel, Hildebrandt, and Schiering find is that only 9 of the 63 languages converge on a single prosodic word domain, contra the prediction of the Prosodic Hierarchy framework. Thus, empirically attested phonological patterns support positing distinct levels of phonological structure for different languages, supporting the idea that linguistic domains should be determined on a language-specific basis. Both in its methodology and its conclusions, the typological approach is consistent with the learning-based approach, and it significantly informs the work of this dissertation.

3.2.2. Distinctive features. The fundamental assumptions of Mielke’s (2008) discussion of distinctive features in phonology are congruent to those made in this dissertation regarding morphological domains. Mielke’s focus is on motivating distinctive features, the properties of sounds used to make natural class groupings. One example of a distinctive feature is [voice], which can be used to distinguish [+voice] sounds such as /b, d, g/ from their [-voice] counterparts, /p, t, k/. Mielke stresses that he is not necessarily questioning whether distinctive features are broadly useful in phonological description and theory; rather, he is asking questions related to the source
of distinctive features, their status as universal structures, their cross-linguistic comparability, and the like.

Mielke (2008) contrasts two different views of the source of linguistic structure: what he calls innatist and emergentist. The innatist view of distinctive features views these elements as part of Universal Grammar, which makes them both innate and universal. What he refers to is as the emergentist approach corresponds to the learning-based approach elaborated upon in Section 2. In Mielke’s application of this approach to distinctive features, he considers them to be “learned and language-specific” (p. 3) and the feature system as a whole to be “constructed (by the language learner or a linguist) on the basis of [observable patterns in the language]” (p. 4). Mielke’s characterization of features under an emergentist approach, therefore, serves as an excellent model for considering morphological domains in a learning-based framework.

The innatist versus the emergentist approaches lead to two distinct characterizations of the connection among phonetics, phonological patterns, and distinctive features. In an approach where features are innate, sound patterns are governed by the features, which themselves are typically thought to be grounded in phonetics: “Phonological patterns emerge (at least in part) from the effects of features” (Mielke 2008, p. 9). The role of phonetics in sound patterns is more indirect and marginal; phonetics is used to explain instances that are harder to explain in terms of features but that can be explained by considering the effects of phonetically-grounded sound change. In an approach where features are emergent, on the other hand, phonetics shape the sound patterns more directly, as these patterns are considered the result of phonetically-motivated historical change, without any need for features intervening between the phonetics and the sound patterns. Features are a part of an emergentist approach to phonology, not as part of the innate language faculty, but rather because they are motivated by the patterns encountered by the child acquiring the language:
“Features are abstract categories based on generalizations that emerge from phonological patterns” (p. 9). In other words, features are linguistic constructs that are posited by the learner as organizational tools that arise via general learning mechanisms.

In order to distinguish the innatist and emergentist approaches empirically, Mielke compares how each approach handles unnatural patterns, which are those that involve groups of sounds that cannot be characterized using distinctive features. Drawing on a large data set that includes 6077 classes of sounds from 628 language varieties, Mielke demonstrates that unnatural patterns are relatively common, and that models based on innate features do not account for them particularly effectively: “No single theory [that uses distinctive features] is able to characterize more than 71 percent of the classes, and over 24 percent are not characterizable in any of the theories” (p. 3). Thus, innate feature systems on their own cannot adequately account for a significant number of phonological patterns in the world’s languages.

In an innatist approach, two ways of addressing the problems posed by these unnatural patterns are to either broaden the set of features posited to be part of the language faculty or to develop a different type of explanation for these processes that are considered more marginal. If the former approach is taken, then the question raised is the extent to which this expanded feature set is motivated. As Mielke observes, “It is unclear how often such an explanation can be invoked” (p. 5). In the latter approach, which is in fact the one more typically taken, phonetically-motivated sound change (e.g., telescoping, whereby one a synchronic pattern is the result of two sequential sound changes) is generally invoked as an explanation for unnatural patterns: “Idiosyncratic phenomena whose explanation is best left to the domain of historical linguistics” (Clements 1985, p. 246). Sounds patterns, therefore, are divided into two groups: those based on innate features and those that are the result of historical sound change.
As Mielke points out, however, the patterns that can be explained using distinctive features is a subset of the patterns that can be explained using historically-based explanations, and the distinction between the two is unnecessary. Moreover, the two types of patterns are not treated differently by speakers. More specifically, there is no evidence that non-natural patterns present any learning difficulties. All of this motivates an emergentist approach in which all patterns, regardless of whether they are typically classified as natural or unnatural, are explained via phonetically-motivated sound change. One of the primary differences between natural and unnatural patterns, which has justified treating them via distinct explanatory mechanisms, involves their distribution among the world’s languages: “Natural classes are a special case of idiosyncratic historical residues, i.e., they are the ones which most transparently reflect their phonetic origins and which therefore occur most frequently and are most likely to be encountered and embraced by phonologists” (Mielke 2008, p. 5). The innatist approach treats the source of the common patterns (i.e., the natural patterns) differently from the source of the uncommon patterns (i.e., the unnatural patterns); whereas, the former are attributed to principles of UG (which explains their commonness), the latter are explained via historical change (which does not necessarily explain their rarity). In contrast, the emergentist approach offers a unified explanation for all patterns and can account for both commonness and rarity. Both are explained by the phonetic properties of the sounds involved. Common synchronic patterns are the result of sound changes that tend to recur independently, whereas uncommon synchronic patterns are either the result of sound patterns that do not tend to recur or the result of more than one independent sound pattern (the aforementioned telescoping) (J. Blevins 2004). Thus, the emergentist approach to distinctive features offers an alternative to the innatist approach that does a better job describing the patterns.
In addition to presenting an alternative characterization that more effectively and elegantly explains both natural and unnatural sound patterns than an innatist approach, Mielke also offers arguments that show that innateness is actually a problem. To illustrate, we can consider the argument against innateness based on signed languages. Though several alternatives have been proposed to deal with the differences between spoken and signed languages, substantive evidence has not been found to support the idea that signed and spoken languages use the same set of innate features (Brentari 1995, 1998). On the contrary, both signed and spoken language features seem particularly attuned to their modality; whereas feature hierarchies of spoken language involve vocal tract articulators and auditory modifications (e.g., lips, tongue, larynx, obstruction, frication) (Hayes 2009), those for signed languages involve manual articulators and movement (e.g., handshape, palm position, fingers, orientation, location) (Sandler 1989). The fact that features for both spoken and signed languages are organized by the way in which the language is used is consistent with what would be predicted in an approach in which linguistic structures and constructs arise as generalizations over the input. Indeed, Mielke (2008) refers to these as cognitive categories, and his description of those categories matches that of Section 2.2: “Categories/features emerge as a result of contact with language data, and they naturally reflect the modality of the language being learned” (p. 18). The fact that no evidence exists for a common innate feature system for signed and spoken languages, even though both do exhibit evidence of features, supports the idea of language-specific motivation for linguistic structures and constructs: “There is no reason to believe that these languages have particular features except for the assumption that all languages must have the features which are motivated by other languages” (19). The word these here refers to signed languages, but the principle applies just as well to any set of languages: 
Motivation for one structure in one language is not sufficient to motivate that structure in another language.

In tracing the history of the notion of innateness of distinctive features, Mielke notes that universality was first introduced as a hypothesis by Jakobson, who originally argued that languages should be studied on their own terms but at some point adopted a more universalist perspective. According to Mielke, this change occurred without a corresponding new set of evidence in favor of that assumption. This universalist perspective then became standard in phonological frameworks, a position that was bolstered by Chomsky and Halle’s (1968) *The Sound Pattern of English*: “Chomsky and Halle’s *assumption* that distinctive features are innate is treated in subsequent literature as if it were a *conclusion*.” (Mielke 2008, p. 27). Considered in this context, Mielke’s work on emergent feature theory, therefore, represents a long overdue challenge to the untested assumptions of innateness and universality. His argument is particularly effective because in addition to offering theoretical and empirical arguments against the innatist approach, he also offers a coherent alternative approach, one that he supports with strong empirical evidence from a large selection of languages. As with the work on motivating the syllable and the prosodic word, Mielke’s account of distinctive features serves as a valuable model that shapes the work of this dissertation.

**3.2.3. Grammatical relations.** In addition to linguistic units, other types of linguistic structures have also been motivated following a learning-based approach. For example, Dryer (1997) investigates the motivation for grammatical relations from a cross-linguistic perspective. With the term *grammatical relations*, Dryer is referring to relationships between constituents in a clause, traditionally exemplified by the notions of, for instance, subject and object.
The fundamental question of Dryer (1997) is whether the assumption of grammatical relations as a cross-linguistic notion is supported. This is related to, but ultimately independent from, the question of universality of grammatical relations. Though his primary focus is on grammatical relations, these questions can be applied to any linguistic structure. In Dryer’s discussion, to speak of a linguistic structure as a cross-linguistic category means to consider it something that can be characterized independently of any specific language. Such a conceptualization views linguistic structures as “abstract notions that exist independently of particular languages, but which manifest themselves or are realized in particular languages” (p. 115). Therefore, in questioning grammatical relations as a cross-linguistic construct, Dryer is challenging the view of language as a purely formal computational system, a kind of Platonic ideal that can be discussed without reference to specific languages used by humans, in which “theoretical notions are theoretical primitives existing independent of cognition, or as components of innate linguistic knowledge” (p. 115-116). Indeed, given how an innatist approach characterizes universality and cross-linguistic comparison (cf. Section 2.3.2), the idea of linguistic structure as a cross-linguistic notion works well for an analysis that relies on innate linguistic knowledge. However, in an approach that explains linguistic structure through functional and cognitive principles – what Dryer calls a functionalist approach, which is consistent with the characterization of the learning-based approach in Section 2 – grammatical structure as a cross-linguistic notion is certainly not necessary.

A functionalist, learning-based approach does allow for the possibility of grammatical relations as cross-linguistic categories; however, they must be established empirically rather than taken as a priori assumptions. Moreover, other related questions should be addressed before they can be established. Dryer (1997) suggests four types questions that can be asked of grammatical
relations: “There are four kinds of things that might exist in the domain of grammatical relations: (a) grammatical relations in particular languages, (b) similarities among these language-particular grammatical relations, (c) functional, cognitive, and semantic explanations for these similarities, and (d) grammatical relations in a crosslinguistic sense” (p. 116). From a learning-based perspective, the first question – whether grammatical relations in particular languages exist – necessarily precedes all the others. Before we can discuss grammatical relations at all, they should be established for specific languages. Then, we can consider the similarities that these structures have across languages. Only on the basis of similarities that can be shown to exist can we then ask about explanations for those similarities and about the potential universality of those structures. The primary focus of Dryer’s discussion is grammatical relations, but he also discusses how this set of questions can be applied to other linguistic structures and constructs, such as phonemes and word classes. The present dissertation considers the same set of questions for morphological domains, directly addressing the first and the second and offering implications of the present analysis for the fourth question.

In his analysis of grammatical relations as cross-linguistic categories, Dryer (1997) offers a variety of principles and techniques that can be applied to any cross-linguistic analysis under a learning-based approach. To begin with, the linguistic structures and constructs are defined language-specifically, “on the basis of language-internal properties” (p. 120). Those properties can include processes, constraints, and other linguistic relationships, and a linguistic structure is defined in terms of a convergence of such properties. With regard to grammatical relations, for example, he considers morpho-syntactic properties such as agreement, case, and position relative to other linguistic elements, and he looks for whether such properties converge to create distinct classes of clausal constituents (i.e., subjects and objects). Dryer illustrates this process using
English, with the qualification that his discussion is not a fully-developed analysis for English. A simplified version is reconstructed here with the same caveat. If we consider the sentence construction *Maria likes the cats*, we can observe that the form of the verbal element *like* changes depending on the whether Maria or the cats are doing the liking (cf. *The cats like Maria*). Based on this sentence and others like it, we can posit that at least two classes of clausal constituents exist: those that trigger agreement with a verbal element in a given construction and those that do not. For the construction *Maria likes the cats*, the constituent *Maria* belongs to the class that triggers agreement (let’s call it the Agreement-A class) and *the cats* does not (let’s call it the Agreement-B class). Next if we consider case, we can observe at least two classes of elements that are affected by case in a sentence construction: those that take nominative case when pronominalized and those that take accusative case. In the case of *Maria likes cats*, we can pronominalize both nominal constituents to yield *She likes them*, in which we can observe that *Maria* takes nominative case in its pronominal form (let’s call this class Case-A) and *the cats* takes accusative case (let’s call the class Case-B). Finally, we can consider the position of each constituent in the sentence construction: *Maria* occurs before the verbal element (Position-A) and *the cats* occurs after the verbal element (Position-B). In this example and others like it, we find a clustering of the properties. Whereas a maximum of 8 possible combinations of the two dimensions of each of the three properties is possible (AAA, AAB, ABA, ABB, BAA, BAB, BBA, BBB), what we observe is that only two combinations occur consistently (AAA, BBB). Thus, the independent grammatical properties converge on two grammatical classes: what have traditionally been called *subject* and *object*. This cursory analysis of English demonstrates that grammatical properties tend to interact in a way that supports the positing of broader grammatical categories, which can be ascertained by looking at various properties of the language. The approach sketched...
above for English demonstrates how one would go about motivating grammatical relations for a specific language, and answers the first question posed by Dryer – Do grammatical relations exist in a specific language? – in the affirmative for English.

In order to address the second question – Do similarities exist among language-particular grammatical relations? – this process would first have to be applied to other languages. In doing so, we would not be surprised to find that similarities do indeed exist across different languages. In an innatist approach, such similarities would be strongly predicted (so much so that their absence would seriously call into question the foundations of the framework), and their existence would be explained by the fact that all languages share the same innate architecture. In a learning-based approach, those similarities, which are expected but not critically so, would be explained as “reflections of deeper functional and cognitive principles that interact at the level of language change to cause languages to be similar to each other in the way they are” (p. 123). In Dryer’s approach to cross-linguistic comparisons, therefore, we find strong resonances with Mielke’s (2008) account of emergent distinctive features in that language change plays a pivotal role in explanation.

In considering the question of whether grammatical relations exist as cross-linguistic categories, Dryer (1997) discusses four languages that pose problems for this view: Dyirbal, an ergative language; Achenese, which has a split-intransitive system; Cree with its inverse construction typical of Algonquian languages; and Cebuano, typical of Philippine languages. For these four languages, Dryer asks: “What are the grammatical relations in language X? What should we call the grammatical relations in language X?” (p. 124). In a view of linguistics in which structures are language-specific, what to call them is a relatively trivial question. Though we might consider using a common term for the sake of terminological convenience, this choice need not
have theoretical implications, as long as it is understood that, for example, *subject* in language A has some similarities with but is ultimately a different entity from *subject* in language B. In an innatist view, on the other hand, what to call these entities is an important matter since *subject* is an entity that exists independent of any specific language but is manifested in specific languages. Thus, calling an entity a *subject* in language A has implications for the relationship it will have with what is called *subject* in language B.

In order to answer these questions, Dryer (1997) discusses the grammatical details of each of the four languages, drawing on previous analyses of their grammatical properties. He shows that in all these languages, grammatical relations do seem to be motivated. Moreover, these grammatical relations are readily identifiable from a language-internal perspective: Three classes can be readily identified in Dyribal (what has been called an *absolutive*, *ergative*, and *other*) based on a convergence of morphological and syntactic rules; two classes are discernable in Achenese (what may be labeled as *actor* and *undergoer*); two distinctions are necessary in Cree (*proximate* versus *obviative* on the one hand and *actor* versus *goal* versus *other* on the other hand) as well as a category that includes *actor* in direct and inverse clauses and *goal* in passive clauses; and in Cebuano two distinctions are necessary (*topic* versus *non-topic* on the one hand and *actor* versus *goal* versus *other* on the other hand).

If each language is considered on its own terms, grammatical relations are relatively straightforward. A problem arises only if we ask the question: What is the subject? No common set of criteria can be identified that characterize the subject in the same way in all four of these languages, and this is not for lack of effort on the part of analysts. From a functionalist, learning-based perspective, this type of variance is not unexpected. However, from an innatist approach, this indeterminateness poses a substantive challenge. If subjects are universal, then they should be
clearly identifiable cross-linguistically. Thus, as with distinctive features discussed in Section 3.2.2, once we evaluate what linguistic structures and constructs are motivated on a language-specific basis, we find that what is motivated for one language is not necessarily motivated for another. As Dryer argues, linguistic structures and constructs cannot necessarily be thought of as cross-linguistic notions, certainly not prior to a comprehensive investigation. Whether or not a particular structure can be thought of as a cross-linguistic category is one of several questions that can be asked in the context of cross-linguistic comparison. Importantly, it is a question to be explored empirically and not an assumption to be taken prior to analysis, which is consistent with the learning-based methodology of the present study.

4. Methodology

The methodology of this dissertation follows work on other linguistic structures and constructs that have been motivated using what may be characterized as a learning-based approach. As discussed in the previous section, such work illustrates how linguistic elements such as syllables, prosodic words, distinctive features, and grammatical relations can be motivated via a set of heuristics that converge on these linguistic elements. This dissertation applies a similar procedure to motivate morphological constituents in Hebrew, Navajo, and Spanish. Given that such research has not been conducted previously, a large inventory of cross-linguistic morphological constituents akin to that of J. Blevins’ (1995) discussion of the syllable, Mielke’s (2008) work on distinctive features, Bickel, Hildebrandt & Schiering’s (2009) study of prosodic words is not yet available. Even the kind of work that Dryer’s (1997) study, which focused on just four languages, involves already having a sense of the grammatical relations available cross-linguistically. In addition, the kind of work involved in motivating constituents under a learning-based approach requires an intensive and comprehension exploration of linguistic patterns, such
that the logical starting point is an examination of the constituent structure in a small but representative set of languages, from which insights can be gained to then conduct a larger-scale project such as the work referred to in Section 3. The present section elaborates on the learning-based methodology that will be applied to the linguistic patterns in the representative languages – Hebrew, Navajo, and Spanish – including a discussion of the analytical procedure, the source of data for this process, and a rationale for the selection of these three languages as the focus languages.

4.1. Analytical procedure. One of the primary guiding principles behind the methodology of this dissertation is that linguistic constituents are motivated based on whether a given generalization is better stated with a particular constituent than without it (J. Blevins 1995). The generalizations that will be used to motivate a given morphological constituent are descriptions of patterns in each language. As illustrated by the motivation for the syllable discussed in Section 3.1, a constituent serves as the convergence point for a variety of patterns. Since the focus is on morphological constituents, morphological patterns are of prime importance in providing evidence for a particular constituent. However, as mentioned in Section 2.4, since the view adopted in this dissertation is that linguistic structures and constructs are motivated by different types of connections among linguistic items, other types of patterns will also be marshalled to motivate morphological constituents. Thus, morphological constituents will be motivated based on processes, constraints, and distributions in morphology, phonology, syntax, and semantics that make reference to a morphological constituent.

A morphological constituent, therefore, is a linguistic category that is defined by a convergence of criteria specific to the patterns of a given language. For instance, a word-internal constituent such as a stem would be motivated if it represents a set of word-internal components
that can be identified using a convergence of several morphological and other criteria based on linguistic patterns of the language in question. Thus, the patterns drive the constituents rather than the inverse. Considering the issue from the perspective of acquisition, one could say that it is these patterns that draw attention to a given morphological constituent and that in attempting to capture the generalization for future application for either production or comprehension, the learner posits that constituent as an organizing structure of the language. From the point of view of the analyst, a given morphological constituent is useful to posit because it serves to describe particular patterns of the language that is being studied. Thus, following the discussion in Section 3.2.1, if in a language such as Vietnamese there are not patterns that depend on the prosodic word as an independent unit intermediate between the foot and the phrase, then the prosodic word is not posited for that language. Similarly, though empty or zero morphs are not in principle precluded from being posited, they are avoided unless there is evidence from patterns of the language that they are useful, not simply out of a desire to have a theoretical description that is maximally symmetrical or parsimonious, since neither of these are driving principles in a learning-based approach.

An important aspect of this analytical procedure is that it will be applied language-specifically. As discussed in Section 2.3.2, universality is not a primary concern under a learning-based approach. Furthermore, as illustrated with regard to grammatical relations in Section 3.2.3, attempting to apply a linguistic structure that works well in one language to another language can be both empirically and theoretically problematic. Therefore, each of the three languages will be explored on its own, with constituents established exclusively on the basis of patterns in that language. Only after the constituent structure of each language is determined will larger cross-linguistic generalizations be made.
4.1.1. **Word as starting point of analysis.** As discussed in Section 2.4, previous abstractive approaches to morphology have determined that the most fruitful starting point of analysis is the grammatical word; therefore, the initial hypothesis that will be tested for each of the languages examined in this dissertation is that the grammatical word is a relevant morphological constituent. Following J.P. Blevins (2016), the claim that the grammatical word is a primary morphological unit is not to be assumed a priori. However, given how previous work has demonstrated the utility of the word as a morphological unit, it is a reasonable assumption that such will be the case in a learning-based approach to morphological constituents, and therefore a reasonable first hypothesis to be considered.

Previous work that has demonstrated the utility of the grammatical word as a linguistic constituent includes theoretical studies, computational work, and typological comparisons. In considering the utility of different models of grammatical description, Robins (1959) offers a defense of the word as the primary unit of analysis. His arguments for the word are situated in the post-Bloomfieldian context of linguistic analysis in which the morpheme is treated as the primary grammatical unit. Though Robins does not deny that the construct of the morpheme can be useful for certain kinds of analysis, he does limit its usefulness by presenting it as “not to be defined as a semantic element” (p. 128) and as not “the most suitable unit to bear the assignment of all the grammatical functions fulfilled by the words into whose composition it enters” (p. 127-128). In Robins’ view, the word is the basic unit with regard to both syntax and morphology. Thus, both syntagmatically and paradigmatically, the word is a more effective unit around which to organize the grammatical system. As Robins argues, “grammatical statements are abstractions, but they are more profitably abstracted from words as wholes than from individual morphemes” (p. 128). Indeed, from the perspective of language teaching, it is noteworthy that pedagogical traditions are
based on the word as a construct, not on a smaller unit such as a root or morpheme (J.P. Blevins 2014), which indicates the utility of the construct for adolescents or adults attempting to acquire the grammar of a language. In addition, the utility of the word as a construct has been demonstrated computationally as well. For instance, Geertzen, Blevins, and Milin (2016) show computationally, using an information-theoretical model that considers which unit boundaries (sentence, word, or morph) are the most informative, that “words are the optimal-sized units for describing regularities in at least the languages considered [i.e., English, Estonian, Finnish, and Hungarian]” (p. 20). The benefit of adopting the word as the organizing unit of the grammar, therefore, arises not from an a priori preference for a word-based account, but rather because it is useful for describing linguistic patterns.

The kinds of linguistic patterns for which the word is useful as a descriptive construct are also the kinds of patterns that offer motivation for it as a construct in a learning-based approach, given that a linguistic unit is determined by a convergence of generalizations about patterns in a language. The question of what criteria can be used to define the construct word has been treated in a number of studies. Such studies have concluded that there are not reliable criteria for defining a word in a way that is applicable universally. As Bazell (1953) observes, “criteria [for defining a word] may be found which are either necessary, or sufficient, but not both” (p. 67-8). Indeed, a cross-linguistic investigation of the types of criteria that are often offered for identifying a word (e.g., free occurrence, potential pauses, uninterruptibility, etc.) reveals that “we have no good basis for a general, cross-linguistically viable word concept” (Haspelmath 2011, p. 32). In addition, in some cases, criteria that are relevant for determining a word in one language are not applicable in another (Matthews 2002). Such conclusions are problematic for an account that treats the word as
universal construct, or, as in the words of Dryer (1997), as a cross-linguistic notion, since it resists definition in a way that is applicable to all languages.

However, the fact that a word cannot be identified cross-linguistically using universally applicable criteria is not a problem for approaches that treat linguistic constructs in language-specific terms: “‘Words’ as language-specific units are often unproblematic… but the criteria employed in different languages are often very different” (Haspelmath 2011, p. 70). In a learning-based approach, linguistic units are motivated for a given language by the patterns of that language, and larger generalizations that apply across other languages are made only when further cross-linguistic evidence indicates that they are warranted. In this way, the learning-based approach heeds Matthews’ (2002) counsel that “we need to be reminded that there are many general concepts that should not be generalized beyond the point at which their application is illuminating” (p. 273). By remaining focused on constructs such as the word as they apply to a particular language, the methodology of this dissertation maximizes important insights about the word: It is a maximally efficient construct for making generalizations about the patterns of a language, and it is a construct that is best understood in language-specific terms. Thus, though the various factors that have been proposed as criteria for defining words cross-linguistically (free occurrence, potential pauses, uninterruptibility, etc.) are not assumed a priori to apply to the patterns of Hebrew, Navajo, and Spanish. However, given that they are indeed relevant for a variety of languages, they will be used to inform the type of patterns that are considered in analysis of the word as a potential morphological constituent of each of the languages.

An important point that merits discussion regarding the word as a linguistic unit is that this term is used both for phonological and grammatical description, an observation that motivates the distinction for two distinct constructs: the phonological word and grammatical word. Though each
of these constituents belongs to distinct types of hierarchies, the two are not entirely independent, and there can be significant cross-linguistic variation with regard to the relationship between the two: “In some languages the two types of word coincide and one can then felicitously talk of a single unit ‘word’, which has a place both in the hierarchy of phonological units and in the hierarchy of grammatical units. In other languages, phonological word and grammatical word generally coincide, but do not always do so…. Or there can be a more complex correspondence between the two types of word” (Dixon & Aikhenvald 2002, p. 1). Though the distinction between phonological word and grammatical word will be kept in mind in the methodology employed in this dissertation, the fact that the two types of constituents are related will also be considered.

Therefore, the process of motivating the grammatical word will proceed as follows: Evidence for the phonological word will be considered first, justified in part because one of the factors that is most commonly used to establish a word – often expressed as a version of Bloomfield’s criterion of the word as a ‘minimum free form’ (p. 120) – points to the phonological word. Once evidence is offered for a phonological word in the given language, the hypothesis that the phonological word in the language also often corresponds to a grammatically relevant unit will be tested. This notion will be referred to throughout the dissertation as the Grammatical Word – Phonological Word Congruency Principle, in (1).

(1) **Grammatical Word – Phonological Word Congruency Principle:** For a given language, learners will posit that grammatical words map directly onto phonological words unless they encounter evidence to the contrary.

This principle is motivated by the notion that a learner seeking to make sense of the patterns in the linguistic input would expect that a phonologically salient unit is also relevant grammatically. This notion is encapsulated in the principle of Transparency (Kusters 2003), which is connected to the principle of One-Meaning–One-Form and involves the “clarity of relation between meaning and
form” (e.g., Miestamo 2008, p. 32). Though languages do exhibit violations of these principles (e.g., with homonymy, allomorphy, fusion, etc.), the idea behind these principles is that learners are guided in the acquisition process by positing that a salient phonological form corresponds to a stable meaning or grammatical function. The result of applying these principles to the methodology for motivating morphological constituents under a learning-based approach is a process in which motivation for a phonological word is considered first for a given language, followed by a confirmation that such a unit is also grammatically or semantically relevant for the language, followed by a brief discussion of the ways in phonological and grammatical words are not perfectly aligned in the language. This process is discussed in Section 2 of each of the chapters motivating the morphological constituents of a specific language.

4.1.2. Terminology. Adopting a language-specific approach to analysis signifies not assuming that the morphological constituents motivated for one language will necessarily correspond to those motivated for another language. For example, following the discussion in the previous section, a grammatical word in one language may not necessarily be thought of as the same type of unit in another, given that different criteria are likely to identify the grammatical words in each of the two languages. Following Dryer (1997), such correspondences between languages can be explored only after the constituents have been explored individually for each language (cf. Section 3.2.3). Recognizing this fact might lead one to use different terms for the constituents in each language in order to avoid the problem of implying false equivalences simply through one’s choice of terminology. Blust (1998), for example, recognizes this when he observes that the term root as discussed in language families such Indo-European, Semitic, and Austronesian is likely best considered a different entity for each of the three language families because “the principal common denominator in [the construct root in each of] the three cases
appears to be an accidental coincidence in terminology” (p. 2). Thus, an argument can be made for using terminology that does not imply relationships that are not meant to be implied, terminology such as Hebrew sub-word constituent 1 and Hebrew sub-word constituent 2 instead of stem and root.

Ultimately, however, terms such as stem and root will be used in this dissertation, with the caveat that, for example, a stem in Navajo and a stem in Spanish should not be thought of at the outset as the same type of constituents. The reason for adopting the more traditional terms is to be able to more effectively engage with previous work in these languages and language families. Within the traditions of each of the languages there is greater agreement about what the terms mean. For example, though researchers in Hebrew and Semitic languages in general disagree about the status of the root (cf. Section 1.2 in Chapter 2), there is consensus about what constitutes a root in those languages. Therefore, in the spirit of maintaining a dialogue with the literature, conventional terms such as word, stem, and root will be used in each of the chapters focusing on those languages, with the understanding that such a term in one chapter is not necessarily to be understood as referring to the same type of entity in another chapter. The question of the extent to which morphological constituents motivated for one language are comparable to constituents motivated for another is addressed in Chapter 5.

4.2. Sources of data. The data for this dissertation are drawn from a variety of sources, including previous descriptive, theoretical, and experimental work on the languages in focus and corpus data from a variety of sources. In addition, data are confirmed through native speaker intuitions when questions of their authenticity arise.

Given that morphological constituents are motivated on the basis of linguistic patterns that converge on particular morphological structures, linguistic patterns for each language will serve
as the primary source of data. Since all three languages have a relatively rich descriptive tradition, many relevant patterns of the language have been described. Thus, important sources of data are the various grammars of each of the languages. Such grammars include both grammars intended to document the patterns of a language, such as Young and Morgan’s (1987) extensive description of the linguistic features of Navajo, and grammars that are pedagogically-oriented, such as Coffin and Bolozky’s (2005) general reference book of Hebrew rules and structures intended for students learning Modern Hebrew as a foreign language. Similarly, dictionaries and other reference books will provide data in some cases. For instance, patterns of verbal paradigms can be found in resources such as Neundorf’s (2006) dictionary of Navajo verbs and Bolozky’s (2008) compendium of Modern Hebrew verbs.

In addition, a variety of relevant patterns are detailed in studies that are focused on developing general linguistic theory, such as Arad’s (2005) Distributed Morphology approach to Hebrew roots, Bermúdez-Otero’s (2013) Stratal Optimality Theory and Distributed Morphology approach to thematic vowels in Spanish, and McDonough’s (1990) reanalysis of the templatic approach to Navajo. Though the assumptions associated with studies such as these and the theoretical mechanisms they propose are not all necessarily consistent with a learning-based approach, they do present data that can serve as evidence for morphological constituents. In each of these sources, linguistic patterns described in terms of a morphological unit (e.g., word, root, stem) will be identified and evaluated against potentially more succinct descriptions using other units. Whenever this literature does not make use of primary sources, the data they provide are verified, either by consultation with the primary source referenced in the study or by consultation with native speakers. Though the data in many instances are directly linked to a specific
morphological constituent, the data in other cases are presented for reasons unrelated to morphological constituency but can nevertheless serve as evidence for a given constituent.

Though the primary focus of the present study is on language-internal motivations, external evidence also serves as validation for theoretical constructs. For instance, theoretical issues involving the root in Semitic languages have been illuminated by evidence from research in psycholinguistics, neurolinguistics, and lexical studies (e.g., Deutsch, Frost, & Forster 1998; Berent & Shimron 2003; Prunet 2006). In addition, even work that has not explicitly focused on evidence for a given constituent can serve as indirect evidence for that constituent. For example, if patterns in acquisition can be productively stated in terms of a given morphological constituent (e.g., studies in Navajo acquisition such as Saville-Troike 1996 and Courtney & Saville-Troike 2002), then those studies also help to motivate that constituent. Therefore, in this dissertation, external evidence for morphological units comes from previous research in psycholinguistics, language acquisition, language contact, and literary traditions.

In addition, data for the dissertation come from corpora and speaker intuitions, broadly defined. Examples of language in use is taken from a variety of resources that contain utterances from each of the languages. For example, with regard to Navajo, Young and Morgan’s (1987) dictionary contains a wide sample of utterances expressed by speakers. Another resource that is considered a kind of corpus is material produced by native speakers and published online, using services such as YouTube. In terms of intuitions, these are primarily used with data from Spanish, where utterances offered are ones that the investigator, a native speaker of Spanish spoken in the Southwestern United States, considers to be representative of the language. Such impressions for Spanish were also validated by other speakers of the same variety of Spanish if there were questions of whether they were used by the larger community; similarly, data for Hebrew and
Navajo, which come from the aforementioned resources, were also corroborated with native speakers when appropriate. Data for Hebrew were checked with two native speakers of the language who currently reside in Jerusalem, and data for Navajo were checked by participants in the 2015 and 2016 Navajo Language Academy’s summer workshop.

4.3. Selection of focus languages. Hebrew, Navajo, and Spanish have been chosen as the set of languages to be explored because they represent genetically unrelated languages with rich, distinctive morphological systems. Moreover, in all three cases, the conventional analyses of sub-word constituents have been questioned. In addition, these three languages have a significant body of literature on their morphology (and, indeed, on their language family more broadly) from which to draw for data and analysis.

All three languages have relatively rich inflectional and derivation systems, though with significant differences among them. For example, all three can be said to have verbal conjugation classes, but the nature of these is quite different. To illustrate, verbal conjugation classes in Navajo are conventionally characterized as based on a classifier prefix, which, though it can affect surrounding segments, does not result in a different set of affixes relative to other classifier prefixes (Faltz 1998). Indeed, in some treatments, conjugation classes are not mentioned, only classifiers (Goosen 1995). In Spanish, on the other hand, conjugation classes represent a set of inflectional patterns shared by verbs in a given class, though no phonological element is shared by all the inflectional patterns (e.g., thematic vowels are not present in all forms of a conjugation class). In general, the same can be said of Hebrew, but where Hebrew and Spanish differ is in the fact that some conjugation classes have grammatical properties associated with them in the Hebrew but not in Spanish (e.g., the hifʿil conjugation class involves many causative forms, the nifʿal many passive forms, etc.). Conjugation classes are just one of the ways in which each of the three languages can
be said to represent rich morphological systems, overlapping with each other in some ways and distinctive in others. In addition, all three languages have a tradition of being analyzed with word-internal constituents, synchronically as well as diachronically (e.g., elements referred to as roots have been reconstructed for the proto languages of Hebrew, Navajo, and Spanish). Furthermore, this sample covers three distinct morphological types, what have been characterized as a root and pattern system, a slot-and-filler template, and “head-thorax-abdomen” structure (J.P. Blevins 2016, p. 1954). Thus, these three languages are representative of complex and distinctive morphological systems.

4.3.1. Hebrew. Hebrew and other Semitic languages are of particular interest to morphologists because they exhibit a typologically rare, non-concatenative morphological system that has been described as organized around a discontinuous root and template pattern. The root as an organizing element in the morphological system has long been used in Semitic grammatical descriptions, and has influenced broader morphological theory. For instance, Aronoff (1994) speculates: “It may thus well be that all Western linguistic morphology is directly rooted in the Semitic grammatical tradition” (p. 3). Both Arabic and Hebrew medieval grammarians have relied on roots, though it seems that during medieval times roots were not necessarily treated in the same way by all grammarians. Notably, though canonical consonantal roots did organize Arabic dictionaries of over 1000 years ago, it was not until the rise of the Hebrew grammatical tradition in 10th-12th century Al-Andalus that roots were treated as formatives (Aronoff 2013). It seems, then, that a debate of the status of roots as central morphological constituents in Semitic has a long tradition, continuing to the present day. Indeed, contemporary accounts can be found in which roots in Semitic morphology are viewed as foundational in some treatments (e.g., McCarthy 1981; Arad 2005) and irrelevant in others (e.g., Bat-El 1994, 2003a,b; Ussishkin 1999, 2005). Given the
current debate in the study of Semitic languages, the typological distinctiveness of the morphological system, and the influence that work in this language has had on broader theory, a representative language from the Semitic languages family is an invaluable part of any discussion of cross-linguistic morphological constituency.

4.3.2. Spanish. In such a discussion, it is also important to consider languages with more typical concatenative morphology. Spanish, as an Indo-European language of the Romance branch, represents such a language. In terms of its structure, it has many of the properties that are expected according to many morphological accounts. For example, whether we view it as a root or a stem or some other kind of base, the core semantic component is readily identifiable, typically at the beginning of the word. Derivational elements (e.g., elements that signal nominal and verbal properties) follow this unit, which in turn are followed by inflectional elements (e.g., signals of grammatical features such as tense, aspect, number, person, and gender). Despite this relatively transparent structure, however, many questions regarding segmentation remain. For example, the structure to which thematic vowels should be assigned is a topic of discussion in the field of Spanish morphology, the answer to which involves disentangling roots and stems (e.g., Bermúdez-Otero 2013). Exploring morphological constituents motivated for Spanish, therefore, helps in illuminating both our understanding of Spanish morphology and of morphological constituents in languages with the more familiar profile of Spanish.

4.3.3. Navajo. In contrast to Spanish with its more canonical morphological system, Navajo exhibits certain peculiarities, common to fellow Athabaskan languages but unusual compared to other language families (Spencer 2012). For one, the core semantic component, which is conventionally referred to as the stem, is found word-finally, preceded by a multitude of derivational and inflectional elements. In addition, the overall structure of the verb is intricate and
difficult to describe in a straightforward manner. The most common description is that it consists of a complex template in which, for example, inflectional prefixes occur closer to the root than derivational prefixes (Kibrik 2005). A variety of distinct though related descriptions of the structure of the language exist, and structures such as the root, stem, stem complex, base, theme, conjunct, disjunct have all been proposed as components of the verb (e.g., Kibrik 2005; Faltz 2000; Young and Morgan 1987; Reichard 1951). Exploring a language such as Navajo, with its complex and typologically rare verbal system, may yield important insights regarding potential morphological constituents across different languages. Taken together, these three languages – Hebrew, Spanish, and Navajo – represent a set of languages whose study offers important insights that contribute to discussions regarding the research questions of the dissertation.
Chapter 2: Motivating Morphological Constituents in Hebrew

1. Background

The present chapter follows the learning-based methodology established in Chapter 1 and offers an analysis of morphological constituents of Hebrew. Section 1 provides background information on the language, including a presentation of morphological issues involving Hebrew and other Semitic languages. Section 2 presents evidence motivating the grammatical word as a constituent in Hebrew. Section 3 presents evidence motivating the word-internal morphological constituents of Hebrew, arguing that two word-internal constituents, the root and the stem, are motivated for verbs, whereas only the stem is motivated for nouns and adjectives. Other morphological elements that are relevant for understanding the linguistic patterns of Hebrew but that are not constituents are briefly discussed in Section 4. Section 5 summarizes the chapter.

1.1. General background. Hebrew is classified as a Semitic language, along with languages such as Arabic, Ugaritic, Aramaic, and Amharic. The Semitic branch, in turn, forms part of the large Afro-Asiatic language family, which includes other branches such as Berber, Chadic, and Cushitic (Faber 1997). Though it is difficult to establish features that all Semitic languages have in common to the exclusion of other languages in the greater Afro-Asiatic language family, there is widespread agreement on which languages constitute Semitic because they share a “gestalt compounded of phonological, morphological, and lexical elements” (Bennett 1998, p. 20). Though internal classifications of Semitic may vary, Hebrew is consistently grouped with other Canaanite languages, such as the extinct Phoenician and Moabite, as well as endangered varieties of Neo-Aramaic. By the more traditional account, these languages constitute the Northwest Semitic subgrouping (Faber 1997). According to a more recent classification, these languages constitute the Central Semitic subgrouping along with Arabic (Huehnergard 1992).
The linguistic history of Hebrew is unique among the world’s languages. Though a level of unity is recognized between the language spoken during Biblical times (Biblical Hebrew) and that spoken in present-day Israel (Modern Hebrew), there is not a continuous line of native speakers connecting these two linguistic systems. Hebrew, whose origins can be traced to Israelite tribes that settled in Canaan around the fourteenth and thirteenth centuries BCE, ceased to be a spoken national language after the Babylonian siege of Jerusalem in 587 BCE. It continued to be used by at least some communities as a native language until around 200 CE. Thereafter, the language would evolve from use as a spoken vernacular to use for primarily literary, liturgical, and commercial purposes (Sáenz-Badillos 1993), eventually to be replaced by Aramaic, which had become the lingua franca of the region (Ostler 2005).

Modern Hebrew (WALS and ISO 639-3 codes: heb) is the result of efforts by Jewish immigrants to Palestine in the late 1800s to transform Hebrew, which had been the literary and religious language of Jews throughout the world for centuries, into a spoken vernacular (Sáenz-Badillos 1993). As a result, the contemporary language’s grammar and phonology reflect significant influence from the native languages of those immigrants, which included Yiddish, German, and Russian (Zuckermann 2009). Nevertheless, despite the fact that potentially over 3000 years separate the periods when Biblical Hebrew and Modern Hebrew are spoken, these varieties of Hebrew and those that occurred in between are characterized by remarkable mutual comprehensibility relative to diachronic variations of other languages (Tobin 1997, p. 126).

Modern Hebrew is spoken in Israel and in Israeli Diaspora communities throughout the world. This variety of the Hebrew language is also sometimes referred to as Israeli or Israeli Hebrew (Zuckermann 2009). It is one of the official languages of the State of Israel (Katzner 1995), along with Arabic, a fellow Semitic language. Modern Hebrew is therefore used by about 7 million
Israeli citizens, more than 5 million of whom are Jews for whom it is a mother tongue (Zuckermann 2009). Despite a wide variety of different cultural and linguistic origins of Israelis, Modern Hebrew does not exhibit significant regional variation (Berman 1997). Data for this chapter are drawn from Modern Hebrew (which will be henceforth referred to simply as Hebrew) unless otherwise noted and come from generally available sources such as dictionaries and reference books (e.g., Coffin & Bolozky 2005; Glinert 2005; Bolozky 2008). Two native speakers of Hebrew confirmed the data taken from reference sources in order to ensure that the data presented reflect contemporary usage.

1.2. Overview of Hebrew morphology. The morphological system of Hebrew and other Semitic languages is traditionally described as non-concatentive, and it stands in contrast to concatenative systems in which morphemes are strung together sequentially (cf. Chapter 4 on Spanish). In Semitic languages, words are conventionally organized around a discontinuous root and template system. As mentioned in Section 4.3.1 of Chapter 1, the question of whether the system is root-based or template-based has a long history, though both elements have been assumed to be useful for describing the morphology of Semitic languages. Recently the description of the system as non-concatenative has also been called into question, as discussed below. In general, though, the root and template system is considered a distinctive hallmark of this language family.

Under the traditional analysis of Semitic, words can be decomposed into at least two lexical units: a consonantal root and a vocalic/prosodic template⁴; the former unit carries the semantic content and the latter carries inflectional and/or derivational information. In this analysis, the root

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⁴ In some accounts, the template is further divided into a vocalic melody and a prosodic skeleton (cf. Ussishkin 2005).
and the template are treated as morphemes (i.e., form-meaning pairings). The reasons for such an analysis and the arguments against it will be provided in this section, with a focus on the root.

One reason to view the root as a morpheme is because one of the striking characteristics of the root is that it is found both within a lexeme and across lexemes. The former is illustrated in (2) and the latter in (3)\(^5\).

\[(2)\]
\[
\begin{array}{l}
a. gadal ‘he grew’ \\
b. godelet ‘she grows’ \\
c. nigdal ‘we will grow’
\end{array}
\]

\[(3)\]
\[
\begin{array}{l}
a. gidel ‘he raised’ \\
b. higdil ‘he enlarged’ \\
c. gadol ‘big’ \\
d. godel ‘size’
\end{array}
\]

The basis of the notion for the Semitic root is the widely noted observation that, particularly in the verbal system, a discontinuous consonantal sequence can be discerned in all forms of an inflectional paradigm for a given lexeme. This pattern is exemplified in (2)\(^6\), in which all the words in the set consistently contain the consonants \(g-d-l\), in that order; notably, these words contain no other segments in common. This sequence is what is traditionally referred to as the root. It most commonly consists of three consonants, though some roots consist of two consonants or four or more consonants. In addition to the root being found within a lexeme, it is also identifiable across lexemes. For instance, in the set of words in (3), \(g-d-l\) is found in a variety of words whose meanings all relate to growth in some way. According to the root-template analysis, this is because the sequence itself is a morpheme whose meaning corresponds to GROWTH. Thus, in this analysis, the determination of morphological constituents is pending discussion of the evidence, the glossing provided in these examples and throughout the dissertation minimize decomposition into morphemes, favoring instead synthetic interpretations of the structure of the words. When boundaries of exponents are relatively straightforward (e.g., with affixes of person, number, and gender), they are indicated if they facilitate exposition of the argument.

\(^5\) Given that determination of morphological constituents is pending discussion of the evidence, the glossing provided in these examples and throughout the dissertation minimize decomposition into morphemes, favoring instead synthetic interpretations of the structure of the words. When boundaries of exponents are relatively straightforward (e.g., with affixes of person, number, and gender), they are indicated if they facilitate exposition of the argument.

\(^6\) Unless otherwise indicated, Hebrew data cited in this chapter can be corroborated in at least Bolozky (2008) and typically using other sources readily available reference books, such as dictionaries.
a word such as *gadal* ‘he grew’ would be decomposed into the meaningful root *g-d-l* and the template C₁aC₂aC₃, which corresponds to 3SG.MASC.PST. Such a pattern is widespread in the linguistic system, though more so with regard to verbs than to other elements.

The root-template approach characterizes a number of generative accounts. This idea can even be seen in pre-generative structuralism. For instance, Harris (1941, 1951), potentially influenced by his own work in Semitic languages, introduced the concept of *long components*, linguistic units that extend over more than one surface continuous sequence of phonemes. From this theoretical construct follows the idea that morphemes can consist of non-contiguous phonemic sequences, a phenomenon exemplified clearly in Semitic languages in general (Harris 1951) and specifically in Hebrew (Harris 1941). In addition, this discontinuous sequence is an essential aspect of Chomsky’s 1951 master’s thesis on the morphophonemics of Hebrew, published in 1979.

These ideas serve as the foundation for subsequent formal accounts of the Semitic morphological system. In his seminal work on the topic, McCarthy (1981) appeals to the framework of Autosegmental Phonology to introduce the notion of separate tiers in Arabic that correspond to different kinds of morphemes. The root is considered a morpheme that is formally represented as a consonantal melody that occupies its own autosegmental tier, in which case it is discontinuous at the surface level but not at a more abstract level of representation. Thus, a word such as *godel* in Hebrew would be represented as in Figure 2.

![Figure 2](chart.png)

*Figure 2:* Formal representation of the *g-d-l* root as a morpheme (μ), following McCarthy (1981)
In such a representation, the root, *g-d-l*, is one unit and the template, CVCVC, is another unit, with *o e* specified as the vocalic melody for 1SG.MASC. The form *godel* is derived from the union of one morpheme and another, when the root consonants associate with the C slots of template, one to one, from left to right, with the vocalic melody intercalated in the same fashion.

This approach has been the basis for other generative treatments, including a Distributed Morphology approach by Arad (2005). In her analysis, the root is an atomic unit that pairs a phonological form with a core meaning and is not decomposable further, making the root a sign in the Saussurean sense (Arad 2005, p. 6,12). In other words, roots such as *g-d-l* in (2) are lexically-stored, meaningful morphemes. Under the Root Hypothesis of this account, all nouns, verbs, and adjectives are based on such roots.

As noted above, though, both the distinctiveness of this system and the grammatical status of the root have recently come under debate among linguists. Whereas the traditional account of the root has treated it as a morpheme around which the morphological system is structured (e.g., Harris 1941; Chomksy 1979; McCarthy 1981; Arad 2005), more recently, the claim has also been made that Semitic roots do not form a part of the linguistic system at all (Bat El 1994; Benmamoun 2003; Ussishkin 2005) and that the characterization of the Semitic morphological systems as non-concatenative is misleading (Bat El 2003a).

An alternative to the root-template account that has been proposed in the literature involves taking the word as a foundational lexical unit. Under the current word-based approaches proposed for Semitic languages, the abstract consonantal root is neither necessary nor sufficient to account for the distributional patterns observed in the linguistic patterns exemplified in (2) and (3) (e.g., Bat El 1994; Benmamoun 2003; Ussishkin 2005).
Indeed, viable models can be developed that do not employ the root as a grammatical unit. For instance, a form such as *godel* ‘he grows’ can be derived directly from the citation form *gadal* ‘he grew’ by simply modifying vowels, akin to the process of ablaut in English, in which *sang* may be derived from *sing*. Bat El (1994) calls this Stem Modification, as in Figure 3.

\[
gadal \text{ ‘he grew’} \rightarrow \text{gadal} \rightarrow \text{godel ‘he grows’}
\]

*Figure 3: Formal representation of the derivation of gadal → godel, following Bat El (1994)*

Under this approach, the lexical units of a linguistic system consist of stems (that is, surface words minus inflectional affixes), specified with both consonants and vowels, such as *gadal*. A form such as *godel* is derived from the citation form *gadal* by overwriting the vocalic melody (the strikethrough on the *a a* vocalic melody in the supplanted by *o e* vocalic melody), which happens without any reference to a root. In this process, the overall structure of the basic word remains intact with Melodic Overwriting as the process by which inflectional changes occur, with the stem as the basis of inflection. Since processes such as Stem Modification make no reference to a consonantal root, linguists working under such frameworks have concluded that such a unit is not relevant to the grammar, as in Bat El (1994): “The analysis of Modern Hebrew stem formation presented in this study does not refer to a consonantal root at any stage of its derivation, and therefore holds the view that such a morphological unit does not exist in the grammar” (p. 591).

As currently formulated, this analysis does not include roots as grammatical units.

Moreover, not only can models be developed in which the root as a morpheme is unnecessary, in some cases roots as derivational formatives are not sufficient. This can be seen with clusters in five-consonant denominal verbs, as in (4).

(4)  

a. *priklet* ‘to practice law’ < *praklit* ‘lawyer’  
b. *nistelg* ‘to be nostalgic’ < *nostalgia* ‘nostalgia’
In (4a), the denominal verb has the syllable shape CCVCCVC, whereas in (4b) it has the shape CVCCVCC. Under a root-template model in which root consonants are extracted from the source word and inserted into the appropriate template, the position of the cluster should not depend on the source noun. Given that the reference to the source noun is required, these denominal verbs cannot consist of solely a root and template in Hebrew (Bat El 1994). Benmamoun (2003) makes a similar case for Arabic with regard to the nominal system. On the basis of observations such as these, roots under the current word-based models do not have lexical status.

One of the open questions regarding Semitic morphology, therefore, involves the status of its morphological constituents. The primary focus of extant analyses is on the root as a constituent, with the traditional accounts positing a root as the basis of word structure in Semitic and with more recent alternatives claiming that the root plays no role in the morphological system of languages such as Hebrew.

1.3. Overview of the chapter. The remainder of this chapter addresses the question of what morphological constituents are motivated for Hebrew under a learning-based approach. The first constituent to be motivated, in Section 2, is the grammatical word. This section is followed by Section 3, in which the word-internal constituents of the word are motivated. The primary claim regarding word-internal morphological constituents of Hebrew is that the root and the stem are motivated for verbs and the stem is motivated for nouns and adjectives. Section 4 addresses morphological elements that are not constituents but that are relevant for describing patterns in Hebrew. Section 5 concludes the chapter by offering a summary of the main points.

2. Motivation for the grammatical word

As discussed in Chapter 1, the grammatical word is the first element motivated under a learning-based analysis. The present section offers evidence that the grammatical word is indeed
motivated by various linguistic patterns in Hebrew. Following the Grammatical Word – Phonological Word Congruency Principle detailed in Section 4.1.1 of Chapter 1, first the phonological word is motivated via phonological patterns in Section 2.1; then, based on the assumption that learners assume a general alignment between phonological word and grammatical word, the grammatical word is motivated via grammatical patterns in Section 2.2. Cases of misalignment between the phonological word and the grammatical word are discussed in Section 2.3.

2.1. Phonological word. The phonological word in Hebrew is motivated by a convergence of various criteria, each of which are discussed in greater detail in turn. The criteria presented include independence, internal cohesiveness, and involvement in phonological processes.

2.1.1. Independence. The criterion of independence refers to the fact that phonological words are those elements that can stand on their own, either as an utterance or as an answer to a question. A learner of a language would be expected to attend to the fact that certain elements but not others can exist independently.

In Hebrew, elements that can stand alone correspond to a wide range of types of content words, as illustrated in (5), (6), and (7)⁷.

(5) Question: ma ṭasita ṭetmol? ‘What did you do yesterday?’
   Answer: yafanti ‘I slept’

(6) Question: eize χajot maχmad yef leχa? ‘What pets do you have?’
   Answer: χatulim ‘cats’

(7) Question: eiχ ha marak? ‘How’s the soup?’
   Answer: taʔim ‘tasty’

⁷ All data in this section were generated with confirmation from the native Hebrew speakers mentioned in Section 1.1.
As these examples show, elements that are traditionally classified as verbs (as in (5)), nouns (as in (6)), and adjectives (as in (7)) can be uttered in isolation as an answer to a question. Whether a certain type of element can occur in isolation is a phonological property that learners would be expected to be attuned to in the learning process. Fluent speakers of the language identify such units as words. Another manifestation of the criterion of independence that learners would be expected to attend to is that fact that when speakers pause within an utterance, they do so readily between words but not between elements within words, as illustrated with the utterance in (8).

(8) ʔetmol yafanti ʔad tefa ‘Yesterday, I slept until 9.’

In this example, pauses occurring between ʔetmol and yafanti, or between yafanti and ʔad, or between ʔad and tefa do not sound unusual to native speakers. In contrast, a pause within any of these elements (e.g., between ʔet and mol, between ya and fanti, etc.) is unexpected and would be perceived as highly marked. Thus, the criterion of independence – whether an element can stand alone as an utterance or whether its boundaries can serve as a locus of potential pause – is a robust cue to learners regarding the phonological word as a construct in Hebrew.

2.1.2. Internal cohesiveness. The criterion of independence establishes the elements that are the minimal utterances in a word. Related to this criterion is the fact that elements of this same type exhibit internal integrity in that their components are in a fixed relationship to each other. Independence and integrity of phonological words contribute strongly to the phonological word being generalized as a necessary construct for Hebrew.

The criterion of internal cohesiveness of the word is best illustrated in contrast to the lack of such cohesiveness for larger units, such as phrases or sentences. Whereas elements in a sentence (i.e., words and phrases) can occupy more than one position, elements in a word (i.e., morphs) occur in a fixed order, as illustrated in (9) and (10).
In (9), we can observe that the order of words and clauses in a sentence is relatively flexible. Though the more common expressions are that of (9a-b), all four of the expressions are acceptable to speakers, and all are considered to be the same semantically. The order of word-internal components, on the other hand, is not at all flexible. In (10), there are no other configurations of the word that are associated with that gloss: Some rearrangements lead to unattested and unacceptable forms (e.g., (10b)) and some lead to a different word altogether (e.g., (10c)). Learners attempting to determine possible orders of linguistic elements in the language would be expected to note that elements such as words display a fixed order of components that is not necessarily applicable to larger elements of speech.

2.1.3. Phonological patterns. The status of the phonological word as a construct in Hebrew is further supported by its role in phonological patterns: The unit that meets the criteria of independence and internal cohesiveness is also relevant for describing patterns such as those involving stress and those involving spirantization in Hebrew.

Though stress in Hebrew does exhibit certain regularities, it cannot be systematically described using a unified set of rules (Bat-El 1993). Therefore, two observations can be made regarding stress in Hebrew, both of which contribute to the motivation for the phonological word as a construct in the language. One observation is that patterns of regularity make use of the construct of the phonological word, and the other is that lexical stress is a property of the language.
As in many other languages, stress in Hebrew is a property of the phonological word, a claim about Hebrew that is indicated by the fact that we find only one primary stress per word.

One of the most widely applicable generalizations about stress in Hebrew is that final syllables of words typically bear stress, meaning that the vowel of that syllable is longer and louder (Coffin & Bolozky 2005). Such a pattern would be useful for learners as they attempt to parse the speech stream they encounter. In the process of parsing the speech signal, learners would be expected to posit the category of the phonological word, which often ends in a stressed syllable.

As already suggested, not all words exhibit word-final stress, which indicates that lexical stress is also a feature of Hebrew. Lexical stress also supports the construct of the word. After all, the fact that the domain of lexical stress is the phonological word supports a learner’s generalization of the construct of the phonological word. Applying a non-native stress pattern to a word can lead to judgments of a learner as not a fluent speaker, and in some cases can even lead to the production of a different word than the one intended. For example, minimal pairs in the language exist such that the contrastive feature is stress rather than segmental differences, as in the case of the minimal pairs in (11), where stress is indicated in bold.

(11) a. bo\text{\text}ker ‘morning’
    b. bo\text{\text}ker ‘cowboy’ (Coffin & Bolozky 2005, p. 28)

Though assignment of stress (11b) can be predicted based on the word-final pattern typical of the language, a learner must memorize the fact that (11a) bears penultimate stress. Whether assigned by default or stored lexically, the stress patterns of these two examples are properties of the words themselves, and in either case must be described with reference to a syllable’s position in the phonological word. Minimal pairs can also be found among pairs that belong to the same lexeme, indicating that the stress pattern of word can also be grammatically meaningful. Such pairs can be seen in (12).
Though the particular alternations in (12) tend to be restricted to more formal speech, they demonstrate another way in which patterns in the Hebrew draw attention to the phonological word through stress patterns. As with the minimal pair in (11), the fact that stress is grammatically or semantically relevant and the fact that the domain of stress is the phonological word support the learner’s generalization of the phonological word as a constituent in the language.

Related to both stress assignment and the phonological word as a domain, another process that needs to be described in terms of the phonological word involves vowel reduction. Vowel reduction, like stress assignment, follows some predictable patterns (i.e., reduction in open unstressed syllable) yet must still be specified lexically since not all words that qualify for vowel reduction undergo the process (Ravid & Shlesinger 2001), as illustrated in (13) and (14).

(13)  a. dvarim ‘things’
     b. davar ‘thing’

(14)  a. davarim ‘mailmen’
     b. davar ‘mailman’ (Ravid & Shlesinger 2001, p. 381)

The singular forms of both (13) and (14) are homophones, but their plural forms are not. The general pattern that yields the reduced form in (13) is that the low vowel is reduced, either to schwa or by deletion, in the open unstressed syllable of the word. Again, we see a phonological process that references stress, which is a property of the word. Additionally, the exception to this reduction process (e.g., (14)) must be indicated idiosyncratically (i.e., part of lexical storage), as a property of the word. All these patterns, therefore, reinforce the construct of the phonological word, which supports the learner in the acquisition process.

Another general phonological process whose application reinforces the construct of the phonological word is spirantization. Spirantization in Hebrew refers to the alternation that occurs
between certain stops ([b], [p], [k]) and fricatives ([v], [f], [x]), an alternation which can be formalized as in (15).

(15) \{b, p, k\} \rightarrow \{v, f, \chi\} / V ___

In the general case, three of the stops of the language (which do not form a natural class) become fricatives post-vocalically. As discussed below, though, this is not a strictly phonological process since it does not occur to all potential targets. This process in the modern language is inherited from a more extensive historical spirantization process that involved all stops. In sets of words that exhibit this alternation, the spirants occur post-vocalically, as can be seen in (16).

(16) a. bikef ‘he asked’
    b. mevakef ‘he asks’

The two words in the pair are members of the same lexeme, connected via the consonantal sequence b-k-f. In the case of (16a), the initial consonant of that sequence is [b], but in the case of (16b), the consonant, which occurs in a post-vocalic environment, is expressed as the spirant [v]. Though such alternations can be found in many words in the language, spirantization is not a context-free phonological process. Exceptions to the generalization that spirants are found in post-vocalic position abound, an example of which is illustrated in (17).

(17) medaber ‘he speaks’

The fact that [b] rather than [v] occurs in post-vocalic position indicates that spirantization does not reflect a surface-true generalization. In the examples provided so far, whether a form exhibits the pattern or not is a stable property of that form. In other words, tokens of the form in (16a) consistently reflect [b], those of (16b) consistently reflect [v], and those of (17) consistently reflect [b]. Thus, word tokens exhibit a particular consistency that supports positing the phonological word as a constituent.
There are some instances of sociolinguistic variation in the language involving spirantization. Though such variation is not particularly widespread, as the non-alternating form has become widespread in the colloquial language (Glinert 2005), this sociolinguistic pattern also potentially offers evidence in support of the construct of the phonological word for some speakers. This stylistic variation is illustrated by the forms in (18).

(18)  
   a. paχad ‘fear’  
   b. be=faχad ~ be=paχad ‘in fear’ (Glinert 2005, p. 66)

Whereas the form in isolation begins with the stop, when one of a restricted set of forms (be- ‘in’, ke- ‘as’, le- ‘to’) is attached to the form as a clitic, this can trigger the spirantization process in the formal register of the language. If this stylistic alternation occurs, then the result is that the locus of variation involving spirantization is at the word-initial boundary, thereby offering evidence for the phonological word as a domain for phonological processes. Though this sociolinguistic variation is not necessarily prevalent enough that most learners would be expected to be exposed to them, the other phonological processes discussed in this section are prevalent. Taken together with the evidence discussed in Sections 2.1.1 and 2.1.3, the phonological word is well-motivated by the patterns of Hebrew.

2.2. Alignment of phonological word and grammatical word. Given that the phonological word is motivated for Hebrew, the assumption is that the learner would expect that this salient unit of form is likely to also be grammatically and semantically relevant. In other words, the working hypothesis is that there is an alignment between phonological word and grammatical word. Such an assumption follows the Grammatical Word – Phonological Word Congruency Principle discussed in Section 4.1.1 in Chapter 1. As is discussed in the present section, this assumption is indeed validated by the patterns of the language. The kind of evidence that supports this conclusion and which will be described in this section involves a consideration of which unit
serves as the most stable locus of meaning and grammatical relations in the language, as the basis for lexical categories, and as the basis of compounding patterns.

2.2.1. Stable locus of semantic and grammatical features. The alignment of the phonological word and the grammatical word is supported by the fact that the most phonologically salient unit also serves as the most stable locus of semantic and grammatical features. As discussed in Section 4.1.1 of Chapter 1, two kinds of units have been proposed in the linguistics literature as the basis of the morphological system: the morpheme and the grammatical word. As presented in Section 1.2 of the present chapter, the root has been posited by many theorists as the basis of the morphological system of Semitic languages such as Hebrew. In other words, it has been treated as a morpheme, that is, a linguistic sign in the sense of Saussure – a union of a meaning and a form (e.g., Arad 2005). The present section offers evidence that the grammatical word in Hebrew more reliably indicates semantic and grammatical features than the morpheme, thereby supporting an alignment between phonological word and grammatical word.

An analysis that treats the root (as a type of morpheme) as the basic unit of the morphological system is one in which surface words are decomposed into meaningful constituent elements. To observe how such an analysis would proceed, we can apply a decompositional approach to the example word in (19), in which the different component elements, indicated typographically through underlining, bold, and a morpheme boundary, are discussed below.

(19)  $\underline{\text{hi}z\text{kir}}\text{-}a$ ‘she reminded’

Under an analysis that views morphemes as the locus of semantic and grammatical features, the word in (19) can be said to consist of potentially three distinct morphemes, each of which is associated with a specific meaning or grammatical property. The three putative morphemes are the root, the template, and the suffix. Each of these will be discussed in turn. The first part of the
discussion of each introduces the distributional patterns that have been used to justify their status as morphemes, and the second part presents problems with treating them as the most stable locus of meaning and/or grammatical features.

The consonants indicated in bold, z-k-r, constitute the root and have been argued to form the semantic core of the word, associated with a meaning REMEMBER, a meaning supported by other words belonging to the same semantic field, as in (20).

\[(20)\]
\[
a. \text{zayar} \text{ ‘he remembered’} \\
b. \text{zikaron} \text{ ‘memory’} \\
c. \text{tizkoret} \text{ ‘reminder’}
\]

The sequence z-k-r (or z-χ-r, depending on whether post-vocalic spirantization has applied to k) is a common formal element in all three examples of (20) and in (19), and in all four cases it is associated with a common semantic core. Such patterns have justified morpheme-based analyses such as the conventional approaches to Semitic morphology discussed in Section 1.2. Such an analysis, though, cannot be uniformly applied to all putative roots in the language since many patterns exist in which the semantic core is less transparent than in the words in (19) and (20). The semantic connections in other sets of words sharing a common consonantal sequence are either less transparent, as in (21), or they are opaque, as in (22).

\[(21)\]
\[
a. \text{gadal} \text{ ‘he grew’} \\
b. \text{godel} \text{ ‘size’} \\
c. \text{migdal} \text{ ‘tower’}
\]

\[(22)\]
\[
a. \text{kavaf} \text{ ‘he conquered’} \\
b. \text{kvif} \text{ ‘paved road, highway’} \\
c. \text{kevufim} \text{ ‘pickles’}
\]

In the case of g-d-l illustrated in (21) (as well as in (2) and (3)), a common semantic core of GROWTH can be posited to be the semantic property associated with the root. Forms such as (21a) can indeed be straightforwardly analyzed as being built upon this semantic core. With regard to
(21b), though the word *size* does not necessarily imply that an entity is large or that has grown since *size* can also be used to describe something quite small, it can be said to indicate the level of largeness of the entity, which may be viewed as the result of growth. In the case of (21c), it is possible to see a connection between *tower* and *GROWTH*, though such a connection is not as straightforwardly apparent as it is for other words in that set nor is *GROWTH* as central to the meaning of *tower* as it is to the meaning of *he grew*. After all, not all towers have to be big, and, though their construction does imply a kind of metaphorical growth, such an implication applies to all kinds of buildings and is not unique to the construction of a tower. The lack of transparency is even more apparent in (22), where *conquer*, *highway*, and *pickles* appear to occupy entirely distinct semantic fields. Though historical connections between these words may be recoverable – according to Aronoff (2007) all three words are related to the notion of pressing since paved roads are built from layers pressed together, pickling involves immersion in brine combined with a pressing down with a weight, and conquering can be conceptualized as metaphorical pressing down on a group of people – such connections cannot be said constitute synchronically transparent relationships that speakers would be attuned to. Overall, then, roots as morphemes display certain instabilities across lexemes such that they cannot be argued to be the most stable locus of semantic properties when compared to words. Whereas roots such as *k*-v-ʃ are not reliably associated with a single semantic core across different contexts, words across multiple contexts do display semantic stability. For example, in a wide variety of sentences or phrases *kevufim* consistently refers to ‘pickles’ and *kvif* consistently refers to ‘highway’. Thus, a learner seeking to localize reliable semantic associations is better served attending to the grammatical word than to the root.

The same is true with regard to the template. In (19), the word *hizkira* ‘she reminded’ displays what is referred to as the *hif’il* template, which itself is associated with the prosodic shape
hiCCiC, where C stands for a root consonant. This template is linked with causative constructions (e.g., Glinert 2005), a claim that is supported by the fact that the lexeme represented in (19) is indeed a causative form, as can be seen by comparing it to (23), its non-causative counterpart. In addition, other sets of words also display a causative feature associated with the lexeme in the hif’il template, as in (24).

(23) zoχeret ‘she remembered’

(24) a. poχed ‘he fears’
b. hifχid ‘he frightens’

The forms in (23) and (24b) can be readily described as the causative variants of (19) and (24a) respectively, which supports a morpheme-based analysis in which the hif’il template carries the CAUS grammatical feature. The problem with such an analysis is that, as in the case of the root, not all words in the hif’il template can be associated with CAUS. As with roots, some instances of the hif’il template reflect less transparent cases of causatives, as in (25), and in some instances the relationship is very opaque, as in (26).

(25) a. bataχ ‘he depended on’
b. hivtiχ ‘he promised’

(26) a. karav ‘he approached’
b. hikriv ‘he sacrificed’

To a metalinguistically aware speaker, (25b) can be potentially viewed as having a causative relationship to (25a): In a way, to promise something to someone is to attempt to instill in them a sense of reliance on the person making the promise. Such a connection, however, is not as straightforward as the connection between the forms in (24). The connection is even more opaque in the case of (26), where the two words belong to distinct semantic fields. The fact that the two words seem to share a putative root may reflect an etymological connection; however, claiming that (26b) is the causative form of (26a) is not likely to reflect the naïve speakers’ knowledge of
the relationship between the two. Thus, though some generalizations can be made about certain grammatical features associated with templates, these associations are not reliable across the wider patterns of the language.

With regard to the suffix in (19), namely the -a of hizkira ‘she reminded’, affixes such as this are often reliably associated with a particular grammatical feature. In the case of (19), it is associated with 3SG.FEM, and it is a reliable marker of those features in past tense forms, as can be seen in (27).

```
(27) a. lamd-a ‘she learned’
b. hitpalel-a ‘she prayed’
```

In these two forms, which are associated with different templates from each other and from the template associated with (19), the presence of the suffix -a definitively marks the subject as 3SG.FEM in the past tense with all templates. In the present tense, though, the same suffix is more underdetermined, as it marks simply SG.FEM, though only with certain templates, as can be seen in (28).

```
(28) a. maskim-a ‘I (fem.) agree/you (fem.) agree/she agrees’
b. lomed-et ‘I (fem.) learn/you (fem.) learn/she learns’
```

In (28a), the suffix can be associated with any person, which is in contrast to the suffix in the past tense, which must be associated specifically with 3rd person. Another difference between the past tense and present tense is that in the past all instances of 3SG.FEM are associated with -a, whereas in the present SG.FEM is expressed as -a with some templates (e.g., (28a)) and as -et with others.

---

8 In some cases, speakers may be able to connect such words via a folk etymology. For example, rabbis expounding on sacrifices in the Bible have noted that making a sacrifice is connected to approaching God, as is evident in the fact that both words have the same root. Though it is certainly possible that some of these folk etymologies do indeed capture historical relationships, these connections are not necessarily widely shared by speakers, nor are they available for all such sets, and they typically have to be accessed through conscious effort. Therefore, such folk etymologies cannot, on their own, serve as evidence for a common semantic core.
(e.g., (28b)). In addition to the differences in the features associated with SG.FEM in the past and the present tense, another difference is that, in the future, no forms express SG.FEM with -a, as shown in (29).

(29)  
\begin{align*} 
\text{a. } & \text{ti-}rked-i \text{ ‘you (fem.) will dance’} \\
\text{b. } & \text{ti-}rkod \text{ ‘she will dance’}
\end{align*}

Instead, 2SG.FEM is expressed with the combination of the prefix ti- (or an allomorph) and the suffix -i, as in (29a) and 3SG.FEM is expressed with the prefix ti-, as in (29b). All these examples show that, though some reliable predictions can be made about suffixes and prefixes associated with inflectional features, these features also exhibit a certain degree of unpredictability. The features associated with exponents such as -a are readily identified provided one knows other properties of a word (e.g., tense). In addition, because different exponents may be associated with the same features, knowing a feature such as FEM does not allow one to predict which exponent will be used for a particular word. In other words, sub-word forms are ambiguous in isolation, but not as parts of whole words. This all stands in contrast to the situation with the word as a whole in which, with the exception of potential variation at the phonetic level, the correspondence between form and grammatical features is consistent. Thus, as can be seen by an exploration of the roots, templates, and affixes that constitute the putative morphemes of Hebrew, the most reliable locus of semantic and grammatical features is the grammatical word, a characteristic that supports learners positing it as a relevant morphological constituent in the language.

### 2.2.2. Basis for lexical classes.

Under a learning-based approach, all linguistic elements of a language should be motivated by patterns in the language instead of being posited a priori. This includes morpho-syntactic categories such as nouns, verbs, and adjectives. Though this dissertation does not attempt to decisively motivate these categories for Hebrew, it does offer some evidence that words can be grouped into lexical classes based on their syntactic, morphological,
and semantic properties, such that it is reasonable to speak of elements such as nouns, verbs, and adjectives in Hebrew. To illustrate how such lexical classes serve as evidence for the grammatical word, the distinction between nouns and verbs will be motivated in the present section. In Hebrew and in other languages, such lexical classes are motivated by a convergence of linguistic characteristics (Dryer 1997; Mithun 1999). The factors that will be discussed for Hebrew include morphological, semantic, and morpho-syntactic criteria that motivate the distinction between nouns and verbs. Such criteria apply to grammatical words and therefore offer motivation for the grammatical word as a constituent in Hebrew.

The constructs of noun and verb abound in a wide range of literature involving Hebrew. Such literature includes both academic literature and pedagogical material, which demonstrates the utility of these constructs in a multitude of different contexts. With regard to theoretical analyses, these constructs have been used both in morpheme-based frameworks (e.g., Chomsky 1979; Arad 2005) and in word-based frameworks (e.g., Aronoff 1994; Bat-El 1994). In addition, other kinds of linguistic research have also applied the distinction between nouns and verbs in Hebrew, including psycholinguistic accounts (e.g., Deutsch, Frost, & Forster 1998), work on language development (e.g., Berman 2003), and philologically-oriented work focused on language change and literary analysis (e.g., Koller 2012). Moreover, the constructs of noun and verb have been employed widely in pedagogical material (e.g., Glinert 2005; Coffin & Bolozky 2005), which attests to their utility among general users of the language. Though under a learning-based approach such a priori uses of the constructs are not sufficient to posit that they represent knowledge of speakers, the fact that these structures have proved useful in a wide variety of contexts speaks to the likelihood that learners would be attuned to them as they attempt to make sense of the patterns of the language.
Among the patterns of Hebrew that motivate nouns and verbs in the language are observations involving morphological properties, semantic generalizations, and morpho-syntactic relationships, all of which converge on units that would be considered grammatical words. Among the most reliable indicators of whether a word is a noun or a verb are the morphological properties and exponents of the word. Verbs are readily identified by their vocalic, prosodic template, also known as a *binyan*, and by their inflectional affixes, as illustrated in (30).

(30)  a. rakad ‘he danced’
      b. dibar-ti ‘I spoke’
      c. nit-labeʃ ‘we will dress ourselves’

In all three examples in (30), the vocalic pattern clearly associates the word with a specific verbal template, in these cases *pa’al*, *pi’el*, and *hipa’el* respectively. In addition, the 1SG suffix -*ti* attached to (30b) and the 1PL *ni(t)*- prefix (which can also be analyzed as a part of an allomorph of the template) attached to (30c) are elements that can be found only with verbs. All three of the examples in (30) are grammatical words, and the morphological elements associated with them clearly mark them as verbs. With regard to nouns, they can be marked for gender and number, as shown in (31).

(31)  a. χaver ‘friend’
      b. χaver-a ‘friend (fem.)’
      c. χaver-im ‘friends’
      d. χaver-ot ‘friends (fem.)’

The set of words in (31) represent a noun paradigm. The inflectional features that are marked overtly are FEM, PL, and PL.FEM, associated with the suffixes -*a* (with -*et* as an allomorph), -*im*, and -*ot* respectively. It should be noted, though, that these morphological elements can sometimes be ambiguous, since the markers for the present tense inflectional features are in some cases the same as the markers on nouns. For example, the forms in (32) and those in (33) both bear the same suffixes, and therefore are isomorphic. Those with the glosses given in (32) occur in the same
environments as other nouns, and those glossed as in (33) occur in the same environments as other verbs.

(32)  a. *fomer* ‘guard’
b. *fomer-et* ‘guard (fem.)’
c. *fomr-im* ‘guards’
d. *fomr-ot* ‘guards (fem.)’

(33)  a. *fomer* ‘I (masc.) guard, you (masc.) guard, he guards’
b. *fomer-et* ‘I (fem.) guard, you (fem.) guard, she guards’
c. *fomr-im* ‘we guard, you (pl.) guard, they guard’
d. *fomr-ot* ‘we (fem.) guard, you (pl., fem.) guard, they (fem.) guard’

We therefore encounter some ambiguity when it comes to certain exponents, such as those in (32) and (33), which can function as either nouns or verbs. Given that, as discussed in Chapter 1, linguistic categories in a learning-based approach are considered cognitive categories, they therefore exhibit properties of other cognitive categories, such as fuzzy boundaries and prototype effects. The fact that forms such as (32) and (33) in isolation are ambiguous with regard to whether their morphology marks them as nouns or verbs does not negate the fact that other cases of nominal versus verbal morphology are more clearly determined. Thus, the morphological features of a given grammatical word generally mark the word as belonging to a certain lexical class.

In addition, the semantic features of a particular word indicate whether it is likely to be a noun or a verb. As Mithun (1999, p. 58) points out, two of the classes of words upon which semantic features generally converge are nouns and verbs, with the former associated with entity interpretations and the latter with event or stative interpretations. Indeed, in Hebrew, words that bear nominal morphology, as in (31), are associated with entity interpretations, and those that bear verbal morphology, as in (30), are associated with event or stative interpretations, as illustrated in (34).

(34)  a. *ʔezra* ‘help (noun)’
b. *ʔazarti* ‘I helped’
With regard to semantic field, both of the words in (34) are associated with the meaning HELP, which can itself be readily associated with either an entity or an event interpretation. Which interpretation is the one that a speaker applies is dependent on the morphological exponents associated with the surface word, as shown in the sentences in (35).

(35)  
   a. ʔani mexapes harbe ʔezra ‘I am looking for a lot of help’  
   b. ʔazarti lo ʔetmol ‘I helped him yesterday’

With nominal morphology, such as the marker associated with feminine grammatical gender, an entity interpretation arises, as in (35a). With verbal morphology, as in the vocalic template associated with past of the pa’al conjugation class and the person-of-subject suffix –ti, an event interpretation arises, as in (35b). Notably, the entity or event/stative interpretations are associated with the word as a whole. Thus, learners who attend to the morphological properties of a linguistic form and to its semantic properties will find a convergence of properties on sets of words that may be classified as nouns and verbs.

Furthermore, observations about morpho-syntactic interactions also contribute to a learner’s positing of lexical classes, which consist of grammatical words. In Hebrew, such relationships are classified as agreement relationships since two elements share common grammatical features. Nouns and verbs both participate in agreement relationships; however, the nature of these relationships is distinct for each, in terms of what other elements they agree with and in terms of the features that are shared by the elements in agreement. In Hebrew, nouns agree with adjectives with regard to gender and number and with regard to definiteness, and verbs agree with subjects with regard to person, number, and gender\(^9\), as illustrated in (36), (37), and (38).

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\(^9\) This section provides some evidence for the motivation of constructs such as noun and verb (and, of course, the dissertation as a whole motivates terms such as word and stem). Though in principle, under a learning-based approach, all such linguistic terms should be motivated, some will necessarily be employed as a kind of shorthand, with the understanding that these terms may ultimately prove to be unmotivated for the language and which may or may not prompt a reanalysis of the observations of this chapter. In this
The set of phrases in (36) and (37) demonstrate agreement relationships between nouns and adjectives. In (36), the nouns and adjectives have the same suffixes described in the discussion on (31) that correspond to the properties of gender and number, and in (37) both the noun and the adjective exhibit the definite clitic ha-. Similarly, the set of phrases in (38) demonstrate how the verbs and the subject pronouns with which they are associated share the same properties of gender, number, and person. As with the suffixes in (36), we can observe certain formal correspondences between the suffixes on the verbs and the pronouns that bear the same features (e.g., ani dibartı, ata dibarta, with correspondences indicated in bold and underlined). Given that such agreement patterns are an important part of understanding the language, learners would be expected to attend to the elements that agree, which are grammatical words. Moreover, the fact that these two types of grammatical words have distinct agreement relationships also supports the positing of lexical classes such as noun and verb.10 Taken together with the morphological and the semantic criteria discussed above, lexical classes are motivated for Hebrew, and the members of these lexical classes

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10 A morpho-syntactic relationship that attests to the difference between the category of noun and adjective is the difference in exponents of nouns when they are modified by an adjective (e.g., salı̇m tovim ‘good baskets’) than when they are modified by a noun, in what is referred to as a smichut or noun construct (e.g., salei lejem ‘bread baskets’, where the plural of sal ‘basket’ is indicated by -ei when modified by a noun versus -im when modified by an adjective).
are grammatical words, which offers further support for the posting of the grammatical word as a constituent in Hebrew.

2.2.3. Base of compounding. Another morphological pattern that motivates the grammatical word in Hebrew is compounding, which takes the word as its base. Both diachronically and synchronically, new grammatical words can be formed by combining two grammatical words, as in (39), or by combining parts of grammatical words, as in (40) (Coffin and Bolozky 2005, p. 143; Glinert 2005, p. 121)

(39) a. ramkol ‘loudspeaker’ < ram ‘loud’, kol ‘sound’
    b. kaduregel ‘soccer’ < kadur ‘ball’, regel ‘foot’

(40) a. midraχov ‘pedestrian-only street’ < midraχa ‘sidewalk’, reχov ‘wide’
    b. rakevel ‘cable car’ < rakevet ‘train’, kevel ‘cable’

In each of the examples in (39), the compound is formed by straightforwardly combining what are otherwise two independent phonological and grammatical words into one phonological and grammatical word, with the appropriate phonological modification. For example, in (39b), we see both degemination of the r (since phonemic geminates are not found in surface patterns of the modern language), and stress adjustment (ka.du.ˈre.gel < ka.ˈdur, ˈre.gel), such that the compound exhibits only one primary stress. The examples in (40) are more precisely described as clippings since only parts of each word are combined to form the compound word. Such clippings are generally phonologically-based and, notably, they combine parts of words, as opposed to parts of word-internal constituents such as roots or stems. Thus, in (40a), the common sequence rVχ, and in (40b), the common sequence kev motivate the formation of a new word. Neither of these sequences or the remnants of the original word are morphologically relevant. Word formation via compounding, therefore, offers further evidence for the grammatical word as a morphological constituent in Hebrew.
2.3. Exceptions to alignment of phonological word and grammatical word. Based on the evidence offered in Sections 2.1 and 2.2, the hypothesis that phonologically salient elements are also grammatically and semantically relevant – following the Grammatical Word – Phonological Word Congruency Principle introduced in Section 4.1.1 of Chapter 1 – is indeed supported by the patterns of the language. One relevant observation that speakers are expected to note is that elements that meet the independence criterion are also a stable locus of semantic and grammatical features. Such a generalization is true for all phonological words. However, the converse does not necessarily hold: Not all grammatical words are phonologically independent. Exceptions to the one-to-one alignment of phonological and grammatical word involve elements conventionally referred to as clitics (e.g., Matthews 1991; Aikhenvald 2002). Such elements, which are relevant for understanding linguistic patterns in Hebrew, meet the criteria for the grammatical word in that they are reliably associated with specific grammatical or semantic features, but they do not meet the criteria for phonological words since they are not phonologically independent.

In Hebrew, clitics interact primarily with nouns. Such elements are not found in isolation and cannot bear stress, characteristics that make them different from phonological words (cf. Section 2.1). In contrast to the putative morphemes discussed in Section 2.2.1, which do not necessarily exhibit stable semantic or grammatical features across different contexts, the clitics in Hebrew do have reliable grammatical functions associated with them, as illustrated in (41).

(41) a. ?ani holex le=χanut ‘I go to a store.’
    b. hu noten maχma?a le=yeled ‘He gives a compliment to a child.’
    c. yef sefer le=talmid ‘A student has a book.’ (lit. ‘There is a book to a student.’)

In all the instances where the clitic le= appears in (41), it carries a directional sense, which may be referred to as a lative or a dative (cf. the English particle ‘to’), whereby an entity is directed
towards a particular point. In some cases, this directional sense is literal and involves movement, as in (41a). In others, it is metaphorical as in (41b). In yet other instances, the sense of direction towards a point is yet more abstract, as in (41c), in which the clitic is used indicate possession, whereby an entity is metaphorically directed to its owner. The other clitics in Hebrew include particles such as $be=\text{‘in/at’}$, $ke=\text{‘like/as’}$, and $h=\text{‘the’}$, and they function similarly. In all cases, they are reliably associated with a particular grammatical feature, more reliably than roots and templates. In this way, they function like grammatical words, even if phonologically they are not expressed without being attached to other grammatical words.

Given the nature of clitics, they do represent a misalignment between the phonological and the grammatical word, such that we cannot assume that a single phonological word consists of a single grammatical word. This misalignment, however, is not problematic for a learner who assumes that phonological words are likely to be grammatically relevant. Indeed, even in cases where a phonological word consists of a clitic group, this clitic group is grammatically relevant and displays a stable correspondence of semantic and grammatical features. For instance, a learner encountering the form $le=\chi anut$ ‘to a store’ in an utterance such as (41a), is not incorrect in assuming that this grouping will have the same meaning and function across different contexts, an assumption that does not hold for smaller components such as roots or templates (cf. Section 2.2.1). The fact that learners may not necessarily assume that a phonological word consists of only a single grammatical word demonstrates that they need to posit the phonological word as well as the grammatical word as linguistic constituents. However, this misalignment does not necessitate that learners reject the hypothesis encapsulated in the Grammatical Word – Phonological Word Congruency Principle that phonologically salient units are grammatically or semantically relevant. The primary claim motivated by the linguistic patterns presented in Section 2, therefore, is that
learners of Hebrew are expected to generalize a morphological constituent that we can refer to as the grammatical word.

3. Motivation for word-internal constituency

Given that the grammatical word is motivated as a morphological constituent for Hebrew, the next question that can be explored is whether word-internal constituency is also motivated. The claim of this dissertation is that sub-word structure is indeed motivated by the linguistic patterns of Hebrew. As will be demonstrated in the present section of this chapter, a key idea to understanding word-internal structure in Hebrew is the distinction between certain types of lexical classes. As argued in Section 2.2.2, the relevance of the constructs noun and verb in Hebrew is motivated by a convergence of morphological, semantic, and morpo-syntactic factors. Another difference between these two classes of words is their word-internal structure. Therefore, in order to understand word-internal constituents, we need to explore the linguistic patterns of verbs and nouns separately, with elements such as adjectives patterning with nouns. Section 3.1 addresses the motivation for word-internal constituents in verbs, which are argued to consist of two word-internal constituents, the root and the stem. Section 3.2 addresses the motivation for word-internal constituents in nouns and adjectives, which are argued to consist of one word-internal constituent, the stem.

3.1. Motivation for word-internal constituency of verbs. As presented in Section 1.2, arguments for the primacy of roots in Semitic languages are based primarily on the structure of verbs. Indeed, as Section 3.1.1 demonstrates, linguistic patterns in Hebrew involving verbs do indeed motivate the root as a word-internal constituent under a learning-based approach. Notably, the root in the present analysis does not necessarily exhibit the same properties as roots proposed in the more conventional models discussed in Section 1.2. One key difference is that roots in the
present analysis are not posited to be fundamental constituents beyond the domain of verbs. In addition, though it receives less attention in the literature, another word-internal constituent that is motivated for verbs in Hebrew is the stem, arguments for which are presented in Section 3.1.2.

3.1.1. Motivation for the root in verbs. The conventional use of the term root in Semitic languages refers to the discontinuous, consonantal sequence discussed in Section 2.1. The term is used in this dissertation in the same way to refer to a word-internal morphological constituent that is found in all verbs. Roots may be identified by considering a surface word without its vowels and without its affixes. Evidence for the root as a basic constituent of Hebrew verbs comes from a variety of linguistic patterns in the language – intra-lexeme paradigmatic relationships, cross-lexeme relationships, morpho-phonological effects, phonotactic constraints, and external evidence – each of which is discussed in turn in this section.

3.1.1.1. Intra-lexeme paradigmatic relationships. Hebrew verbs participate in a complex set of inflectional patterns involving typologically rare non-concatenative (i.e., surface discontinuous) relationships. Despite a range of possible morphological exponents within a single lexeme, however, the forms within a lexeme are united via a common morphological element, the root, which serves as the anchor to the inflectional paradigms of verbal lexemes. It is in its role as the anchor to the paradigms of a verbal lexeme that the root plays its most important morphological role.

For any given verbal lexeme, its members are inflected for tense, number, person, and gender. In addition, verbs are associated with one of seven conjugational classes (a.k.a., binyanim), each of which is associated with specific morphological exponents. The seven conjugation classes are conventionally named pa’al, nif’al pi’el, pu’al, hif’il, huf’al, and hitpa’el. As a result of the
different kinds of morphological information that a verb expresses, the different members of a
verbal lexeme can exhibit a wide variety of differences in form, as illustrated in (42).

(42)   a. *diber* ‘he spoke’
       b. *medaberet* ‘I (fem.) speak, you (fem.) speak, she speaks’
       c. *jedabru* ‘they will speak’

At first glance, the set of words in (42) appear to have few formal commonalities among them:
Vowels are distinct across all forms, syllabic structure is different for the three forms, and few
consonants can be found in common. What the set of words do all share, though, is a common
consonantal sequence of *d-b-r*. Though these consonants do not always occur in the same position
in the word (e.g., *d* is word-initial in (42a) but word-medial in (42b) and (42c); *b* and *r* form a
cluster in (42c) but are separated by vowels in (42a) and (42b); etc.), they can be found in all
forms in the given example, and, indeed, in all forms of the paradigms for the lexeme associated
with *SPEAK*, always occurring in the same order relative to one another. The consonantal sequence
*d-b-r* is what is referred to as the root of the lexeme, and it is what unifies all the forms of a given
verbal lexeme.

In addition, roots are the most readily identifiable elements in the verbs of Hebrew. The
existence of different conjugation classes of the language results in verbs that on the surface can
be quite distinctive, as can be seen by (43), (44), and (45).

(43)   *lamad* ‘he learned’
       *lomedet* ‘I (fem.) learn, you (fem.) learn, she learns’
       *jilmedu* ‘they will learn’

(44)   *himfîx* ‘he continued’
       *mamfîza* ‘I (fem.) continue, you (fem.) continue, she continues’
       *jamfîzu* ‘they will continue’

(45)   *hitpalel* ‘he prayed’
       *mitpalelet* ‘I (fem.) pray, you (fem.) pray, she prays’
       *jitpalelu* ‘they will pray’
The sets of examples in (42), (43), (44), and (45) exhibit matched inflectional features (i.e., the $a$ examples in each set all correspond to 3SG.MASC.PST, the $b$ examples to SG.FEM.PRS, and the $c$ examples to 3PL.FUT). Each set, however, belongs to a different conjugation class (i.e., (42) is a pa’al lexeme, (43) is pi’el, (44) is hif’il, and (45) is hitpa’el). As a result of the different conjugational classes, even surface grammatical words that share inflectional features can have rather distinct forms. For instance, if we consider the SG.FEM.PRS forms in (42) – (45), we can observe that the exponents of those features is the suffix -et in some cases (e.g., (42), (43), and (45)) and -a in others (e.g., (44)); the vowels are different across the forms; and the initial syllable is distinct (in addition, though three out of four of the forms beginning with $m$ (e.g., (42), (44), and (45)), each is followed by different vowels). Certainly, some generalizations can be made regarding exponents of particular features (e.g., 3PL.FUT forms all begin with a $j$-initial prefix and end with a -u suffix) and to particular conjugation classes (e.g., hitpa’el forms all feature a prefix that contains the form Cit-). However, such generalizations are often rather specific in that they apply to only certain forms and only in certain circumstances. In all cases, though, the root can be readily identified by comparing a given surface form to other forms of the same lexeme. This straightforward identifiability of a root for verbal lexemes and its pervasiveness in the verbal system offers strong evidence for learners on the lookout for generalizations that can be made about the verbal patterns of Hebrew.

3.1.1.2. Cross-lexeme relationships. In addition to how it serves as the anchor for verbal lexemes, another property of the root that makes it an important element in the morphological system of Semitic languages such as Hebrew is the fact that it also serves to connect derivationally-related lexemes. This property is one of the motivations for positing that Semitic languages are root-based (cf. Section 1.2). Though the discussion in Section 2.2.1 demonstrates that roots do not
necessarily display a stable semantic core across lexemes and therefore should not be treated as the unit that serve as the basis of the morphological system, the fact that many roots do display semantic correspondences across morphologically related lexemes does offer additional motivation for the root as a word-internal constituent.

The kinds of cross-lexeme semantic correspondences that would reinforce the construct of a root for a learner are discussed in Section 1.2, but they will be reiterated in this section with a different set of examples, namely, those associated with the root χʃ-v. This root is associated with a semantic core of MENTAL ACTIVITY, and is illustrated in (46) (all examples are drawn from Arad 2005, p. 16).

(46)  
a. χaʃav ‘he thought’  
b. χiʃev ‘he calculated’  
c. heʃʃiv ‘he considered’  
d. maʃʃev ‘computer’  
e. maʃʃava ‘thought’  
f. taʃʃiv ‘calculus’  
g. χeʃbon ‘account’

Though it is an empirical question whether Hebrew speakers in general recognize that all the words in (46) are related to one another, it is reasonable to assume that most speakers recognize at least some of the words as strongly related. For instance, even if speakers do not recognize the relationship between ‘account’ in (46g) and ‘he thought’ in (46a), they are more likely to readily recognize that the ‘he considered’ in (46c) and ‘he thought’ in (46a) are formally and semantically connected, despite the fact the vowels, the syllable structure, and the initial phones are different. What unites these distinct but related lexemes is the root, and only the root.

As exemplified in (46a), (46b), and (46c), the root can connect related verbs that occur in different conjugation classes. In this way, Semitic languages are different from other languages with conjugation classes. For instance, in contrast to a language such as Spanish, where taking a
verb and changing its conjugation class results in an entirely different and unrelated lexeme (e.g., Section 3.2.1 of Chapter 4), in Hebrew such a process often yields semantically close words, as in (47).

(47)  
a. ʔaχal ‘he ate’  
b. ʔiχel ‘he digested’  
c. heʔeχil ‘he fed’

(48) ʔoχel ‘food’

The three words in (47) have a related semantic core, EAT, but they belong to three different conjugation classes, pa’al, pi’el, and hif’il respectively. Given that roots in Hebrew can relate words across conjugation classes, as in the forms in (47), as well as across lexical classes, as can be seen by comparing (47) and (48), where the verbs and the noun share a common root, this results in a significant number of lexemes that are related semantically via a root. Such relationships would be expected to further draw learners’ attention to the usefulness of positing a construct root for describing linguistic patterns in Hebrew.

3.1.1.3. Morpho-phonological effects. Other evidence for the root as a constituent comes from morpho-phonological effects that take the root as a domain. Linguistic processes that require the root for their description include formation of a repetitive by addition of ʃ, reduplication for pluractionality, and root-alternation patterns.

A morphological process in Hebrew that provides evidence for the root as a constituent is the addition of ʃ to add a repetitive meaning to a word. This can be seen in (49) and (50) (examples modified from Faust 2015, p. 95).

(49)  
a. kotev ‘he writes’  
b. kitev ‘he wrote’  
c. meʃaχtev ‘he rewrites’  
d. ʃiχtev ‘he rewrote’

(50) a. doreg ‘he ranks’
b. *darag* 'he ranked'
c. *mefadreg* 'he reranks’
d. *fidreg* ‘he reranked’

These examples demonstrate that addition of the form /ʃ/ adds a repetitive sense to a word, a process similar to that of adding *re-* in English. We can observe that the site of insertion of /ʃ/ directly precedes the first root consonant. The root in (49a-b) is *k-t-v* and the root in (50a-b) is *d-r-g*, and in both lexemes the root of the repetitive counterpart is the base root with /ʃ/ affixed at the beginning.

In addition, we can also observe that the addition of /ʃ/ can result in a new template. Though in (50) both the base and the repetitive form are associated with the *pi’el* conjugation class, in (49) the base is a *pa’al* verb and the repetitive counterpart is a *pi’el* verb. The reason for this change is that the addition of /ʃ/ to the base root makes the root a quadriradical root and quadriradical roots are best accommodated in the *pi’el* conjugation class (Faust 2015, p. 295). This process, therefore, is sensitive to root-template associations. Thus, the addition of repetitive /ʃ/ serves to emphasize the root both because it marks the initial boundary of the root as the attachment site and because it has a root-based effect, namely the assignment of quadriradical roots to the *pi’el* conjugation class.

A similar argument can be made on the basis of reduplication as a marker of pluractionality. This process is when the final root consonant is repeated in order to indicate pluractionality, which refers to a sense of the action of a verb being pluralized by being, for example, repeated or applied to multiple participants (Greenberg 2010, p. 120). It is exemplified in (51) and (52) (examples adopted from Faust 2015, p. 302).

(51)   a. *layaf* ‘he whispered’
b. *ligef* ‘he whispered repeatedly’

(52)   a. *tsaxak* ‘he laughed’
b. *tsiųkek* ‘he giggled’
These two pairs of words demonstrate how a pluractional sense of the verb is associated with a reduplicated final root consonant ($l\chi\rightarrow l\chi\chi\chi\chi$ in (51) and $ts\chi\rightarrow ts\chi\chi\chi\chi\chi$ in (52)). In addition, the novel lexeme is associated with the *pi’el* conjugation class, motivated by the fact that a new root, one with four consonants, has been generated. As with the addition of repetitive $f$, the final root consonant is the target of pluractional reduplication and the addition of a consonant results in a root-motivated assignment to a particular template. Thus, both these processes serve as further motivation for learners attempting to make sense of the language to pay attention to the root as a constituent.

Roots in Hebrew are also useful in characterizing certain morphological alternation classes. Aronoff (2007) observes that, for example, some words with $n$-initial roots drop the $n$ in certain cases and some other words do not. This is illustrated by (53) and (54), which have words associated with the roots $n-s\chi\chi$ and $n-h-g$ respectively.

(53) a. *pa’al* conjugation class: *nasa* ‘he traveled’, *jisa* ‘he will travel’
    b. *hif’il* conjugation class: *masia* ‘he transports’

(54) a. *pa’al* conjugation class: *nahag* ‘he drove’, *jinhag* ‘he will drive’
    b. *hif’il* conjugation class: *manhig* ‘he leads’

In the third singular masculine past, ‘travel’ is *nasa* and ‘drive’ is *nahag*. In the future, the $n$ drops for *jisa* ‘travel’ but not for *jinhag* ‘drive’. Thus, these two words belong to two different alternation classes. What we can observe is that when in other conjugation classes where the $n$ might potentially drop, the root behaves the same. For example, in the *hif’il* conjugation class, the $n$ also drops for the word associated with the first root but not for the word associated with the second root: We find *masia* ‘he transports’ versus *manhig* ‘he leads’. Thus, these morphological alternation classes are root-based. Taken together with the morphological processes described
above, the root-based alternation classes offer further evidence of the utility of the root in
describing linguistic patterns in Hebrew.

3.1.1.4. Phonotactic constraints. Another linguistic phenomenon that serves as evidence
for the root as a constituent in Hebrew involves a set of co-occurrence restrictions, commonly
referred to as Obligatory Contour Principle (OCP) constraints. These constraints also seem to have
a psycholinguistic reflex that reflects speakers’ knowledge about the language (Berent & Shimron
2003, as discussed further in Section 3.1.1.5 below). OCP restrictions take the root as the domain
and therefore serve as evidence for the root as a constituent.

Several observations can be made about possible consonants in the root. These
observations, initially stated by Greenberg (1950), are illustrated in (55).

(55)  a. *kV{k}Vt, *kVgVt
     b. *kVtV{d}
     c. ?ided ‘he encouraged’, madad ‘he measured’
     d. zirez ‘he hastened’, nigen ‘he played’, tigen ‘he fried’, tarad ‘he perturbed’

Among the unattested forms, neither identical nor homorganic first and second consonants occur
in roots (as represented in (55a)). Another prohibition in the language is on homorganic second
and third consonants (as represented in (55b)), a generalization that holds with very few
exceptions. On the other hand, identical and homorganic consonants can be found in roots, but
only in other types of sequences. For instance, many examples of identical second and third root
consonants can be found in the language (e.g., (55c)), as well as, less frequently, identical and
homorganic first and third consonants (e.g., (55d)). These observations hold only of roots (i.e.,
these observations do not hold of the word as a whole) and therefore serve as evidence for the root.

These co-occurrence restrictions have served as an important motivation in conventional
modern analyses of Semitic languages for the root as a constituent. Though the specific theoretical
proposals of such analyses are not necessarily motivated under a learning-based approach, given
their importance in justifying the root in formal approaches, the argumentation in support of the root is worth mentioning. In his seminal work on Semitic morphology, McCarthy (1981) accounts for this pattern in Semitic by appealing to the Obligatory Contour Principle (OCP), which is a statement about the dispreference for adjacent identical elements in the underlying representation. Though the OCP was formulated initially to account for tonal patterns in the framework of Autosegmental Phonology (cf. Leben 1973; Goldsmith 1976), McCarthy adopts it for Semitic and introduces separate tiers that correspond to different kinds of morphemes. One of those tiers is the root tier, which consists of precisely the consonants that participate in the co-occurrence restrictions. The consonantal root (C₁C₂C₃) is considered a morpheme that is formally represented as a consonantal melody that occupies its own autosegmental tier. Thus, a word such as *gadal* ‘he grows’ in Hebrew would be represented as in Figure 1 (repeated below as Figure 4).

![Figure 4: Formal representation of the g-d-l root as a morpheme (μ), following McCarthy (1981) in this root tier, the root consonants are indeed adjacent and the OCP applies straightforwardly. This accounts for the absence of first and second identical and homorganic consonants and for lack of second and third homorganic consonants. The attestation of forms with identical second and third consonants is accounted for by positing bi-consonantal roots and right-ward spreading, such that a form such as *madad* ‘he measured’ consists of two root consonants, *m-d*, and the second root consonant spreads to fill the C₃ slot, as in Figure 5.](image-url)
In this way, McCarthy accounts for the distributional facts by appealing to a more generally attested phenomenon, the OCP, and to an abstract level of representation to which this phenomenon applies in Semitic. Critical to this analysis is a constituent of a root. Even if one adopts a different model, as the present dissertation does, these observations related to OCP constraints demonstrate that the root nevertheless remains a construct that is useful in accounting for this set of patterns.

3.1.1.5. Psycholinguistic evidence. As mentioned in Section 1.2, the question of whether Semitic languages should be described as root-based or word-based has been heavily debated by researchers. In an attempt to help resolve the issue, psycholinguistic work has been carried out in order to determine the extent to which the root is psychologically real to speakers. Though the psycholinguistic evidence has not definitively resolved the issue of whether a formal analysis of Semitic should be root- or word-based, the fact that some studies have shown that the root is a psychologically valid construct in at least certain instances offers support to the argument of this dissertation that the root is motivated as a constituent for Hebrew.

To begin with, regarding to the OCP restrictions mentioned in Section 3.1.1.4, Berent and Shimron (2003) find that when presented with nonce words, Hebrew speakers disfavor those nonce words that had identical or homorganic consonants as the first and second radicals more than those nonce words that had identical or homorganic consonants as the second and third radicals. This, they claim, is explainable as a violation of the OCP. Since the OCP states that adjacent identical
segments are prohibited, their findings suggest that the radicals are indeed adjacent, which would be the case if the root is a constituent. Even if an OCP-based analysis is not adopted, the fact remains that speakers are sensitive to distributional relationships in a root.

In addition, findings in the domain of language disorders have also been used to support the root as a cognitively real entity. Idrissi, Prunet, and Beland (2008) looked at a French/Arabic aphasic patient and found that he produced 25 times more consonantal metathesis in Arabic than in French, including the resurfacing of glides that were not present on the surface but were posited to be in the root. This suggests that in Arabic, non-adjacent consonants are more strongly linked with each other than they are in French because Arabic but not French has consonantal roots as morphemes. Similar results would be expected with Hebrew as a fellow Semitic language.

Much research on the question of the status of the root has also involved psycholinguistic priming experiments. Feldman, Frost, and Pnini (1998) asked participants to create nonce words based on a source word that either had a transparent root (i.e., a root such as $g$-$d$-$l$ in (3), in which the posited meaning of the root is reflected in a multiplicity of lexemes) or an opaque root (i.e., one with minimal lexemes associated with it). What they found was that participants were able to generate the nonce word more readily when the root was transparent than when it was opaque. The fact that speakers use roots in generating nonce words supports the construct of the root as a constituent in the language. In addition, the fact that differential effects are found for transparent and opaque roots suggests that the root emerges only when sufficient evidence is available to support that particular root, a point that speaks to the fact that roots are not always reliable carriers of meaning (cf. Section 2.2.1) and that roots are not necessarily motivated for all types of words (cf. Section 3.2.2).
In an experiment involving a masked priming experimental paradigm, Frost, Forster, and Deutsch (1997) found that lexical decisions and naming of target words both were facilitated by primes that shared a root with the target word relative to primes that were just orthographically or semantically related. This provides further evidence of a root-like element priming linguistic processing, and, therefore, as a construct that speakers would be expected to be attuned to.

These and other studies on the psycholinguistic role of the root have been used to argue that the linguistic system Hebrew treats the root as a morpheme, that is, as a consistently reliable pairing of form and meaning. As discussed in Section 2.2.1, this conclusion is too strong, as there are many instances where roots are not reliable carriers of semantic or grammatical features across lexemes. Moreover, the psycholinguistic results do not themselves support this conclusion. The strong conclusions drawn from the psycholinguistic experiments are based on, for instance, an assumption that activation of a word by a prime such as a root implies grammatical decomposition of the word into the unit that has primed it. The assumption that a unit that primes must be the unit around which the morphological system is based, however, is not directly motivated. Roots can be relevant for some words in a limited manner (e.g., as the anchor to the inflectional system of a verbal lexeme but not necessarily the source of a consistent semantic core across all words with that root) without necessarily being the unit around which the morphological system is organized. Therefore, the psycholinguistic experiments should not be taken to prove that the root is the basic unit of all content words in the language. These results, however, can be marshalled in support of the assumption that roots do play at least some role as a constituent in the morphological system of Hebrew, particularly when taken together with the other observations in this section about the utility of the root in describing many of the linguistic patterns of verbs in Hebrew.
3.1.2. Motivation for the stem in verbs. The term stem in a language such as Hebrew refers to the component of a word without inflectional affixes, either affixes that express person, number, or gender or affixes that express conjugation class. This construct, which represents essentially a verb’s root plus the interdigitated vowels and which will be exemplified in greater detail below, is useful for describing certain verbal patterns in Hebrew. These patterns include the following: person/number/gender inflection for tense paradigms, assignment to conjugation class, and morpho-phonological effects.

3.1.2.1. Base of person/number/gender inflection. The patterns that most reliably identify a stem involve person/number/gender inflection for a given tense of a verb, as exemplified in (56), (57), and (58).

(56)  

a. gorem ‘I (masc.) cause, you (masc.) cause, he causes’  
b. gorem-et ‘I (fem.) cause, you (fem.) cause, she causes’  
c. gorm-im ‘we, you, they cause’  
d. gorm-ot ‘we, you, they (fem.) cause’

(57)  

a. garam-ti ‘I caused’  
b. garam-ta ‘you (masc.) caused’  
c. garam-t ‘you (fem.) caused’  
d. garam ‘he caused’  
e. garm-a ‘she caused’  
f. garam-nu ‘we caused’  
g. garam-tem ‘you (pl.) caused’  
h. garm-u ‘they caused’

(58)  

a. ḫe-grom ‘I will cause’  
b. ti-grom ‘you (masc.) will cause’  
c. ti-grem-i ‘you (fem.) will cause’  
d. ji-grom ‘he will cause’  
e. ti-grom ‘she will cause’  
f. ni-grom ‘we will cause’  
g. ti-grem-u ‘you (pl.) will cause’  
h. ji-grem-u ‘they will cause’

The forms in (56), (57), and (58) represent the paradigms for the present, past, and future tenses respectively, of the lexeme CAUSE. What unifies the paradigms of the lexeme as a whole is the root
$g$-$r$-$m$, which is the common formal element of the lexeme and which serves as the anchor to the inflectional pattern as a whole. However, we can also observe an element that serves as an anchor to each of the tense paradigms of the lexeme. Allowing for vowel reduction patterns of the kind discussed in Section 2.1.3, we can observe that in (56), the present tense forms share the element *gorem* (or allomorph *gorm*, resulting from unstressed vowel reduction); in (57), the past tense forms share the element *garam* (or the allomorph *garm*); and in (58), the future tense forms share the element *grom* (or the allomorph *grem*). Thus, the stem serves as an anchor for the tense paradigms of the lexeme. If the root can be said to serve as the anchor to all the paradigms of a lexeme (and also serves to connect a verbal lexeme to other related lexemes), the stem can be said to serve as an anchor for certain paradigms within a lexeme. Under a learning-based approach, having one element as an anchor to a lexeme does not preclude having other elements as anchors within sub-groups of the forms of a lexeme.

There is variation regarding how extensive a stem is within a lexeme. The most limited role of a stem is as anchor to a single tense paradigm. This can be seen in the tense paradigms of the lexeme *CAUSE* in (56), (57), and (58), in which each stem is associated with only one tense paradigm. This lexeme is associated with the *pa’al* conjugation class. In other conjugation classes, however, the stem has a larger role, serving as an anchor to more than one tense paradigm, as exemplified in (59) and (60).

(59) a. medaber ‘he speaks’
    b. *diber* ‘he spoke’
    c. jedaber ‘he will speak’

(60) a. matχil ‘he starts’
    b. *hitχil* ‘he started’
    c. jatχil ‘he will start’
In (59), which are forms from the lexeme for SPEAK and in the pi’el conjugation class, the stem serves as the anchor for both the present tense (59a) and the future tense (59c), both of which share the stem daber, which is distinct from the stem for the past tense in (59b), diber. In contrast, in (60), the three stem forms of the lexeme START in the hif’il conjugation classes represent all three tenses, and they all share the same form of the stem, tqil. In all these examples, the stem is readily identifiable as the element that remains when affixes are removed; such a unit is useful in connecting forms within a paradigm.

In addition, suppletion also offers evidence for the stem as a constituent. The domain of suppletion in Hebrew verbs is the stem, as demonstrated in (61).

(61)  a. ḥomer ‘I say’
     b. ḥamar ‘I said’
     c. ḥagid ‘I will say’

The lexeme SAY is unlike the typical verbal lexeme in that the present and past tense forms, (61a,b), are expressed in the spoken language using a very different form than the future tense, (61c). Given that the forms have both a different root (ʔ-m-r in the former and n-g-d in the latter) and a different conjugation class (pa’al in the former and hif’il in the latter), the domain of suppletion is larger than the root. Given that inflectional affixes are as expected in each of the cases, the domain of suppletion is smaller than the grammatical word. Therefore, the domain of suppletion is the stem, and verb suppletion offers additional evidence for the stem as a constituent.

3.1.2.2. Markers of conjugation class and morpho-phonological processes. Membership in conjugation class in Hebrew is marked by two morphological elements. One element is the
prefixal material on a verb and the other element is the shape of the stem. It is also possible to analyze the two – prefixes and stem shape – as a single entity, the template. In either case, however, the stem is useful in determining the conjugation class of a given verb.

Each conjugation class is marked by a unique set of prosodic patterns that include particular prefixes and vocalic melodies. In most cases, either the prefix sequence or the vowel patterns are sufficient to indicate the conjugation class of a word, as illustrated in (62), which lists the conjugation classes by their conventional names and offers sample words for each.

(62)  a. pa’al: ūafav ‘he thought’
      b. nif’al: nigmar ‘he/it was finished’
      c. pi’el: filem ‘he paid’
      d. pu’al: fulam ‘it/he was paid’
      e. hitpa’el: hitnaged ‘he opposed’
      f. hif’il: hizmin ‘he invited’
      g. huf’al: huzmim ‘he/it was invited’

The conjugation class of each of the sample words can be identified in certain cases by a particular prefix. For instance, the prefix hit- indicates that a word belongs to the hitpa’el class, as in (62e). In other cases, though, a form does not display a conjugation prefix. In such instances, though, the conjugation class is nevertheless readily identifiable by the stem shape. For instance, a stem that consists of an open syllable followed by a closed syllable and that has low vowels as the nucleus (represented as Ca.CaC) is unambiguously an indicator of a member of the pa’al conjugation class, as in (62a). Especially given that a single root can be associated with more than one conjugation class in Hebrew (cf. Section 3.1.1.2), the fact that the stem serves as a reliable indicator of conjugation class contributes to its relevance as a constituent in the language.

Conjugation class membership is related to a couple of morpho-phonological patterns, sibilant metathesis and blocking of spirantization, that occur only with particular conjugation
classes. Since stems and not roots are the constituents that express conjugation class (cf. Section 3.1.1.2), these processes take the stem as their domain. Sibilant metathesis is illustrated in (63).

(63)  
   a. lehítalet ‘to dominate’
   b. liflot ‘to control’

Both the forms in (63) are associated with the root /ʃ-l-t/, with the former in the hitpa’el conjugation class and the latter in the pa’al conjugation class. What we can observe in the former is that a metathesis process has applied whereby the /t/ of the prefix lehit- metathesizes with the first root consonant, the /ʃ/ (cf. lehitlabeʃ ‘to dress oneself’, which represent the typical pattern, without metathesis). Such a metathesis occurs in a very specific domain: with the hitpa’el conjugation class when a sibilant occurs in the initial position of the stem. It should be noted that metathesis is not a general phonological process of the language, as sibilants can be found after alveolar stops in other words in the language (e.g., tfa esre ‘nineteen’). The process of sibilant metathesis, therefore, supports the positing of a stem as a construct because it applies to the initial boundary of the stem and because it is restricted to a specific conjugation class, which is marked in part by the shape of the stem.

The other process that is limited to certain conjugation classes is the blocking of spirantization. Spirantization (introduced in Section 2.1.3) is a common process in Hebrew whereby /b/, /p/, and /k/ alternative with fricatives /v/, /f/, and /χ/ post-vocically. This process, however, does not apply in all cases, as illustrated by (64).

(64)  
   a. χover ‘he joins’
   b. meχaber ‘he connects’

In this set of words, both of which are associated with the root /χ-b-r/, we can observe the expected case of intervocalic spirantization of the second root consonant in (64a). Unexpectedly, though, this process does not apply in the case of (64b). The critical difference between the two forms is
conjugation class, with the former in *pa’al* and the latter in *pi’el*. The exception to post-vocalic spirantization occurs only with certain conjugation classes, those which historically contained geminates, such as *pi’el*. As with sibilant metathesis, then, the root is a useful construct for describing this exception, both because the blocking applies to the stem as a domain and because the stem itself indicates whether a verb is in the conjugation class in which this process is blocked. The utility of the stem, therefore, is based on its role as the anchor to paradigms within a lexeme, as a clear indicator of conjugation class of a verb, and as the domain of morpho-phonological processes that are connected to certain conjugation classes.

3.2. Motivation for word-internal constituency of nominals. As argued in the previous section, word-internal structure is strongly motivated by the verbs of Hebrew. Such structure is also motivated for nominals (i.e., nouns, adjectives, and adverbs)\(^{12}\), though to a lesser extent. Both stems and roots can be identified in nominal elements, but with significant differences between those elements in nominals and in verbs. The former will be discussed in Section 3.2.1, and the latter in Section 3.2.2. One difference between nominals and verbs is that, whereas stems are motivated for both types of words and roots are motivated for all verbs, roots are not motivated for all nominals.

3.2.1. Motivation for the stem in nominals. The primary motivation that supports the positing of the stem in nominals under a learning-based approach is the fact that the stem serves as the base of inflection for nominals. In this way, it functions similarly to the stem in verbs. Another set of patterns that supports the positing of a stem as a constituent of nominals comes from word formation, as evidenced by denominal verbs. These factors are discussed in turn.

\(^{12}\) The term *nominal* will be used as a cover term for nouns, adjectives, and adverbs, a usage also followed by Halliday and Matthiessen (2014), who use the term in this fashion in their Systematic Functional Grammar (SFG) approach to linguistic structure. It is meant to ease exposition, given that nouns, adjectives, and adverbs pattern similarly to each other, rather than to imply adherence to an SFG theoretical model.
3.2.1.1. Base of inflection. The stem is conventionally thought of as the element that serves as the base of inflection. This conceptualization of the stem is based on a derivational approach to morphology, one in which words are built up from constituent elements. In a learning-based approach, the surface structures (e.g., words) are the starting point of analysis, and therefore in such an approach the corresponding conceptualization of the stem would be as the element that remains after inflectional material has been accounted for. This view corresponds well to the way in which stems in Hebrew nominals can be identified.

Given that nominals are inflected for fewer inflectional features than verbs, it is not surprising that inflectional patterns in Hebrew are significantly less populated than those for verbs. Whereas a verbal lexeme can exhibit more than twenty different grammatical forms associated with it, nominals exhibit a maximum of four, as shown in (65) and (66).

(65)  a. saykan ‘actor’
      b. saykan-it ‘actress’
      c. saykan-im ‘actors’
      d. saykan-ot ‘actresses’

(66)  a. tov ‘good (sg. masc.)’
      b. tov-a ‘good (sg. fem.)’
      c. tov-im ‘good (pl. masc.)’
      d. tov-ot ‘good (pl. fem.)’

Both sets of words in (65) and (66) represent lexemes that can be inflected for both number and gender, a noun in the case of the former and an adjective in the latter. As these examples show, the inflectional markers are as follows: -a/-it SG.FEM, -im PL.MASC, -ot PL.FEM, with SG.MASC typically unmarked. This is the typical situation with adjectives, which, as noted in Section 2.2.2, enter into agreement relationships with nouns with regard to the features of gender and number. The situation represented in (65), though, is not necessarily typical for nouns, many of which express a single, lexically-based grammatical gender, as in (67) and (68).
(67)  
   a. ʃaʔon ‘clock’
   b. ʃaʔon-im ‘clocks’

(68)  
   a. ʃulχan ‘table’
   b. ʃulχan-ot ‘tables’

The lexeme in (67) is inherently masculine and therefore can be inflected only for number, as can be seen in (67b) with the -im PL.MASC suffix. Similarly, the lexeme in (68) is inherently feminine and it too can be inflected only for number, as reflected in its -ot PL.FEM suffix in (68b). Thus, for many nouns, the paradigms consist of only two members, and, overall, the maximum size for all nominals is four. To the extent that an anchor of the inflectional paradigms of nominals can be determined, though, that anchor can be treated as the stem, which is also the term used to refer to the anchor of tense paradigms within a verbal lexeme (cf. Section 3.1.2.1).

The stem in nominals, therefore, is the form that remains after inflectional information for gender and number have been accounted for. Thus, the stems of the nominals discussed above are as follows: faχkan in (65), tov in (66), faʔon in (67), and fulχan in (68). It is worth noting that in all these cases, the stem is identical to the singular masculine grammatical word. Though one could posit a zero morph as the SG.MASC suffix, under a learning-based approach such a structure would be posited only if independent evidence exists to support it (e.g., patterns that distinguish between an uninflected stem and word with a zero affix, psycholinguistic effects that speakers exhibit that treat the zero morph the same as the overt morphs, etc.). Therefore, the analysis that will be adopted is one in which, for example, the stem in (68) is fulχan, which also happens to be one of the grammatical words associated with the lexeme. This is not always the case, since there are nominal lexemes in which the anchor to the inflectional paradigm is not identical to the unmarked singular, masculine form, as can be seen in (69).

(69)  
   a. rofe ‘doctor (masc.)’
   b. rofa ‘doctor (fem.)’
c. *rofim* ‘doctors’

d. *rofot* ‘doctors (fem.)’

In the lexeme in (69), the form that all members of the paradigm share is *rof*-, which means the stem is not identical to one of the grammatical words of the lexeme, unlike the previous examples. Thus, nominal stems may or may not be the same as the unmarked member of the lexeme. (For an analysis that uses the notion of complexity to describe the difference between a stem such as *rof*-, which is not found in the language in isolation, and a stem such as *fulχan*, which is, see Section 3.3.2.2 of Chapter 4 on Spanish and the discussion in Section 1.4 of Chapter 5.) In all cases, however, a form – the stem – can be readily identified that serves to connect all the members of a nominal lexeme, with the exception of suppletive forms (e.g., *iʃ* ‘man, person’, *anaʃim* ‘people’, with stems in bold), in which case the element that is suppled is the stem, with suppletion therefore also serving to provide evidence for the stem (cf. Section 3.1.2.1). In addition, the nominal stem consists of a continuous sequence of both consonants and vowels, like the verbal stem and unlike the verbal root. Thus, stems are motivated as relevant morphological constituents both for verbs and for nominals.

### 3.2.1.2. Comparison of nominal and verbal stems.

Stems in nominals and stems in verbs are therefore both identified in the same way: as the element that remains after inflectional information is accounted for. Yet, there are some notable differences. For one, the fact that inflection is more involved in verbs than in nominals means that the process is more straightforward in nominals than in verbs. One complication with verbs is that it is unclear whether the vowels should be considered to convey information about tense, which is conventionally considered to be inflection (e.g., Haspelmath & Sims 2010). In some conjugation classes, tense can be determined with vocalic patterns, as in (70), and in others, it cannot, as in (71).

(70) a. *lomed* ‘he learns’
b. *lamad* ‘he learned’
c. *yilmod* ‘he will learn’

(71)  

a. *mitlabef* ‘he dresses himself’  
b. *hitlabef* ‘he dressed himself’  
c. *jitlabef* ‘he will dress himself’

In (70), which represents a *pa’al* lexeme, the vowel patterns for each tense are different and thus knowing the vocalic melody allows a speaker to immediately recognize the tense of the grammatical word. Therefore, in this conjugation class, the vowels could be argued to be inflectional (though even in this conjugation class, the vocalic patterns alone do not express tense since affixes are also particular to tense, such as the prefix *ji-* in (70c), which is found only in future tense forms). In contrast, in (71), which represents a *hitpa’el* lexeme, the vocalic melody offers no information about tense, which must be determined using affixal information. Given that tense features are not necessarily determined via vocalic melodies, the present analysis will treat them as non-inflectional, preserving the claim that, for both verbs and nominals, stems are the remnant of grammatical words when inflectional information is removed. The alternative argument, however, is not a problem for the overall analysis: If one were to argue that in cases such as (70) the vocalic patterns of the stems are inflectional, then one would simply need to qualify the more general statement above by restricting the inflectional features referenced to person, number, and gender. In either case, though, stems are readily identified morphologically.

Another difference regarding inflection between nominal and verbal stems involves the fact that nominals do not participate in conjugation classes the way that verbs do. Though patterns can be found among nominals that resemble the templates of verbs – the nominal patterns are conventionally referred to as *mishkalim* (singular *mishkal*) and are compared to the *binyanim* (a.k.a. templates, singular *binyan*) of verbs – the nominal patterns are neither clearly delimited nor obligatory. In contrast to the *binyanim*, which are readily defined (5–9, depending on one’s
analysis), the number of *mishkalim* proposed for Hebrew ranges from 100 to close to 400 (Shatil 2014). Moreover, all verbs are assigned to a *binyan*, but not all nouns are assigned to a *mishkal*. Therefore, given that *mishkalim* do not motivate declension classes in nominals the way that *binyanim* motivate conjugation classes in verbs, exponents associated with *mishkalim* are not treated as inflectional. These exponents will be addressed further in Section 4; for the present analysis, though, they are not considered inflectional and therefore are not removed in determining the identify of stems in nominals. Given the qualifications regarding what counts as inflectional information in nominals, therefore, stems in nominals can be treated as the same type of element as stems in verbs.

3.2.1.3. Denominal verb formation. As discussed in Section 2.1, denominal verb formation is one of the processes that is used to demonstrate that word formation proceeds not through roots but rather through stems. The argument is repeated below and expanded upon since it serves as further motivation for the positing of the stem as a constituent in Hebrew nominals.

In many cases, it is difficult to determine whether the source of denominal verbs is the stem or the root, as can be seen with (72) (adapted from Bat-El 1994, p. 575).

(72)  
   a. *varod* ‘pink’  
   b. *hivrid* ‘to become pink’

In this pair of words, one analysis that can be put forth is that the formation of (72b) from (72a) proceeds via a root: The root is extracted from the nominal and is then placed into the appropriate verbal conjugation class, from which it then receives its vocalic pattern. One could also argue, however, that there is no need to proceed to a more abstract level than that of the stem, but that instead one can simply refer to the consonants of the nominal surface form, as Bat-El (1994) argues. Either mechanism would yield the correct result in this particular example. Therefore, in order to explore the question further, we can consider forms with more complex consonantal
relationships, such as five-consonant denominal verbs, as in (73) and (74) (repeated from (4) and adapted from Bat-El 1994, p. 578).

(73) a. priklet ‘to practice law’
     b. praklit ‘lawyer’

(74) a. nistelg ‘to be nostalgic’
     b. nostalgia ‘nostalgia’

The focus of these two examples is on the location of clusters. If denominal verb formation proceeded via root extraction, then we would not expect the verb to reflect information about clusters since root consonants are always adjacent. However, what we observe is that the clusters in the verbs in (73a) and (74a) reflect the clusters in their nominal counterparts in (73b) and (74b), respectively. Such an observation is not surprising if the stem is the basis of denominal verb formation since clusters occur in stems, which are specified with syllabic structure. The fact that clusters are transferred from the nominal to the verb supports the notion that the stem serves as the basis of denominal verb formation.

Another pattern that indicates that denominal verb formation proceeds via stems involves vowel transfer, as demonstrated in (75) and (76).

(75) a. hitχateχ ‘to become handsome’ (adopted from Bolozky 1982, p. 73)
     b. χatiχ ‘a hunk (handsome man)’

(76) a. hitbokses ‘to box’
     b. boks ‘box (blow)’ (Bat-El 1994, p. 580)

The typical case of formation of words that result in a new lexeme in the hitpa’el conjugation class is shown in (75a), where the vocalic pattern is hitCaCeC. In (76), in contrast, we see a more peripheral pattern, hitCoC(C)eC, where the penultimate vowel is a o rather than a. In addition, we can also note the maintenance of the cluster ks in the attested form. Such a result cannot be predicted from a denominal verb formation process that is based on the root, whereas it is well-
aligned with a word formation process that is based on the stem. The patterns of denominal verb formation, therefore, support the fact that the nominal stem is a useful construct for understanding the patterns of Hebrew.

3.2.2. **Lack of motivation for the root in nominals.** As mentioned in Section 3.1.1.1, one of the main factors motivating roots in verbs is that they are anchors to all the paradigms in a given verbal lexeme. The only element that all the forms within a verbal lexeme share is the abstract consonantal root. The same, however, cannot be said of nominals, for which the stem, as demonstrated in the previous section, plays this role. Lacking this unifying role and not readily generalizable from the patterns of the language, roots in Hebrew nominals are not strongly motivated.

This is not to say that roots are not identifiable in nominals at all; rather, they are not consistently generalizable from nominal patterns (especially when taken on their own, without consideration to related verbal lexemes) and their identification does not facilitate description of nominal patterns. The identifiability of roots in nominals ranges widely, as demonstrated in (77), (78), and (79).

(77) a. *seder* ‘order’
    b. *lesader* ‘to arrange’

(78) a. *maʔabada* ‘laboratory’
    b. *laʔavod* ‘to work’

(79) a. *misrad* ‘office’
    b. *lisrod* ‘to survive’

In all three examples, a canonical tri-consonantal root can be identified in the nouns: *s-d-r* for (77a), *ʔ-b-d* for (78a), and *s-r-d* for (77a). Only in some cases, though, does root extraction in

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13 Though (78a) and (79a) are not as straightforward as (77a) since (77a) requires simple extraction of consonants, *mi-* and *ma-* are commonly markers of both binyanim and mishkalim (e.g., Coffin & Bolozky
nominals offer insight into other patterns of the language. As mentioned above, root extraction
does not serve the purpose of connecting the members of a nominal lexeme, a role that is instead
relegated to stems. The role of the root in certain nominal lexemes is the same as that discussed in
Section 3.1.1.2 for verbs: connecting morphological related lexemes. This is the case for (77),
where the formal and semantic link between noun and verb is straightforward. For certain nominal
lexemes, though, the nominal root that is extracted is less transparently connected to the
counterpart verbal root. For instance, in (78), though a connection between work and a laboratory
is discernable since scientists do work in a laboratory, this connection is not necessarily
immediately obvious to speakers. After all, work happens in places other than a laboratory and
only specific kind of work (e.g., scientific research) is associated with a laboratory. Furthermore,
in other cases, a semantic connection between a nominal root and what would be is corresponding
verbal root is opaque or non-existent, as can be seen in (79), where the noun and the verb share a
root that cannot be said to have a semantic core common to both forms. This argument against the
root as a basic constituent in nominals, therefore, echoes the argument made in Section 2.2.1
against morphemes as the basic morphological constituent in Hebrew.

In addition, the root extraction process in nominals is often not straightforward, certainly
less so than it is for verbs, but also less so than is represented by the forms in (77a), (78a), and
(79a). One of the complications involves the difference between verbal templates and affixes on
the one hand and nominal templates and affixes on the other. As introduced in Section 3.2.1.2,
unlike the former, the latter are only sporadically motivated, as illustrated in (80) and (81).

(80)  a. potẓan ‘can-opener’
     b. liftoaḥ ‘to open’

(81)  a. šulḥan ‘table’

2005; Glinert 2005) and therefore a certain amount of experience with the verbs and nominals in the
language allows one to not include the $m$ in consonantal extraction for roots.
b. *lifloaχ* ‘to send’

One pattern that is somewhat consistent in the language is that involving the nominal pattern ending with the suffix *-an*, which sometimes but not exclusively characterizes an object associated with an action, as shown in (80a), ‘can-opener’, which is a tool that performs the action of (80b), ‘opening’ (Glinert 2005, p. 117). However, not only are there other associations available for this nominal pattern, but sometimes removal of the pattern in an attempt to find a root is not productive, as is the case in (81a) where the algorithm applied in (80a) fails to yield useful element since ‘table’ and ‘to send’, which appear to share a root if this procedure is applied, are not connected at all.

Another way of stating the observation that consonantal roots are not strongly motivated for nominals is to note that vowels and affixes in nominals are also not particularly relevant on their own. Whereas vocalic patterns and affixes in verbs often carry information about inflectional properties, this is not reliably the case in nominals, with the exception of the inflectional affixes associated with number and gender. Thus, two key differences between verbs and nominals that contribute to the positing of roots in the latter as constituents but not in the former are the fact that roots serve as formal anchors to all the paradigms in verbal lexemes but not in nominal lexemes and the fact that templates and affixes are straightforwardly identified for verbs but not for nominals.

Indeed, the distinct properties of nominals and verbs is a motivation under a learning-based approach for positing different constituent structures in the two types of words. Such an asymmetry has also been observed under a generative approach. Arad (2005), for instance, notes that unlike with verbs, purely consonantal roots cannot be extracted from many nouns. Her solution for this asymmetry is to posit two kinds of roots: consonantal roots and syllabic roots (i.e., specified for both vowels and consonants such that syllable structure is evident). Such a solution is certainly
motivated if one assumes that the structure of all lexical words must be the same for a language. However, such an assumption is not adopted a priori by a learning-based approach. What Arad refers to as syllabic roots are treated as nominal stems in the present approach, consistent with the observation that they are akin to verbal stems, which themselves are also syllabic. Thus, the conclusion of the present analysis is that roots and stems are motivated as constituents of verbs and that only stems are motivated as constituents of nominals. The role of roots in nominals is like that of morphemes overall in the language. As discussed in the next section, nominal roots are motivated in certain cases, but not consistently for nominals and not as basic constituents in the language.

4. Other morphological elements

A learning-based approach to constituency in Hebrew, therefore, results in the positing of three morphological units: the grammatical word, the stem, and the root. The grammatical word is treated as the primary unit, which means both that it is treated as the highest level of structure and that it is the unit around which the morphological system is organized. In addition, word-internal constituents are motivated for the language, with two different kinds of overall structure posited, one type of structure that corresponds to verbs and one that corresponds to nominals. The structure of verbs includes three hierarchically arranged units, which can be represented as follows: \[\text{word}\ldots\text{stem}\ldots\text{root}\ldots\]. Thus, the grammatical word that is a verb consists of a stem, which consists of a root. The structure of nominals, in contrast, is simpler: \[\text{word}\ldots\text{stem}\ldots\]. Though this structure is similar to that of verbs, it does not contain a root as an element that is motivated for nominals as a whole. As noted in Section 2.2.1, though these two structures may be the only ones motivated as reflecting the morphological constituency of the language, such a claim does not preclude the motivation of other morphological elements as useful for describing the patterns of
the language. In fact, other morphological elements are also motivated, even if they are not considered constituents. Two such elements are morphemes (which include nominal roots) and templates (primarily for verbs, but also for nominals), both of which have been referenced throughout the chapter. The role of these two elements will be addressed more explicitly in the present section. Morphemes are discussed in Section 4.1 and templates in Section 4.2.

4.1. Morphemes. Following the conventional definition of the morpheme as a form-meaning pairing (cf. Chapter 1), it has already been demonstrated that morphemes are relevant for Hebrew. Indeed, elements such as roots, affixes, and templates can in some instances be described as morphemes using this definition. In order to understand the role of morphemes in Hebrew, however, we should bear in mind that the positing of certain morphemes does not necessitate a morpheme-based morphological structure. Moreover, just because certain roots, affixes, or templates have morphemic properties does not necessitate that all such elements are treated as morphemes.

With regard to roots, many can indeed be considered morphemes, though whether a root can be viewed as a morpheme depends on what one considers a root. Not all elements that are potentially roots because of their form (i.e., abstract consonantal sequences that can be identified in a word) would qualify as morphemes. If one focuses on paradigms within a verbal lexeme and the root as the anchor to those paradigms, then it can certainly be claimed that the root is a form-meaning pairing, as shown in (82).

(82)  a. mesader ‘I arrange’
     b. sider ‘I arranged’
     c. yesader ‘he will arrange’

In the lexeme in (82), the one element that is consistently associated with the meaning ARRANGE is, in fact, the root $s-d-r$. Within a verbal lexeme, roots can indeed be called form-meaning pairings.
In this limited sense of the construct of lexeme, which is the one most strongly motivated under a learning-based approach (cf. Section 3.1.1.1), the root can be treated as a morpheme. Yet, the view of the root typically goes beyond this restricted conceptualization and includes the root as an element that connects distinct but related lexemes. This conceptualization of the root can sometimes be treated as a morpheme, as in (82) and (83), but sometimes it must be treated as simply a morph (i.e., a unit of form that is not necessarily also a unit of meaning), as in (84).

(83) a. lesader ‘to regulate’
    b. seder ‘order’

(84) a. lehitkarev ‘to approach’
    b. lehakriv ‘to sacrifice’
    c. krav ‘battle’

Looking at the examples in (82) and (83), we can observe that the root *s-d-r* does qualify as a morpheme since a semantic core akin to *ARRANGEMENT* can be ascertained. However, the sequence *k-r-v* in (84), which does serve as the anchor to the lexeme in (84a) and (84b), does not have a readily identifiable semantic core across lexemes. As argued in Sections 1.2, 2.2.1, and 3.2.2, this kind of inconsistency with regard to roots is one reason we do not want to treat the root as the basis of the morphological system. It is also a reason that the root cannot always be considered a morpheme. Yet, the fact that roots as morphemes do explain certain patterns, such as those exemplified in (82) and (83), suggests that we do want to posit the construct *morpheme*, that in some cases includes roots.

Another type of morphological element in Hebrew that in many cases qualifies as a morpheme is the affix. In terms of inflectional features, certainly many of the affixes that convey properties of person, number, or gender do so in a consistent way across lexemes and can therefore be considered pairings of form and grammatical function, as shown in (85).

(85) a. *raʔi-nu* ‘we saw’
b. *dibar-nu* ‘we spoke’
c. *hitxal-nu* ‘we started’

In all three forms in (85) the suffix *-nu* is consistently associated with 1PL and therefore can be called a morpheme. Moreover, as shown in (86) and (87), this form has applicability to other lexical classes as well, though to a more limited extent.

(86) a. *açi-nu* ‘our brothers’
    b. *aç-im* ‘brothers’

(87) a. *shel* ‘of, belongs to’
    b. *shela-nu* ‘ours’

In (86a), the suffix *-nu* is the element that conveys the genitive feature of the noun, specifically associated with 1PL (cf. (86b)), and in (87), it attaches to the preposition and conveys the same feature, 1PL. Thus, inflectional affixes such as this can be treated as morphemes. In addition to inflectional affixes, other affixes, which may be called derivational, also qualify as morphemes. One such affix is the *-ut* suffix shown in (88), (89), and (90) (adopted from Glinert 2005, p. 115-116).

(88) a. *itut* ‘slowness’
    b. *iti* ‘slow’

(89) a. *normaliut* ‘normality’
    b. *normali* ‘normal’

(90) a. *mehirut* ‘speed’
    b. *mahir* ‘quick’

In all three forms in (88), (89), and (90), the suffix *-ut* is consistently associated with a noun that conveys the abstract entity sense of its related adjective (functioning in a similar manner to *-ness* or *-ity* in English). Since such an element can be found in different lexemes with a similar grammatical function across those lexemes, it therefore also serves as an example of a morpheme,
a role that is shared by other derivational affixes, which reinforces the claim that the morpheme is a useful construct for describing linguistic patterns in Hebrew.

4.2. Templates. Morphological templates, which have been referenced throughout this chapter, are also relevant for describing linguistic patterns in Hebrew. The template is a generalization that expresses the skeletal prosodic structure of a word, including the position of root consonants, the vowels of the stem, and affixes attached to the word and is an essential part of verbal inflectional paradigms. Thus, the template of a word such as hitpalel ‘he prayed’ is hitCaCeC. The template, therefore, is a generalization over a word that contains information related to the root (in that it specifies where the root consonants will be found), the stem (in that it expresses the vowels and the syllable structure of the stem), and affixes (in that it explicitly identifies the affix). Templates are most commonly associated with verbs (and are referred to as binyanim), though templates can also be associated with certain nominals (mishkalim). As noted in Section 3.2.1.2, templates characterize all verbs but not all nominals. Certain templates may be said to exhibit certain morpheme-like qualities. In addition, verbal templates organize conjugation classes, which are morphological elements that play an important role in many linguistic patterns of Hebrew.

As noted in Section 2.2.1, many exceptions exist to generalizations regarding templates and derivational features. Therefore, with regard to the morphemic qualities of templates, the best examples come from the inflectional system. For instance, in the pa’al conjugation class, the only exponent of tense in some forms is the template, as shown in (91).

(91)   a. kotev ‘he writes’
       b. katav ‘he wrote’

The two forms in (91), from the same lexeme, represent minimal pairs in which the difference in tense is conveyed solely by the vocalic template. Because the templatic form is paired with a
grammatical function, it can be said to exhibit the properties of a morpheme. This situation, where the only exponent of tense is the template, is relatively rare. More common is the situation where the choice of a particular person/number/gender marker also conveys tense, as in (92), from the same lexeme as (91).

\[(92)\]
a. *katavti* ‘I wrote’
b. *niχtov* ‘we will write’

In (92a), the feature of *PST* is conveyed by the same vocalic template as in (91b); however, the choice of the *-ti* suffix for person and number also indicates that this form is in the past tense since this suffix only occurs in the past tense. Similarly, both the CCoC and the Ci- prefix in (92b) convey that the form is in the future tense. Thus, though some inflectional features are exclusive to a particular template, many of these features are redundantly expressed through other mechanisms. This observation does not detract from the morphemic properties that are characteristic of some templates, but it does indicate that the motivation for a learner to treat the template as a morpheme that expresses inflectional features is not as strong as it would be if templates were the primary means of understanding inflection.

The main role of verbal templates in Hebrew is the expression of conjugation class, which is a construct that helps to account for many paradigmatic patterns in the verbal system. Membership in a particular conjugation class is what determines many aspects of the form of a verb. Knowing, for example, that a verb associated with a tri-consonantal root is in the past tense and expresses *3SG.FEM* allows one to know that it will have an *-a* suffix. However, this information is not enough to allow one to know the prosodic structure, the prefixal sequences (if any), or the vocalic pattern of the verb. For that, one must know the verb’s conjugation class, which is an abstract category that is concretely expressed through the template, which is linked to the stem and
optional prefixes of a given verbal form. Therefore, knowing a lexeme’s inflectional features and conjugation class determine the form that will surface for that lexeme, as illustrated in (93).

(93)  
   a. *dibr*-a ‘she spoke’
   b. *him fis*-a ‘she continued’

Both the forms in (93) share the inflectional features of 3SG.FEM.PST. Knowing this, we can predict that they will have an -a suffix. Knowing that the former belongs to the pa’al conjugation class and the latter to the hif’il conjugation class then allows us to know the precise syllable structure and vowels of each. The verbal template, therefore, is inextricably tied to conjugation class. Therefore, whether or not morphemic properties can be associated with certain templates, as a generalization that expresses a great deal of morphological information about a word, the template is an important morphological element for understanding the patterns of the language.

5. Summary

As argued in this chapter, the linguistic patterns of Hebrew motivate the grammatical word as the primary unit of morphological structure in the language. As the basis of the morphological system, the word is the starting point of analysis. The present analysis therefore supports the assumptions of other word-based analyses that treat the word, rather than the root, as the unit around which the morphological system is organized. The linguistic patterns of the language also motivate constituent structure within the word. Two word-internal structures are motivated – the stem and the root – though these two constituents are not relevant for all types of words. In fact, two different types of hierarchical structure are motivated, corresponding to two different types of words. The structure of verbs has two levels below the word: the stem and the root. The structure of nominals is best characterized with only one constituent below the level of the word: the stem. Though roots can be identified in many nominals, they cannot be thought of as consistent constituents of the word. Instead, they are structures that are only sporadically motivated on a case-
by-case basis. In this way, they are like other morphemes in the language. Morphemes in Hebrew are motivated in many cases, such as those where affixes are associated with a reliable meaning or grammatical function. Not all morphs, however, can be considered morphemes, as in the case of many nominal roots. Another morphological element that is relevant for understanding the patterns but is not a constituent itself is the template. As a generalization over words that conveys information about, in particular, conjugation class, the template is an important construct in Hebrew and other Semitic languages. A learning-based analysis of the morphological constituents of Hebrew is consistent with aspects of other approaches to Semitic languages, though it is distinct from any single approach. For instance, it supports the root as an important constituent for describing the patterns of the language, consistent with a root-based approach. However, it challenges the primacy of the root as the basis for the whole morphological system, a challenge that is consistent with the claims of a word-based approach. The present analysis also makes predictions that can be empirically tested, a point that will be discussed in Chapter 5. In that chapter, the constituents of Hebrew will also be compared to those of Navajo and Spanish, each of which will be motivated in the next two chapters.
Chapter 3: Motivating Morphological Constituents in Navajo

1. Background

This chapter explores the evidence for the morphological constituents that are motivated in Navajo under a learning-based framework. The chapter begins with an introduction to the language in Section 1. Sections 2 focuses on the motivation of the grammatical word as a basic morphological constituent of the language, and Section 3 focuses on the word-internal constituents of the language, namely, the stem, conjunct, and disjunct. Section 4 addresses the role of other morphological elements, including the morpheme, the root, and the paradigm. The chapter concludes with Section 5, which presents a summary of the main points of the argument in the chapter.

1.1. General background. Navajo (WALS and ISO 639-3 codes: nav) is an indigenous language of North America, spoken primarily on the Navajo Nation in the Southwestern United States. Diné Bikéyah, as the land is called in the Navajo language, is located in the Southwestern United States, straddling the states of Arizona, New Mexico, and Utah. The Navajo Nation occupies more than 27,000 square miles, and its population consists of more than 250,000 inhabitants (History 2011). According to a 2013 census, Navajo speakers number approximately 169,000, most if not all of whom are also English speakers. Navajo is classified as a threatened language, corresponding to the fact that the language is “used for face-to-face communication within all generations, but it is losing users” (Lewis, Simons, & Fennig 2016). Despite the large number of speakers relative to other Native American languages of the United States and active efforts at revitalizing the language, Navajo is considered endangered because few children are learning it at home (Benally & Viri 2005).
Navajo is an Athabaskan language of the Na-Dené language family. It is closely related to languages such as Western Apache, Chiricahua-Mescalero, and Plains Apache, also spoken in the American Southwest. Together, these languages comprise the Southern Athabaskan, or Apachean, branch. They are more distantly related to Athabaskan languages of the Pacific Coast, such as Hupa, and Athabaskan languages of the Northwestern Canada and Alaska, such as Ahtna, Chipewyan, and Carrier. Athabaskan languages, in turn, are related to Eyak and Tlingit languages, the other two primary subdivisions of Na-Dené (Krauss 1979; Mithun 1999; Fountain 2008). Of all the languages of the Na-Dené family, Navajo is by far the most widely spoken. Its speakers represent about three-fourths of all speakers of the language family (Fernald & Platero 2000). Thus, Navajo is an important member of its language family.

1.2. Overview of Navajo morphology. Athabaskan languages in general and Navajo in particular are of special interest to linguists because of their relatively distinctive morphological system. The morphology of the language is commonly treated as being organized around a position class, or slot-and-filler, template (Kari 1989). One example of such a template is shown in Figure 6, following the Young and Morgan (1987) characterization of the Navajo verb.

<table>
<thead>
<tr>
<th>0</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
<th>VI</th>
<th>VII</th>
<th>VIII</th>
<th>IX</th>
<th>X</th>
</tr>
</thead>
<tbody>
<tr>
<td>La</td>
<td>Lb</td>
<td>Lc</td>
<td>ld</td>
<td>le</td>
<td>object</td>
<td>distributive plural</td>
<td>dative subject</td>
<td>adverbial - thematic</td>
<td>modal - conjugation marker</td>
<td>subject</td>
</tr>
<tr>
<td>object of postposition</td>
<td>null postposition</td>
<td>adverbial - thematic</td>
<td>reflexive</td>
<td>reversive</td>
<td>semilative</td>
<td>stem</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Figure 6: Young and Morgan Navajo verb template (Fountain 2008, p. 18 and Young 2000)*
According to this particular template, the Navajo verb consists of eleven positions (0-X), two of which (I and VI) can be further sub-divided. The most contentful element is referred to as the stem, at the rightmost position (X). The remaining ten positions represent a variety of inflectional, derivational, and adverbial/thematic elements, some of which are obligatory and some of which are optional (Young and Morgan 1987). For example, position VIII is associated with the obligatory subject agreement exponent; position Ie is associated with the derivational semeliterative (‘one more time’) exponent; and position Ib can be associated either with obligatory elements that must co-occur with particular stems (e.g., yá-14 with words related to speaking, cf. Section 3.3.2) or with optional adverbial elements (e.g., ch’i ‘out horizontally’) (Young 2000, p. 44).

The application of a position class approach to analysis of Navajo words is illustrated in (94). This example shows how an introductory text (Wilson 1995, p. 32) decomposes the word ánádajílífíh ‘they (pl.) drink repetitively’, using a simplified version of the template in Figure 6.

(94) proposed composition of ánádajílífíh ‘they (pl.) drink repetitively’

<table>
<thead>
<tr>
<th>Morpheme positions</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>á</td>
<td>ná</td>
<td>da</td>
<td>ji</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>d</td>
<td>dlíih</td>
<td></td>
</tr>
</tbody>
</table>

In this kind of analysis, all verbs can be decomposed into an underlying form consisting of a set of ordered morphemes. The underlying form, which resembles that of languages that are characterized as agglutinative, is then related to the surface form via a series of morphophonological rules, such as one that deletes the d in position 9 when it is followed by a consonant

---

14 The examples from Navajo will be written using the standard orthographic system of Navajo, which largely corresponds to the IPA. Of note is the fact that high tone is indicated by an acute accent (e.g., á) and nasalization by a nasal hook below the letter (e.g., á). The digraph sh represents ʃ, ch represents ʃt, zh represents ʒ, gh represents y, and y represents j. The glottal stop is indicated with an apostrophe, and glottalization is indicated by an apostrophe following the stop (e.g., t’).
(Kari 1976, p. 49). This type of approach requires a wide variety of concatenation rules to connect the underlying agglutinative form to the surface form, which is better characterized as exhibiting a synthetic word structure. Some of these rules are phonetically natural and consistent with patterns across a multitude of languages, such as a devoicing rule for continuents following voiceless constituents (Kari 1976, p. 46), and some are highly idiosyncratic patterns, such as the distributional observation that the 2sg.sbj exponent ni- is not present when it would otherwise immediately precede the classifier-stem complex and follow a CV sequence (Kari 1976, p. 41). Though the details vary both across Athabaskan languages and among different analyses for Navajo, the template is a commonly utilized tool in theoretical and descriptive treatments of Navajo and related languages (Kari 1989).

Despite the pervasiveness of the template approach to morphological analysis of Navajo, the synchronic utility of the position class template approach has been questioned. For example, McDonough (1990) abandons the position class template approach in favor of a bipartite structure. Relegating the template’s primary utility to the description of diachronic processes, she argues that it is ineffective as a synchronic word formation device in part because it lacks internal consistency and in part because it results in highly marked structures. For instance, some positions in the template exist for a single morpheme and others for multiple morphemes; the semantic and grammatical functions of some position classes are extremely transparent and those of others are very opaque; and some position classes are never filled at the same time, thereby making the ordering between them more paradigmatic than syntagmatic (McDonough 2000). The complexity of a synchronic morphological system organized around a template such as the one proposed for Athabaskan would indeed make it unlike the systems of most other languages, even those with a similarly rich system of inflection and derivation.
McDonough’s (1990) alternative consists of a much simpler system, one that is better aligned to those of other languages. Her bipartite structure consists of two primary constituents, as shown in Figure 7.

![Diagram](image)

*Figure 7: McDonough’s (1990) bipartite structure for the Navajo verb (adapted from p. 49)*

The two primary constituents of this structure are what are referred to as Verb and Infl (which can be preceded by clitics). Both are considered the same type of unit, and proposed to correspond to the putatively universal categories of V and INFL in generative grammar. Each structure is composed of a core element, what she calls a stem, which expresses the grammatical features of the constituent (the mode/subject features in the case of Infl and the core semantic features in the case of Verb). Each stem can be preceded by affixes. The affix that attaches to the Verb stem is the classifier and those that attach to the Infl stem are the agreement and aspect markers.

McDonough motivates her analysis by offering the kind of evidence that serves as motivation for constituents under the learning-based approach adopted by this dissertation and discussed in Chapter 1. For example, she concludes that Verb is a viable morphological constituent based on a variety of morpho-phonological patterns that apply to Verb as a domain or that occur at the initial and final boundaries (most of which will in turn are offered as evidence for the stem constituent in this dissertation in Section 3.1 of this chapter). Though correspondences can be identified between the template and the bipartite structure, overall, the bipartite approach offers a simpler structure that is more consistent with the structures of other languages.

Both the position class template and the bipartite structure can be used to answer the question: What are the morphological constituents of Navajo? Under the bipartite structure, three morphological constituents are relevant: the word, the Infl constituent, and the Verb constituent. McDonough (1990) proposes that for verbs, the verb word is made up of two constituents at the
same level of hierarchy: [word [Infl …][verb …]]. In this way, verbs in Navajo can be thought of as compounds, with a unit expressing tense-aspect-mood, referred to as mode in the Navajo literature and henceforth in this chapter, combined with a contentful stem. Clitics may also occur to the left of the main compound. Broadly speaking, the bipartite structure can be mapped onto the template: The Infl unit corresponds to positions IV-VII, the stem to positions IX-X, and the clitics to the right of the compound to positions 0-III (p. 25).

Other ways of grouping the position classes of the template into morphological units are also available. These characterizations overlap in some ways with one another and are in other ways peculiar to a particular analysis, such that a consensus of the set of morphological constituents of Navajo does not yet exist. One can see the various views in the field by considering the different ways in which researchers have characterized the morphological units of Navajo. For example, Young (2000) distinguishes between two types of pre-stem elements, those of the disjunct (positions 0-III) and those of the conjunct (positions IV-XI). Reichard (1951) groups elements of IX-X into a constituent she calls the stem complex, which is to be distinguished from the stem, corresponding to position X (p. 28). Faltz (2000) discusses the verbal constituents referred to as the base, the theme, and the satellite, which do not overlap with Young’s disjunct and conjunct nor with Reichard’s stem complex, though Faltz (1998) does make frequent reference to the conjunct and the disjunct. Though the components of some of Faltz’s constituents do correspond to consistent template positions (e.g., both the base and the theme contain the classifier, which corresponds to position IX), because Faltz’s constituents also make reference to elements such as argument structure and conjugation class they do not map precisely and consistently onto the template. These units are not unique to Faltz’s analysis. For example, the notion of theme is described by Rice (1989): “The verb theme consists of the classifier, the verb stem, and any
prefixes that must always occur with the classifier and stem” (p. 425). The obligatory prefixes that Rice refers to are known as thematic prefixes and they can occupy a number of positions in the template. To a first approximation, Rice’s definition strongly overlaps with Faltz’s, but as noted by Kibrik (2005), this term and others are often imprecise, referring to related but distinct concepts.

Thus, a variety of different units have been posited to describe Navajo morphology. Some units, such as the stem, are consistently referred to across different approaches, at times linked closely to the classifier to its left (as in McDonough’s bipartite approach where the classifier is a prefix) and at times distinct from it (as in Young’s (2000) treatment of it as being associated with the conjunct rather than with the stem). Other units are particular to a given analysis (e.g., Faltz’s (2000) satellite is not described elsewhere in the literature). Furthermore, the units have been posited for a variety of reasons, ranging from utility in making cross-linguistic and diachronic comparisons to formalizing observations about the language to supporting the assumptions of particular theoretical frameworks. In short, a great deal of diversity exists with regard to the morphological constituents of Navajo. A learning-based approach to motivating the morphological constituents of the language, therefore, would contribute to the discussion of what constituents are important for describing the linguistic patterns of Navajo.

1.3. Overview of the chapter. As discussed in Chapter 1, morphological constituents will be motivated on the basis of whether they facilitate generalizations of linguistic patterns in Navajo. Section 2 discusses the motivation for the grammatical word as a basic morphological constituent in Navajo. The sub-word constituents – the stem, the conjunct, and the disjunct – are discussed in Section 3 as follows: Section 3.1 presents the motivation for the stem and Section 3.2 the motivation for the conjunct and the disjunct. Section 3.3 makes an argument for a non-hierarchical relationship among the sub-word constituents. Section 4 addresses other morphological elements
that are important for discussing patterns in Navajo but that are not constituents in the way that this term is used in this dissertation. This chapter concludes with Section 5, which offers a summary of the main points of the chapter.

2. Motivation for the grammatical word

The hypothesis set forth in Chapter 1 is that the grammatical word will be motivated for Navajo. In the present section, this hypothesis will be validated by an examination of various patterns in the language. The argument, based on the Grammatical Word – Phonological Word Congruency Principle outlined in Section 4.1.1 of Chapter 1, proceeds as follows: Phonological evidence exists in Navajo for a constituent that is phonologically salient, a constituent that we can refer to as a phonological word. This evidence will be presented in Section 2.1, followed by a discussion in Section 2.2 of evidence that demonstrates that the phonological word generally aligns with grammatical word. Though the grammatical word is supported by a convergence of phonological and grammatical criteria, Navajo also exhibits cases of misalignment between the phonological and the grammatical, necessitating a discussion of an element corresponding to the clitic, which will be presented in Section 2.3.

2.1. Phonological word. A variety of criteria in Navajo converge on a unit that can be referred to as a phonological word: independence, internal cohesiveness, and involvement in phonological processes. Each of these factors is discussed in turn.

2.1.1. Independence. One of the aspects of a language that speakers would be expected to be attuned to is the minimum unit that can be uttered in isolation. Evidence for this in the patterns of a language involves elements that stand on their own as an utterance, for example, as a response
to a question, as in (95), which is taken from a multi-media children’s book\textsuperscript{15} created by students
at Diné College, a tribally-run college on the Navajo Nation.

\begin{itemize}
\item \textbf{Question:} \textit{Ha’át’íí baa naniná? ‘What are you doing?’}
\item \textbf{Answers:}
\begin{itemize}
\item (a) \textit{Íinishta’ ‘I am reading’}
\item (b) \textit{Naashnish ‘I am working’}
\item (c) \textit{Ashá ‘I am eating something’}
\end{itemize}
\end{itemize}

Learners acquiring the language encounter forms such as (95a-c) in isolation. The fact that forms
of this type can occur independently contribute to making such units phonologically salient to
speakers, and mastery of the language would involve knowing that such forms, and not their
constituent elements, can stand alone.

Related to the stand-alone property of phonological words, another criterion that would
demarcate the phonological word involves pauses. Phonologically independent units are those
between which pauses can occur. Examples of this are shown in (96), taken from a YouTube video
produced by a native Navajo speaker on how to make sumac berry pudding (daybreakwarrior
2009).

\begin{itemize}
\item (96) a. \textit{Dii óolyé... ts’aa ‘This is what you call… a Navajo wedding basket’}
\item b. \textit{chi’íchìn... dóó... áshiíh likán... dóó... ak’áán ‘sumac berries… and... sugar... and... flour’}
\end{itemize}

The ellipses indicate where the speaker pauses as he describes ingredients and gives directions.
Thus, the initial and final boundaries of elements such as \textit{ts’aa} and \textit{chi’íchìn} serve as the locus of
potential pause. Notably, pauses do not occur within such elements. As with the stand-alone
property described above, the potential pause property (i.e., having boundaries that serve as a
potential locus for a pause) points to certain types of linguistic elements as phonologically
independent entities. Such elements, exemplified in both (95) and (96), correspond to what

\textsuperscript{15} The multi-media book cited – \textit{Ha’át’íí baa naniná?} by Irene Nakai Hamilton – and others like it
can be found at http://www.dinecollege.edu/cdte/mmbbooks/tst/.
speakers would consider words and what we can refer to as phonological words, consistent with the way this term is used across multiple frameworks.

2.1.2. **Internal cohesiveness.** Related to the fact that phonological words are the minimal elements that can occur independently is the fact that the phonological words also exhibit internal cohesiveness. In contrast to larger constructions, such as phrases, clauses, or sentences, forms within words in Navajo have a predictable distributional relationship. Thus, the phonological word exhibits both independence and integrity.

This integrity can be illustrated by comparing the distribution within a word to the distribution within a sentence. The internal cohesiveness of the word can be seen in (97), where the distributive plural element, -da, occurs in a fixed position in a word.

\[
\begin{align*}
(97) & \quad a. 'ashkii & \text{bil} & naashné^{16} \\
& \quad \text{boy.SG/DU} & \text{with.3} & \text{play.1SG/DU.IPFW} \\
& \quad \text{‘I am playing with (one) boy (or two)’} \\
& \quad b. 'ashiiké & \text{bil} & n\text{daashné} \\
& \quad \text{boy.PL} & \text{with.3} & \text{play.1PL.IPFW} \\
& \quad \text{‘I am playing with (3 or more) boys.’} & \text{(Young 2000, p. 40)} \\
& \quad c. 'ashiiké & \text{n\text{daané}} \\
& \quad \text{boy.PL} & \text{play.3PL.IPFW} \\
& \quad \text{‘The (3 or more) boys) are playing.’} & \text{(cf. Faltz 1998, p. 37)} \\
& \quad d. *\text{danaashné, *naashdané, *naashnéda}
\end{align*}
\]

In (97b-c), -da is associated with plurality and consistently occurs after the initial morph n- (what has been called a thematic element and best described as a na- that has undergone phonological modification). Notably, this is the only position in the word where the distributive plural element can be found (see 97d), regardless of whether it is associated with the object (as in 97b) or the subject (97c) (cf. Faltz 1998, p. 106). The distributive plural affix is representative of all affixes in that its position in a particular word is fixed.

---

\[^{16}\text{As in Chapter 2, glosses provide minimal decomposition into morphemes in favor of synthetic interpretations pending further analysis.}\]
To see what a lack of internal cohesiveness looks like, we can observe how linguistic elements in larger constructions, such as clauses or sentences, behave. Two examples of this include the negation element, the frame *doo…da*, in (98), and the adverbial element *k’ad* in (99).

(98)  

a. *Diné bizaad doo nantl’ah da*. ‘Navajo isn’t difficult.’  
b. *Doo diné bizaad yihool’aah da*. ‘He is not learning Navajo.’ (Goossen 1995, p. 14)

(99)  

a. *K’ad Jim diné bizaad yihool’aah*. ‘Jim is learning Navajo now.’  
b. *Jim k’ad diné bizaad yihool’aah*. ‘Jim is learning Navajo now.’  
c. *Jim diné bizaad yihool’aah k’ad*. ‘Jim is learning Navajo now.’ (Goossen 1995, p. 23)

As these examples demonstrate, the negative frame does not occur in a fixed distribution relative to other elements, as it can occur either around the verb or around the sentence. In (99), the adverbial element occurs at the beginning of the sentence, at the end, or after the subject, without a difference in overall meaning of the sentence as a whole. Consistent with the properties of words in other languages (cf. Section 4.1.1 in Chapter 1), words in Navajo have an internal integrity that is not characteristic of larger forms.

### 2.1.3. Phonological patterns.

Further evidence for the phonological word as a constituent is the fact that the forms that exhibit independence and internal cohesiveness described above also participate in phonological patterns.

Certain phonological processes apply at the edges of the phonological word, thereby drawing the attention of learners to those edges. One such process involves negation. When an utterance is negated, the addition of the negative element *da* (which occurs at or towards the end of the utterance to be negated and is linked with the element *doo*, which occurs at the beginning of the element to be negated) triggers a morpho-phonological effect on the word it precedes, as illustrated in (100).

(100)  

a. *shi’niidlí* ‘I am cold’
b. *doo shí’níiúlì da* ‘I am not cold’ (Wilson 1995)

In (100b), the presence of the negative element causes the vowel of the preceding word to lengthen and to go from having a high tone to having a falling contour tone. This is a not a general phonological process, as can be seen in the examples in (101).

\[
(101) \quad \begin{align*}
    a. & \text{ ahilhane’ ‘conversation’ (Neundorf 1983, p. 11)} \\
    b. & \text{ litso ‘yellow’ (Wilson 1995, p. 124)} \\
    c. & \text{ nida’jizo ‘they write’ (Neundorf 2006, p. 310)}
\end{align*}
\]

Rather than claiming that, for example, the language exhibits a general phonological requirement that a short low toned vowel be preceded by a falling tone (a claim that is challenged by existence of words such as those in (101)), this process is a morpho-phonological pattern that is sensitive to the interaction of the negative element and the final vowel of the word that it follows. This and other phonological processes like it that mark the edges of the word provide further evidence that Navajo learners can use in identifying the phonological word in their language. Combined with the criterion of independence and internal cohesiveness, learners of Navajo would be expected to readily determine that the phonological word is a useful linguistic category in their language.

2.2. **Alignment of phonological word and grammatical word.** Given that the phonological word is motivated for Navajo, the assumption is that the learner would expect that this salient unit of form is likely to also be relevant grammatically or semantically. In other words, the working hypothesis is that there is an alignment between phonological word and grammatical word. Such a perspective follows the Grammatical Word – Phonological Word Congruency Principle discussed in Section 4.1.1 of Chapter 1. As will be discussed in the present section, this assumption is indeed validated by the patterns of the language.

2.2.1. **Stable locus of semantic and grammatical features.** As discussed in Chapter 1, two potential answers exist for the question: What is the most stable locus of semantic and grammatical
features in Navajo? One possible answer is the grammatical word (which in all the cases demonstrated in this section aligns with the phonological word), and the other is the morpheme (which presumes that the morphs that are posited as the basic units have a readily identifiable meaning or function across the contexts in which they occur). As demonstrated in this section, the answer to that question in Navajo is that the grammatical word is the most reliable locus of meaning and of grammatical properties.

To illustrate the difference between positing the word versus the morpheme as the primary locus of meaning and grammatical relationship, we can consider different analyses of the word in (102).

(102) hanilgeesh ‘you cut it out’ (Faltz 1998, p. 45)

Across different sentences and clauses, this form is reliably associated with the meaning with which it has been glossed. As such it serves as a stable locus of meaning and grammatical relations. Another question we need to consider, though, is whether its constituent elements can also be reliably associated with stable semantic and grammatical properties that then combine to yield the semantic and grammatical properties of the composite word as a whole.

Conventional descriptions of Navajo morphology refer to a series of prefixal morphemes that precede the stem of a verb (Young and Morgan 1942, 1987; Young 2000). Meanings for each of these units have been posited, as can be seen, for example, in Young and Morgan’s (1987) cataloguing of over 200 prefixes and their meanings or functions (summarized on a table on p. g37-817, and elaborated upon on p. g39-127). Following this characterization, the locus of meaning and grammatical relations in Navajo verbs would reasonably be expected to be the individual

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17 Young and Morgan’s (1987) *The Navajo Language: A Grammar and Colloquial Dictionary* consists of two components, numbered separately. Pages from the grammar are indicated with *g* and those from the dictionary with *d*.
prefixes and the stem, with the meaning of the word as a whole derivable from the meanings of its component prefixes and stems. From such a perspective, for example, the meaning of *hanîlgeesh* ‘you cut it out’ in (102) would follow from the combination of the meanings and functions of its components. In such a treatment, the word would be decomposed into the constituent morphemes as in (103a) and the meanings or grammatical functions of those morphemes could be characterized as in (103b-g).

(103)  
b. *ha-* ‘up and out’ (ha’ of Young 2000, p. 20; Faltz 1998, p. 20)  
c. ∅ 3rd person object (Faltz 1998, p. 21)  
d. *ni-* 2nd person subject (Faltz 1998, p. 21, 58)  
e. *-l-* causative/transitive (Young 2000, p. 29)  
g. *-geesh* ‘cut’ (Faltz 1998, p. 50)

From a learning-based perspective this analysis is certainly feasible in principle. If learners come to the process of acquisition without prior misconceptions of what will be the primary bearers of meaning in the language, then they might potentially encounter evidence that suggests that *ha-* is associated with ‘up and out’, *-l-* with transitivity, and so forth. The fact that each of the component elements in (103b-g) does not stand on its own and must occur in a fixed position in a word does not preclude each element from being a stable locus of meaning and grammatical function.

In order for this analysis to be borne out, we would need to encounter sufficient evidence that each of the meanings or functions assigned to (103b-g) are reliably found in other forms as well. What we find, however, is that though some evidence of semantic and grammatical relationships among sub-word forms may indeed be found, the overall lack of consistency in the form-meaning associations related to sub-word elements of the word support the notion that the full word itself is the most reliable locus of meaning. The evidence in favor of some associations among the component morphs is discussed in Section 3.1 on the stem and in Section 4.1 on the
morpheme. The lack of consistency is discussed in this section as evidence in support of the notion that the word as the most stable locus of meaning and grammatical properties.

To begin with, the prefixes identified in conventional treatments of Navajo exhibit rampant homonymy, which would present a significant obstacle to a learner attempting to find form-meaning pairs of these sub-word components. For example, the *ha*- prefix of (103b) is considered one of six homophonous forms that occur in the same position in the word, as shown in (104).

(104)  a. *ha*¹-: ‘up out, up vertically’
 b. *ha*²-: ‘up ascending, climbing’ (likely synonymous with *ha*¹)
 c. *ha*³-: variant of postpositional - *ka*- and *há*-, ‘for, after’
 d. *ha*⁴-: with verbs of ‘examine, inspect, watch’
 e. *ha*⁵-: ‘worn out, old’
 f. *ha*⁶-: ‘all the way from one end to the other’ (occurring with *di* as *hadi*) (Young 2000, p. 20)

In addition, other instances of the form *ha* with distinct meanings are also found in other positions of the word (e.g., in the object and subject pronoun positions) (Young 2000, p. 23). Thus, a learner attempting to assign meanings to individual morphemes faces the additional challenge of needing to determine precise positions of each of the various homonymous forms, which would constitute an added challenge in acquisition (Courtney & Saville-Troike 2002, p. 645). Moreover, this particular prefix is by no means unique. In fact, several other morphs (e.g., *di*-, *ni*-, *ná*-, *yi*) exhibit even greater homonymy (Young 2000, p. 20-25). If one assumes that words must be decomposed into constituent morphemes and that each component of a word must be associated with a particular meaning or function, then such widespread homonymy of the prefixal morphemes is necessary. However, if one generalizes linguistic units only on the basis of patterns that support the positing of those units, then associating a form such as *ha*- in *hanilgeesh* with a specific meaning or function is not motivated. In other words, a lexicon built on segmentally minimal
morphs would necessitate a large number of homophonous entries, offsetting the apparent economy of a decompositional approach.

Such an observation is also true if we compare stems across different words. For example, the stem -geesh of in hanilgeesh ‘you cut it out’ in (103) is also found in other verbs, as shown in (105).

(105)  a. ‘aq dah shidigéésh ‘something starts to spread’ (Young, Morgan, & Midgette 1992, p. 210)
    b. shigéésh ‘soaks in’ (Young & Morgan 1987, p. d692)

Neither of the words in (105) supports positing that the stem -géésh means CUT, as does (103a).

As with Hebrew roots (cf. Chapter 2), this lack of semantic invariance is characteristic of many stems in Navajo.

Another difficulty with associating meanings or grammatical functions to forms involves allomorphy. For example, in (103), ni is associated with 2SG. This pairing is indeed motivated by other forms associated with 2SG. However, this is not the only form associated with this grammatical feature, as 2SG is also associated with a null exponent and with a floating high tone (i.e., one that is able to occur in more than one position in the template) (Young 2000, p. 26). Furthermore, as can be seen by (103c), the null exponent itself is also associated with a third person object, and, in other cases a third person subject. It should be noted that, given the more limited set of person and number features, the problem of allomorphy with inflectional exponents is not as intractable as the homonymy and allomorphy of other kinds of prefixes in the Navajo verb. However, if we are considering the question of where meaning and grammatical functions can most reliably be determined, then the word is clearly a more reliable locus than any of its components.
2.2.2. Basis for lexical classes. The sections above have made reference to elements such as nouns and verbs without a deeper discussion of what these terms refer to precisely and why they are relevant constructs for Navajo. Though categories such as noun and verb are widely accepted and utilized in the field of linguistics, under the learning-based approach of this dissertation such categories should be posited only if there is evidence that suggests their utility in describing patterns of the language. As discussed in Section 4.1.1 of Chapter 1, evidence that would support the positing of these types of lexical classes is a convergence of different properties on particular sets of forms, such that categories can be posited that can be distinguished in terms of phonological, semantic, syntactic, and morphological criteria (Dryer 1997). If the forms that these properties converge upon are words, then evidence for lexical classes also serves as evidence for words, which are the members of these categories.

Lexical classes have been presented in various descriptions of Navajo, though researchers have diverged on what those lexical classes are. For example, Reichard (1951) speaks of five lexical classes: “Grammatically noun, pronoun, verb, adjective, and postposition may be differentiated” (p. 47), and Young and Morgan (1942) refer to “four major categories, namely the pronoun, the noun, the verb and the particle (the latter including adverbs, numerals, conjunctions, etc.),” conceding that “the postpositions might be added as a fifth class” (p. 1). Therefore, though lexical classes do seem relevant for Navajo, the details of the nature of those classes remain up for debate. Though determining the precise details of the number and types of lexical classes in Navajo using a learning-based approach is beyond the scope of this dissertation, a demonstration of how at least some of the lexical classes are motivated provides evidence for morphological constituents. In other words, if patterns in the language motivate at least some classes of forms, and if those
forms are grammatical words (as opposed to, for example, morphemes or clauses), then those classes themselves provide evidence for the grammatical word as a morphological unit.

This section explores evidence for two of the lexical classes posited for Navajo – nouns and verbs – in order to demonstrate how the criteria that converge to motivate these two categories are criteria that apply to words. Mithun (1999, p. 58) speaks of three types of criteria that can be used to identify lexical classes: semantic, morphological, and phonological. To this list, we can also add syntactic criteria. Evidence from each of these linguistic domains can be found in Navajo in support of a distinction between nouns, such those in (106), and verbs, as those in (107).

(106)  
   a. ashkii ‘boy’
   b. tsé ‘rock’
   c. hataalii ‘singer, medicine man (i.e., one who chants)’
   d. cha ‘the act of crying’
   e. naanish ‘work, job’

(107)  
   a. íinyáq’ ‘you ate’
   b. si’á ‘it (solid roundish object) sits’
   c. hataal ‘he/she sings’
   d. yicha ‘he/she cries’
   e. naashnish ‘I work’

The most common semantic criteria for distinguishing nouns and verbs is whether a form has an entity or an event/stative interpretation: “We expect nouns to be the names of objects and persons (tree, child), and verbs to denote events and states (jump, live)” (Mithun 1999). Such a distinction is illustrated by comparing, for instance (106a,b) with (107a,b). The first member of each pair clearly refers to an object or person and the second to an action or state. The forms in (c-e) of each of these sets further illustrate how for semantic fields that may have either an entity or an event interpretation (e.g., CRY or WORK) the language assigns the two kinds of interpretations to two distinct forms. For example, both naanish in (106e) and naashnish in (107e) refer to the same semantic field and can be translated as work in English. However, unlike English in which
work by itself can be associated to either an entity or an event, Navajo does not leave open the possibility of ambiguity. A speaker encountering naanish knows this refers to an entity interpretation of work and naashnish to an event interpretation based on the forms themselves. Moreover, this distinction is a property of the words as a whole. Both words have the same stem and root (-nish) and the same thematic prefix (na-). The difference between the two forms is the exponent sh-, which conveys temporal and argument structure information. Indeed, one of the key identifying aspects of Navajo verbs is the fact that verbs obligatorily express temporal and argument structure features, both of which are properties of events rather than entities.

Morphological structure, in fact, strongly supports the distinction between nouns and verbs in Navajo. Verbs are inflected for mode and for person and number of subject and object. Another way to state this is that verbs are organized into paradigms based on mode and person/number (as in (108)).

\[
\begin{align*}
naashnish & \text{ ‘I work’} & neilnish & \text{ ‘we (two) work’} & nideilnish & \text{ ‘we (3+) work’} \\
nanilnish & \text{ ‘you work’} & naolinsh & \text{ ‘you (two) work’} & nidaolinsh & \text{ ‘you (3+) work’} \\
naalnish & \text{ ‘s/he works’} & naalnish & \text{ ‘they (two) work’} & nidaalnish & \text{ ‘they (3+ work’}
\end{align*}
\]

(Faltz 1998, p 47)

Nouns, on the other hand, may also be conceivably organized into paradigms\(^\text{18}\), as in (109), but if so, these paradigms are based on genitive morphology, which is not obligatory on nouns except in a limited class of nouns that are inalienably possessed (Young and Morgan 1987).

\[
\begin{align*}
shi-naanish & \text{ ‘my work’} & nihi-naaishnish & \text{ ‘our work’} \\
ni-naaanish & \text{ ‘your (sing.) work’} & nihi-naaanish & \text{ ‘your (pl.) work’} \\
bi-naaanish & \text{ ‘his/her work’} & bi-naaanish & \text{ ‘their work’}
\end{align*}
\]

(109)

Notably, both of these paradigms consist of words and cannot be effectively structured in terms of smaller or larger elements.

\(^\text{18}\) The genitive prefixes described in this section are perhaps actually better thought of as clitics, following the characterization of clitics offered in Section 2.3. Regardless of whether they are characterized as clitics or affixes, the main point remains that the organization of nouns differs from that of verbs.
Nouns may also contain exponents of argument structure and temporal information associated with verbs. However, if they do, they also have nominalizing morphology associated with them, and they do not enter in paradigms based on that information. For example, the word *hataalii* ‘singer, medicine man’ in (106c) is related to the verb *hataal* ‘he/she sings’ in (107c). What distinguishes the two is the nominal clitic =ii in the former (cf. Section 2.3 for a discussion of clitics). Thus, though *hataalii* retains the inflectional exponents of its verbal counterpart, its morphology unambiguously marks it as a noun. Morphology in Navajo, therefore, strongly reinforces the distinction between nouns and verbs; it also reinforces the motivation for the word as a morphological constituent since morphological exponents are realized on words.

Phonological differences also reinforce the distinction between nouns and verbs in Navajo, the primary difference between the two being minimality constraints (McDonough 2003). Whereas verbs must consist of at least two syllables, nouns can consist of just one, exemplified in (106b,d) (*tsé* ‘rock’, *cha* ‘the act of crying’). The form of CRY in (107d) (*yicha* ‘he/she cries’) illustrates the constraint on verbs as follows: Given that the 3SG.SBJ.IPFV exponent in this form is null and that this form does not have any lexical prefixes associated with it (Faltz 1998, p. 47) and given that no strictly phonological limit exists on a word of this shape (as illustrated by (106d)), the bare stem, *cha*, alone should be all that is required to express cry.3SG.SBJ.IPFV. However, the form that is actually expressed, *yicha*, contains an initial yi syllable, which is not associated with any semantic or grammatical features. The presence of this type of syllable, referred to as a “peg” element by Faltz (1998), motivates the disyllabic requirement for verbs (and, one might surmise, an obligatory expression of the bi-partite morphological structure), a requirement that is not motivated for nouns. The minimality requirement, therefore, motivates the distinction between nouns and verbs, and it motivates the construct of the grammatical word in general.
Syntactic considerations can also be used to motivate the distinction between nouns and verbs in Navajo. For example, verbs exist in a predictable position in an utterance, as they are reliably the final element of a multi-word clause (Reichard 1951, p. 298). Moreover, a variety of grammatical relations are expressed syntactically. Though strictly speaking many of the statements of grammatical relations refer to, for example, noun phrases rather than nouns, they nevertheless support the notion of the word. After all, the word is minimal element that can compose a noun phrase, and, additionally, the head of the phrase (i.e., the obligatory element that determines the grammatical status of the phrase as a whole) consists of a word and not a morpheme. The examples in 110(110), for instance, reflect a prototypical word order, one that conveys relationship between nouns conventionally referred to as subject and object.

(110) a. Ashkii at’éd yiyiits ’ós.
    boy girl kiss.3SG.SBJ.3SG.OBJ
    ‘The boy kisses the girl.’

b. At’éd ashkii yiyiits ’ós.
   girl boy kiss.3SG.SBJ.3SG.OBJ
   ‘The girl kisses the boy.’

c. Díí ashkii yázhi diné bi-zaad yihool’aah.
   This boy small people 3SG.GEN-language learn.3SG.SBJ.3SG.OBJ
   ‘This small boy is learning Navajo.’ (Wilson 1995, p. 28)

In all three examples, we can first observe that the verb occupies the final position, preceded by its two nominal arguments. In (110a) and in (110b), the nominal arguments each consist of a single word. The difference between the two utterances has to do with the identity of the subject and the object. In (110a), ashkii, as the first noun, is the subject, but in (110b), as the second, it is the object. In these two examples, the elements referred to by the syntax are single words, specifically nouns. However, the syntax more generally refers to phrases, as can be seen in (110c), where the subject and the object both consist of multi-word phrases: dií ashkii yázhi and diné bizaad. In both of these phrases, the head of the phrase is a noun consisting of a single word: ashkii and bizaad,
respectively. Thus, though syntactic generalizations are better stated in terms of phrases, they also provide some support for words as constituents since these are the minimal elements that can participate in syntactic relationships, parallel to their role as minimal utterances, as discussed above.

The positing of nouns and verbs as lexical categories is motivated by a variety of patterns that converge on these two linguistic classes. Given that these patterns make reference to words and support classes based on words, the utility of the constructs noun and verb in Navajo therefore also support the construct grammatical word.

2.2.3. Base of compounding. The grammatical word in Navajo is also motivated by the fact that it serves as the base of compounding. New words in the language have been and can be formed by combining existing words, as demonstrated in (111).

(111)  

<table>
<thead>
<tr>
<th>Case</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>tózis ‘bottle, water-glass’ &lt; tó ‘water’, -zis ‘bag, container’</td>
</tr>
<tr>
<td>b.</td>
<td>tsinaabqas ‘wagon’ &lt; tsí-, tsín ‘wood’, nabqas ‘it rolls around hooplike’</td>
</tr>
<tr>
<td>c.</td>
<td>tséyi’ ‘canyon’ &lt; tsé ‘rock’, -yi’ ‘within’ (Young &amp; Morgan 1987, p. g5)</td>
</tr>
</tbody>
</table>

In (111a), two nouns are combined (-zis is a noun that does not occur in isolation but rather is obligatorily possessed, as in bizis ‘his/her bag’, nizis ‘your bag’, etc.) to form a new word; in (111b), a noun and a verb are combined to generate a new word; and in (111c), a noun and a postposition are combined. In these three cases, therefore, compounding takes the grammatical word as its base, offering evidence for the grammatical word as a constituent in Navajo.

Another morphological constituent, the stem, can also serve as the base of compounding. For the sake of offering a comprehensive discussion of compounding, it is illustrated in the present section, in the examples in (112), but given that it offers evidence for the stem, its relevance is primarily for Section 3.

(112)  

<table>
<thead>
<tr>
<th>Case</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>tl’ohchin ‘onion’ &lt; tl’oh ‘grass’, -chin ‘smell’</td>
</tr>
<tr>
<td>b.</td>
<td>tsét ees ‘griddle’ &lt; tsé ‘rock’, -t’ees ‘roast, cook’ (Young &amp; Morgan 1987, p. g5)</td>
</tr>
</tbody>
</table>
As in (111), the examples in (112) demonstrate how compound words can be formed from existing words. In contrast to (111), though, the examples in (112) combine a grammatical word and a stem, a constituent that is motivated in detail in Section 3.1. For now, though, we can note that elements such as -chin and -t’ees do not occur in isolation but rather only as the final syllable of a verb (e.g., yishcin ‘I smell’, yist’ees ‘I roast’, in Neundorf 1983). The compound words in (112), therefore, offer evidence for at least two types of morphological constituents – the grammatical word and the stem – that serve as the basis of compound formation in Navajo.

2.2.4. *External evidence.* The grammatical word as a linguistic category in Navajo is also supported by external evidence, including evidence from language acquisition, processing, code-mixing, and the written representation of the language. It should be noted that the evidence provided in this section is not definitive, in part because the acquisition and processing studies were not explicitly designed to test the hypothesis that the grammatical word is a relevant constituent in the language and in part because a variety of other factors are expected to influence this kind of linguistic behavior (e.g., the tradition of using words in the written system coming from contact with European written languages). However, this kind of evidence does indicate that the assumption that the grammatical word is a relevant unit in the language can be made without posing any significant challenges to psycholinguistic and acquisition research or to the adoption of a writing system for the language.

As noted in Chapter 1, the fact that we can speak of, for instance, a one-word stage in the development of language in young children provides evidence for the word as a constituent (J.P. Blevins 2016, p. 58). Though work on Navajo language acquisition is limited, the work that has been undertaken supports the notion that the word is a relevant construct for children learning the language. A small corpus of Navajo child utterances has been collected, consisting of about fifteen
hours of audiotape with 762 utterances from five Navajo-speaking children, age 1;1 to 4;7 (Saville-Troike 1996; Courtney & Saville-Troike 2002). The project was designed to explore sub-word constituents, such as the stem (the details relating to the stem are discussed further in Section 3.1.4), but the findings also offer support for the usefulness of the word as a constituent. Though the corpus data that are presented focus on the utterances that appear to be bare stems, it is clear from the discussion that child targets are in fact full words. In all cases where children produce what appear to be bare stems (which are not present in adult speech), the researchers readily identify the target as a full form. Though this may be argued to speak more to researchers’ assumptions about words as constituents, the fact that researchers are able to readily apply those assumptions to the data suggests that the word is indeed a relevant construct for discussing patterns related to acquisition.

Another study that also took for granted the reality of the word as a constituent in the language is that of McDonough and Willie (2000), who undertake a preliminary exploration of how less fluent speakers process verbs. In order to consider this question, they present speakers with a list of 100 Navajo forms, half of which contained commonly-occurring “errors” and half of which did not, and asked the speakers to identify the correct forms. As with the acquisition project discussed above, the goal did not directly involve testing whether the word is a constituent in the language. However, the fact that it is implicit in the design of the study (i.e., lists presented to participants are based on words as targets) and that nothing in the behavior of participants challenged this assumption supports the notion that the word can be a useful construct in the language.

Code-mixing offers another piece of evidence in support of the word. As typical of language contact situations, code-mixing is common among bilingual English-Navajo speakers. A
variety of linguistic elements can participate in code-mixing of Navajo and English, including clauses, words, clitics, and stems, as in (113) (Hutchinson 2013). The fact that these types of elements participate in code-mixing offers evidence for those elements as units in the language.

Examples of elements that participate in code-mixing are shown in (113).

(113) a. *shi*-sister
   1.SG.POSS-sister
   ‘my sister’

b. *Yágo*. Give me *yágo dootl’ízh*.
   sky  give me  sky  it.is.blue/green
   ‘Sky-ish. Give me blue.’ (=‘Give me the blue crayon.’)

c. *Ha’iish*    your favorite color, red?
   what.INT    your favorite color, red?
   ‘What’s your favorite color, red?’

d. It smells like *dleesh*.
   It smells like clay
   ‘It smells like clay.’ (Hutchinson 2013, p. 110)

Certainly, words are not the only elements that participate in code-mixing, as shown by (113a) with a Navajo clitic or (113b) with a Navajo NP clause. Though a variety of factors would be expected to contribute to this kind of linguistic behavior, the fact that grammatical words – as in ‘what’ in (113c) and ‘clay’ in (113d) – are among the units in Navajo are readily adopted into English structures and vice versa points to speakers’ awareness of grammatical words as constituents.

Finally, another kind of indirect extra-linguistic evidence for words comes from the written representation of the spoken language. The earliest attempts to write down Navajo date from the late 19th century, though it was not until the late 1960s that writing in Navajo become more commonplace (Yazzie & Speas 2007, p. 2). The various writing systems of the language developed over the years have all been based on the writing system of English. Though some adaptations of the sound-symbol correspondences are necessary, the convention of spaces between words is readily applied to Navajo. Though this is not conclusive evidence that the word is relevant to
Navajo, the fact that this assumption poses no problem for Navajo speakers provides at least circumstantial support for the word as a constituent. In addition, the native speakers’ preference for a dictionary whose entries are fully inflected words also attests to native speakers’ intuition about the word as a constituent in their language. As McDonough (2015, p. 6) points out, though Navajo dictionaries can be organized by stem (e.g., Young & Morgan 1942) or by root (e.g., Young, Morgan, & Midgette 1992), speakers prefer a word-based dictionary organized around fully inflected forms in the case of verbs. Thus, the fact that these word-based conventions have been readily embraced without difficulty indirectly supports the idea that words are a relevant linguistic constituent in the language, a conclusion that is corroborated by a multitude of diverse linguistic patterns in the language and by external evidence.

2.3. Exceptions to alignment of phonological word and grammatical word. It should be noted that, though there is abundant evidence that the phonological word and the grammatical word are generally aligned, exceptions to a one-to-one correspondence between the two types of constituents do exist for Navajo. Importantly, these exceptions do not undermine the working assumption that phonological words are associated with meaningful units. In other words, learners that assume that a phonological word is reliably associated with consistent semantic and grammatical features are not mistaken in their assumption. The misalignment in Navajo instead arises from the fact that sometimes phonological words correspond to more than one grammatical word, the union of which is in fact also reliably associated with certain semantic and grammatical features but which are not the minimal units associated with such features.

To account for the fact that some grammatical words do not exist as phonological words in their own right, we must introduce the construct of *clitic*. Clitics are characterized as units that have the properties of a grammatical word but are bound forms in the sense of Bloomfield (1933);
they instead form a phonological word only when connected to another element (e.g., Matthews 1991; Aikhenvald 2002). Navajo exhibits a significant number of linguistic elements that can be classified as clitics. These are elements that, unlike the morphs discussed in Section 2.2.1, can reliably be associated with stable grammatical and/or semantic features, as can be seen with the enclitic *déę’* in (114).

(114) a. *shighan=déę’*  *lid*  *halchiin*
    my-home=from  smoke  there.is.a.smell
    ‘there is the smell of smoke (coming) from my house’

b. *ko=déę’*  *dah diiyah*
    here=from  up  he.started.to.move
    ‘he started off from here’

c. *’i’ii’á’a=go*  *na’nishkaa=déę’*  *nánísdzá*
    evening=SUBORDINATION  I.herded=from  I.returned
    ‘I got back from herding in the evening.’ (Young & Morgan 1987, p. g17-18)

In (114) we can see that the enclitic behaves in a consistent way, in the same way grammatical words do. Regardless of the element to which it is attached, it conveys an ablative type of meaning, indicating motion from a particular place or activity. Unlike grammatical words that correspond to nouns and verbs, this enclitic does not occur in isolation in Navajo and therefore relies on another grammatical word to serve as a prosodic host. The clitic and the host grammatical word together form a phonological word.

Therefore, though alignment between the phonological word and the grammatical word does not result in a one-to-one form-meaning correspondence, the ways in which misalignments occur do not challenge the approach adopted in this dissertation. The fact that grammatical words often correspond directly to phonological words indicates that the kinds of factors that motivate the phonological word also serve to motivate the grammatical word. In addition, the fact that phonological words consistently occur with predictable associations of semantic and grammatical features does not entail that such predictable associations cannot occur in elements that are
components of more than one phonological word, which is, in the fact, the case with clitics. Thus, though clitics are motivated precisely by the misalignment that occurs between phonological and grammatical words, they do exhibit many of the properties of grammatical words and can therefore be considered as examples of non-prototypical grammatical words (which is not a problem for a learning-based approach, as discussed in Section 2.2 in Chapter 1). In addition, the contrast between the consistent features of clitics and the variable properties of the affixes discussed above indicates that treating sub-word elements as basic would not resolve the challenges posed by clitics, which would still need to be treated as a separate category.

The claim of this dissertation is therefore that clitics are a relevant construct in the language, and that these elements are defined as those which have reliable form-meaning correspondences and whose distribution is relatively free compared to other elements associated with verbs (e.g., stems, prefixes). However, a question that will remain unanswered involves which of the morphs identified in the language as depicted in Young and Morgan’s (1987) list of prefixes are clitics and which should be considered part of the lexical structure of the verb. Such a task would involve a more extensive study of, particularly, those elements that are called disjunct prefixes, of which there are well over a hundred. As a general rule of thumb, those elements that are identified by Young and Morgan as thematic are treated as an integral part of the lexical representation of the word (cf. Section 3.3.2), whereas those that are labeled as adverbial are treated as clitics.

The overall conclusion that may be drawn from the linguistic patterns presented in this section is that the grammatical word is strongly motivated as a morphological constituent in Navajo. Evidence in support of this claim comes from a multitude of patterns, from a range of linguistic and external domains. This conclusion aligns with speaker intuitions about the role of
the word in their language, and is consistent with findings of other researchers regarding the centrality of the word in morphological analysis.

3. Motivation for word-internal constituents

Given the evidence for the grammatical word discussed above, we can then ask whether this constituent can be said to itself consist of internal structure. As discussed in the present section, the answer to this question is in the affirmative. The claim that is offered is that the grammatical word consists of three non-hierarchically arranged constituents – the stem, the conjunct, and the disjunct – as in Figure 8.

Thus, following McDonough’s (1990) terminology, the claim of this dissertation is that the verb word consists of a tripartite structure. Evidence for the stem is provided in Section 3.1. The conjunct and the disjunct are then motivated in Section 3.2 and the non-hierarchical relationship among the three sub-word constituents in Section 3.3. As developed further in Section 3.1.1, these constituents are motivated only for verbs in the language.

3.1. Motivation for the stem. Positing of a grammatical word is not particularly controversial for Navajo. All accounts that have been offered for the language posit the word, even if they do not necessarily offer motivation for it. The same may be said about the stem as a sub-constituent of the grammatical word. Though details may vary from analysis to analysis (e.g., whether the so-called classifier of position IX is separate from the stem: the template account tends to give it its own position, whereas the bipartite approach links it to the stem), all extant accounts posit a stem. Thus, a claim, such as that of the present dissertation, that the stem is a necessary
constituent in the language is not controversial. With regard to the factors that motivate its inclusion in the morphology of the language, McDonough (1990) presents a systematic study of a variety of evidence to support the application of the construct of the stem to Navajo. The motivation offered in this section draws from her work, in addition to offering some novel observations that favor the adoption of the stem as a morphological constituent of Navajo. The evidence to be presented in this section includes the stem’s distribution within the verb, form-meaning correspondences associated with the stem, phonological distributions, and external evidence involving acquisition. Note that another type of evidence for the stem is provided in Section 2.2.3, in which it is shown that the stem can serve as the basis of compounding in addition to the grammatical word. Furthermore, given that evidence for a distinction between the stem and the conjunct (which directly precedes the stem) constitutes evidence for the boundaries of both of those constituents, Section 3.2.1 on the conjunct/stem junction also constitutes evidence for the stem.

3.1.1. Distribution within the verb. The morphological element that is referred to as the stem has a very predictable distribution: It is always the final syllable of the verb, a distributional constancy which would facilitate learning. As discussed in Section 2.2.2, the construct verb is motivated for Navajo through a convergence of several factors. Having identified a verb on the basis of the factors discussed in that section, one can then readily identify the stem, as can be illustrated with the verbs in (115).

(115)  
a. nidoöl-nish ‘you two will work’ (Faltz 1998, p. 152)  
b. yi-cha ‘he/she cries’ (Faltz 1998, p. 55)  
c. náshidiil-haal ‘he/she clubbed me’ (Faltz 2000, p. 151)

In all cases, regardless of the length of the verb or its inflectional properties, the stem is always the final CV(V)(C) sequence (Reichard 1951; McDonough 2003). This straightforward strategy – find
a verb, find its final syllable – consistently locates a stem in Navajo. Given the reliability of this strategy, the stem, therefore, would be expected to be among the first units learned, a prediction that is corroborated by findings in acquisition research (cf. Section 3.1.4).

As the examples in (115) also demonstrate, in addition to its predictable distribution, two other factors are reliable characteristics of the stem: It has a consistent prosodic shape, and it is associated with verbs. As for the first characteristic, this property is invariant. Though not necessarily the case diachronically or in other Athabaskan languages, no stems in Navajo consist of more than one syllable. With regard to the specific shape that a syllable constituting a stem may take, stems stand out from many other syllables in that only a limited set of syllables in the language have codas, and stems are well-represented in that set (McDonough 2003). Notably, final codas are also diagnostic of other constituents in verbs (cf. Sections 3.2.1 and 3.2.2), suggesting that syllable structure serves as a guide to morphological constituency.

Another important property of stems is that they are closely associated with verbs. All verbs consist of a stem constituent. This is not true of any other lexical classes. Though stems may be recognized in words belonging to other lexical classes, they are not characteristic of those lexical classes. Indeed, though a variety of accounts exist for Navajo morphology, these accounts focus primarily if not exclusively on verbal morphology, for the understandable reason that it is the verbs that exhibit the most complex morphology. Interestingly, when stems are identifiable in other types of words, it is because those words are generally derived from verbs. For instance, stems can be recognized in the forms in (116a-b).

(116)  a. ha-taal#igii ‘that which he/she sings’ (Young and Morgan 1942, p. 18)
     b. ha-taal ‘he/she sings’ (Young and Morgan 1942, p. 18)
     c. sin ‘song’ (Young and Morgan 1942, p. d1106)
The stem -taal is identifiable in (116a), which corresponds to a noun in the language. As can be seen by comparing that form with the verb in (116b), we can see that it has a stem by virtue of being derived from a verb. It contrasts with the non-derived form in (116c), which does not consist of a stem (cf. Young, Morgan, & Midgette 1992). Indeed, the stem is an important constituent for discussing verb structure, whereas it plays a minimal role when describing the structure of other types of words in the language, unless those words are derived from nouns. This strong association between verbs and stems is a connection that reinforces both the construct of verb and the construct of stem, both of which are also associated with other properties; those associated with verbs are discussed in 2.2.2 and those associated with nouns discussed below.

### 3.1.2. Semantic correspondences

As argued in Section 2.2.1, the most consistent locus of semantic properties in Navajo is the grammatical word. However, this does not entail that other constituents do not also serve as carriers of meaning in some way. The stem, in fact, is useful in describing certain semantic correspondences, and therefore is motivated in part by the semantics of the language.

Though not as stable a semantic unit as the grammatical word across different contexts, the construct of the stem is nevertheless supported by many semantic patterns. Among the best examples of stems that connect semantically and formally related lexemes are those referred to as the classificatory stems. Such stems are associated with verbs of motion. Three categories of motion are relevant for Navajo: handling (movement of an entity by continued contact), propelling (movement of an entity set in motion by an agent who then releases the entity), and flying (movement of an entity without an explicit external agent) (Young 2000). One of the most transparent examples of a classificatory stem relating lexemes from across different motion categories comes from words involving the movement of non-compact matter (NCM), as in (117).
Before proceeding with the discussion of how these forms exemplify the behavior of classificatory stems, it is important to note that the three forms in (117) are considered related stems, despite the fact that they have different codas. Thus, they can be treated as allomorphs, in which case allomorphy serves as evidence for the stem since the site of allomorphy is the stem. The two forms jool and jooł are allomorphs, along with jol (Young, Morgan, & Midgette 1992, p. 276). The relationship among the allomorphs is discussed in greater detail in Section 4.2, which focuses on the construct root; following the literature, related allomorphs are said to be members of a common stem set. Given that the stems in (117) belong to the same stem set, we can see that this stem set is associated with movement of NCM, which includes entities such as a bunch of hay, a wig, wool, and smoke (Young 2000). This stem can be used with motion that involves handling NCM as in (117a), propelling NCM as in (117b), and flying NCM as in (117c). Thus, these stems are associated the semantic properties of NCM.

The stem set involving jool can apply to all types of motion; other classificatory stems are specialized to particular types of motion, such as those involving solid roundish objects (SRO), as in (118), or those involving mushy matter (MM), as in (119).

(117) a. hááł-jool ‘I took out NCM’
     b. adááł-jool ‘I tossed down NCM’
     c. náá-jool ‘NCM is tumbling around’ (Young 2000, p. 4-5)

(118) a. néiddi-’áq ‘he/she picked it (SRO) up’
     b. shaa yiri’áq ‘he/she brought it (SRO) to me’
     c. nayiil-nee ‘he/she dropped it (SRO)’
     d. naal-ts’id ‘it (SRO) fell’ (Young 2000, p. 3-4)

(119) a. shúlák’eyií-tléé ‘he/she handed it (MM) to me’
     b. ’adáá-tléé ‘I dropped it (MM)’

The most extreme example of allomorphy is suppletion, whose domain is also the stem. Examples of suppletive stems can be seen in verbs of motion (e.g. naaghd ‘he/she is walking around’, naa’aash ‘they (dual) are walking around’, naaakai ‘they (plural) are walking around’, where the suppletive stem is indicated in bold). (examples from Wilson 1995, p. 49)
The verbs of motion related to SRO entities have a different stem set depending on the type of motion, such that SRO verbs have three different stem sets: one for handling verbs (118a-b), one for propelling verbs (118c), and one for flying verbs (118d). Therefore, though SRO stems within a category of motion may belong to the same stem set (118a-b), there is not a common stem set for all verbs associated with SRO entities, in contrast to the situation we observe in (117) for NCM verbs. The examples in (119) show yet another possible configuration: MM verbs share a stem set across two categories of motion (handling, (119a), and propelling, (119b)), and one category of motion (flying, (119c)) has a unique stem set. Therefore, what we can observe for classificatory stems is both that they exhibit clear form-meaning correspondences and that these correspondences are not the same across categories of motion. Some stem sets have a broader range of verbs of motion that they can be associated with than others, which is consistent with the observation in Section 2.2.1 that sub-word constituents are not the most reliable units on which to base the morphological system. Nevertheless, the fact that at least some form-meaning correspondences can be generalized from stem-based patterns indicates that stems, in addition to being motivated by their predictable distribution in verbs, are also in part motivated by certain semantic patterns.

3.1.3. Phonological distributions. The stem also has phonological characteristics that make it distinct from other syllables in the verb. To begin with, the stem is more phonologically rich than other syllables in the verb. Moreover, it is the source of a consonant harmony process that affects other syllables in the verb. Characteristics such as these would mark the stem as a relevant unit in the language.

In addition to having a more complex maximal syllable structure than many other elements in the language (cf. Section 3.1), the stem is also the site of more phonological contrasts than other
positions in the verb. This is true with regard to both consonantal and vocalic contrasts, as can be illustrated with the words in (120).

(120)  
   a. *daniil-gizh* ‘we cut’ (Neundorf 1983, p. 318)  
   b. *nahash-ch’q̕áh* ‘I draw’ (p. 72)  
   c. *ha’ash’-‘aah* ‘I take out SRO’ (p. 52)

McDonough (2003) argues that, in terms of consonants, the verb stem (specifically the onset of the stem syllable) is the site of 32 phonemes, whereas only 11 contrastive phonemes (*s, z, sh, d, n, y, h, l, l, j, b*) can be found in the rest of verb, 4 of which are limited to one morph each (*l, l, j, b*) (p. 3, 7). For example in (120a), the stem begins with *g* and in (120b) with *ch’*, phonemes whose distribution is limited to the stem. McDonough’s claim must be qualified, though, since her conceptualization of the whole verb excludes certain elements of what is known as the disjunct. In some cases, this exclusion is in accordance with the claims of this dissertation, and in other cases, it is not. For example, sounds such as *ch’* can be found in position 1b of the Young and Morgan template, as in the morph *ch’i*, associated with horizontal movement (Young 2000, p. 20). McDonough is most likely treating this morph as an enclitic outside of the main verb complex, which is the way that this morph is treated in this dissertation given how it is associated with a reliable meaning that is independent of the meaning provided by the stem (cf. discussion of clitics in Section 2.3). However, morphs such as *tsí* in *nitsìsêkêez* ‘I thought’ (Young 2000, p. 22; Neundorf 2006, p. 278) are treated differently in the two accounts. Since it is in the same position as *ch’i*, McDonough would also likely consider it outside of the main verb complex. In this dissertation, though, because of its lexical dependency on the stem (cf. Section 3.3.2), it is treated as part of the verb. In either case, though, it is valid to claim that the stem is the locus of all the consonantal contrasts in the language, which is not the case for other parts of the verb.
In addition, the stem is also the site of the full inventory of vowel contrasts in the language (McDonough 2003, p. 7). Navajo has four vowel qualities (a, i, e, o), each of which can be short or long, low toned or high toned, and oral or nasal. All of those contrastive elements can be found in the stem; though true minimal pairs are rare in the language for verbs (McDonough 2003, p. 12), the fact that orality and tone are contrastive can be illustrated by (120b) and (120c), where a high toned, nasal vowel of the stem in the former contrasts with the low-toned oral vowel in the latter. Though metrical stress is not a prominent feature of the language, phonological prominence is instead conveyed through tone, and the fact that tone contrasts are located in the stem means that the stem is the phonologically prominent syllable of the verb (Courtney & Saville-Troike 2002). Therefore, because many of the contrasts of the language, including those associated with phonological prominence, are limited to a single syllable in the verb, that position is expected to be salient to learners. Moreover, in order to describe the phonotactics of the language, an analyst must make reference to that syllable, which, of course, is not simply any syllable, but rather corresponds to a specific morphological constituent: the stem.

Another phonological distribution whose description depends on the stem involves consonant harmony, which is a prominent characteristic of Navajo phonology (McDonough 2003, p. 49). To begin with, the stem is the domain of a static co-occurrence restriction involving anteriority, whereby coronal sibilants in the stem are all either [+anterior] (e.g., s, z, ts, dz) or all [-anterior] (sh, zh, ch, j), as can be seen in the forms in (121).

(121) a. –tsqós ‘to wrinkle, become rugose’
   b. –ch’iish ‘to grate, rasp, file’

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20 Given that codas, contrastive vowel length, contrastive tone, and greater segmental contrasts can be found in stems, these tend to have the kind of prominence associated with stress. However, as McDonough (2003) observes, “If we factor away from the durational effects of phonotactic asymmetries, very little is left in the way of evidence for the presence of structurally encoded phenomena like stress, accent or metric structure as an explanation of the timing and duration facts in Navajo” (p. 107). Therefore, stress is not viewed as a prominent feature of the language in the present dissertation.
Both (121a) and (121b) serve as examples of observed stems in the language because their onsets and their codas match with regard to their anteriority specification, and the non-occurring forms in (121c) represent unattested forms in the language. The domain of this phonotactic constraint is the stem. However, consonant harmony is not restricted to the stem; rather, consonants occurring to the left of the stem participate in a process of regressive assimilation of anteriority, whereby sibilants to the left of the stem share the specification for anteriority of sibilants in the stem (Faltz 1998, p. 60; McDonough 2003, p. 51).

\[(122)\]
\[
\begin{align*}
a. & \text{nitsés-kees ‘I think’} \\
b. & \text{yásh-ti’ ‘I speak’}
\end{align*}
\]

The form in (122b) contains the expected exponent of person and number of the subject: The alveopalatal fricative sh- conveys 1SG.SBJ for the imperfective mode, in this word and more generally across verbs. The form in (122a), however, shows the alveolar fricative s- in that position, whose anteriority specification may be explained as a result of assimilation to the alveolar fricative in the coda of the stem. What we see, therefore, is that the stem serves as the trigger for consonant harmony, and in order to succinctly describe this process, we need to employ the construct of the stem.

\[3.1.4. \text{External evidence.}\] If the stem is indeed an important construct in organizing patterns in the language, then the expectation is that it should play a role in acquisition. One prediction that would follow from the stem’s prominence in the morphological system is that we would see evidence of reliance on the stem in acquisition. Such evidence can indeed be found in Navajo language acquisition.

Evidence for morphological constituency from language acquisition comes from a corpus of Navajo child utterances. To summarize the discussion in Section 2.2.4, Saville-Troike (1996)
collected a corpus of naturalistic child utterances that consists of approximately fifteen hours of audiotape with 762 utterances from five Navajo-speaking children, age 1;1 to 4;7. The aim of the study is to explore sub-word constituents using an analytical lens based on the Young and Morgan template. The focus of Saville-Troike’s analysis is on the elements of the verbal template produced by young children acquiring the language. For example, if a child produces *a-hosh* for the adult target of *a-l-hosh*, ‘it is sleeping’ (p. 140), the absence of the classifier *l* in position IX is noted as an omission of an obligatory form, and the on-target production presence of *a* in position V and the stem in position X are also noted. Comparing across the various ages represented in the corpus, Saville-Troike observes that the stem is the first component of the verb that children acquire and one that exhibits a high degree of accuracy across all participants. Indeed, the youngest child consistently produces verbs with only a bare stem (e.g., *teeh* for *náshidiilteeh* ‘pick me up’, p. 143), despite the fact that bare stems do not occur in the adult input. Interestingly, this was the case even after the child progresses to the two-word stage.

Awareness of the stem as a constituent of the verb, therefore, can be seen early in young children’s acquisition of Navajo. If reliance on the stem aids early language acquisition, it would be expected to support learning at later ages as well. As noted in Section 2.2.4, pedagogical and reference materials for adult use can be organized around a stem. More compelling as evidence, though, is the fact that awareness of the stem as a constituent is also found among children who have limited formal metalinguistic education. Such evidence for the prominence of the stem in the Navajo learning of school-age children is noted by Saville-Troike (1980), who observes that bare stems are also produced by some school-age children with relatively limited mastery of adult Navajo forms, either because their early input was limited or because they had experienced language attrition as a result of immersion in English. Of additional note, as was mentioned in
Section 2.1.1, the primary locus of potential pause in Navajo is the word boundary. However, in certain restricted situations, a speaker may also pause before the stem. McDonough (2003) notes, for instance, that in an elicitation setting where speakers are reading lists of Navajo words, if they do pause during elicitation, that pause occurs before the stem (p. 8). Numerous factors, therefore, indicate that positing of a morphological category corresponding to the stem does indeed appear to be supported by learners’ early experience with Navajo linguistic input. Thus, the reliance of multiple patterns – morphological, phonological, semantic – on the stem, as discussed in this section, offer a variety of evidence that, taken together, present a compelling case for the stem as a morphological constituent in the language.

3.2. Motivation for the conjunct and the disjunct. In addition to the stem, two other constituents are motivated for verbs. The pre-stem elements, typically referred to as the prefixes of the verb, can be grouped into two additional constituents. Traditionally, the elements occurring in positions 0-III of the Young and Morgan (1987) template are said to be in the disjunct and those of positions IV-IX in the conjunct (Young 2000). The constituents that are motivated for the verb under a learning-based approach correspond generally to the conjunct and the disjunct of the template and are referred to as such in this chapter. The tripartite structure proposed is presented in Figure 8, and can be represented using bracketing formalism as follows: [word ([disjunct ....]) [conjunct ....] [stem ....]], with parentheses indicating that the disjunct is not obligatory for all verbs. The primary evidence motivating these two constituents comes from the fact that their boundaries are relevant for a variety of morphological and morpho-phonological distributions. The junction between the stem and the conjunct is discussed in Section 3.2.1 and that of the conjunct and disjunct in Section 3.2.2. Additional evidence for these two constituents as domains is presented in Section 3.2.3.
3.2.1. Motivation for the conjunct/stem boundary. The boundary between the stem and the conjunct is a linguistically relevant position in the word for two general reasons, one involving phonotactics and the other involving morpho-phonological effects.

With regard to phonotactics, the conjunct/stem junct is one of only two places in a verb (the other being the disjunct/conjunct boundary) where surface clusters can occur, as can be seen in (123).

(123)  a. yi.di.yool-héél ‘he/she will kill it’ (McDonough 2000, p. 144)
       b. tā.dish-géésh ‘I shear it (a sheep)’ (Neundorf 2006)

The only place in the verbs in (123) where two adjacent consonants occur is at the conjunct/stem boundary. Given the CV(V)(C) structure of the language (McDonough 2003), another way of stating this observation is that the final boundary of the conjunct and the final boundary of the stem are the only two places in the word where we find syllable codas. In other words, despite the relative length of the verbs in (123), most of the syllables in the words are open syllables, with the exceptions occurring at the end of a constituent boundary. Thus, the presence of a coda at the end of the conjunct would support the hypothesis that the end of the conjunct is similar to the end of the stem, indicating that there are at least two constituents in the words above. (As shown in Section 3.2.2, the final boundary of the disjunct is another place where codas may occur, making it a general principle that codas in verbs appear only at the ends of constituents.)

The end of the conjunct is relevant for describing other linguistic patterns as well. To begin with, it is the locus of a characteristically Athabaskan morpho-phonological effect commonly referred to as d-effect. D-effect is a kind of consonant mutation whereby fricatives exhibit an additional period of closure (McDonough 2003), as illustrated in (124).

(124)  a. neii’né ‘we (two) play’
       b. naané ‘he/she plays’ (Neundorf 1983, p. 548)
c. *biigaas* ‘we (two) scrape’

d. *binighaaas* ‘you (sg.) scrape’ (p. 358)

In both (124a) and (124c), we can see that the onset of the final syllable (i.e., the onset of the stem) differs from that of (124b) and (124d), respectively. The latter two, (124b) and (124c), are representative of the stem onset in the rest of the paradigm. The stem onsets in the first person dual forms in (124a) and (124c) have been altered by the presence of the 2DL exponent, *iid-* , whose final *d* has deleted after causing the *n* to become pre-glottalized and strengthening the *gh*, in accordance with the generalization of d-effect. Therefore, this process, which also occurs with the *d* classifier (introduced in the next paragraph), can be characterized as one in which an element in the conjunct affects an element in the stem. Notably, this position – the juncture between the conjunct and the stem – is the only place in the synchronic patterns of the language where d-effect may occur, thereby providing further evidence that knowledge of this juncture is important for describing the patterns of the language.

Another important role of the conjunct/stem boundary involves the classifiers of the language. Though the term classifier is used consistently in the Athabaskan literature to refer to these elements, there is widespread agreement that this terminology is not in line with the way the construct classifier is conceptualized in other languages. Classifiers in Navajo do not serve to classify words into different classes the way that gender markers do in other languages; rather, they are associated with valence and voice (McDonough 2003, p. 19). However, the role of these elements – of which there are four, *d, l, l*, and *∅*, which occur in position IX of the traditional template (Young & Morgan 1987) – in the synchronic grammar is not necessarily consistent throughout the verbal system, as can be seen in (125) and (126), with classifiers indicated in bold

(125)  
a. *nei*-maas ‘he’s rolling it around (causing it to roll around)’  
b. *naa*-maas (*naa∅-mass*) ‘he’s rolling around’
In some instances, a classifier indicates a change in argument structure. The *l* classifier, for instance, can function as a causative-transitivizing element (Young 2000, p. 29), as illustrated by the pair in (125). These two related lexemes are primarily distinguished by the *l* classifier in (125a), which indicates that it raises the valence relative to (125b), which has the no overt classifier (or, depending on one’s analysis, has the $\emptyset$ classifier). However, not all instances of the *l* classifier are grammatically relevant, as illustrated in (126), which is an intransitive verb despite the presence of the *l* classifier. Young (2000) refers to these and similar elements with opaque functions that overlap distributionally with other elements that are semantically or grammatically relevant as thematic (cf. Section 3.3.2 for a discussion of other thematic elements). Regardless of whether we can describe all classifiers uniformly in terms of their grammatical function, though, at least some of the instances of classifiers are derivationally productive and relate lexemes in a systematic way; therefore, we would want to be able to describe their morphological distribution. Moreover, as can be seen in (125) and (126), they occur in a predictable position in the verb, specifically, at the conjunct/stem boundary. Therefore, this junction is one that learners would be expected to attend to and that an analyst would need to refer to in order to describe the patterns of the language.

The position of the classifier at the conjunct/stem boundary is consistent for all verbs. We might then ask whether it is a component of the stem constituent or of the conjunct constituent, though it should be noted that this distinction is not critical for the main arguments of this dissertation since the primary argument is that both of these constituents are relevant for describing the patterns of the language. Based on the syllable structure of Navajo, the more compelling position is that the classifier is in the conjunct, which is the claim that is made in this dissertation. Taking this position supports the notion that syllable structure aligns with morphological structure,
as articulated by Courtney and Saville-Troike (2002): “In Navajo, syllable division and morpheme boundaries coincide” (p. 637). Including the classifier in the stem constituent would lead to a misalignment of phonological and morphological boundaries, whereby the stem constituent would consist of a syllable plus the coda of the preceding syllable. (Alternatively, one could posit a complex onset that often violates general sonority principles. However, such a structure is not at all motivated by any other patterns in the language.) An argument for the classifier as part of the conjunct constituent is made by McDonough (2000), who argues that, since argument structure is an operation on the verb and the semantic core of the verb is the stem (what she calls the Verb constituent, cf. Section 1.2 and, specifically, Figure 7), then the classifier is part of the stem constituent (p. 146). Recognizing that a complex onset for the stem is unmotivated, McDonough posits the prosodic incorporation of the classifier into the conjunct constituent at a late stage of the derivation. In this dissertation, however, since the word is considered the main unit of organization (cf. Section 2) and since the elements of the disjunct (cf. Section 3.3.2 below) are also posited to be closely connected to the stem in terms of lexical representation, McDonough’s argument regarding the valence connection between stem and classifier does not provide a compelling reason to state that this connection leads to a misalignment between phonological and morphological structure in this case. As mentioned at the outset of this discussion, though, the precise position of the classifier is not critical for the overall argument since in either scenario the conjunct/stem boundary itself (which under a learning-based approach need not perfectly demarcated, cf. Section 2.2 in Chapter 1 on fuzzy boundaries in cognitive categories) is motivated as a participant in a multitude of linguistic patterns of the language.

Another morphological process that points to the conjunct/stem boundary is person-of-subject/mode inflection, an inflection that is a defining aspect of the conjunct, which is found at
the right edge of the conjunct (McDonough 1990). The position of person-of-subject/mode inflection, which is a portmanteau morph corresponding to position XIII of the Young and Morgan template, is to left of the classifier, as shown in (127).

(127)  

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<tbody>
<tr>
<td>a.</td>
<td><em>nan̂l</em>-dloosh ‘you crawl’ (Neundorf 2006, p. 59)</td>
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<tr>
<td>b.</td>
<td><em>nɪl</em>-chin ‘you smell it’ (p. 246)</td>
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In (127a) and (127b) the classifier is marked in bold (*l and *l, respectively) and the inflectional exponent is underlined (*ni-, corresponding to 2SG.IPfv). Given that the classifier directly precedes the inflectional exponent, then it might be argued that that the position of the inflectional markers is not determined by the edge of the conjunct but rather by its position relative to the classifier.\(^{21}\) This is a fair point against the position of the inflectional marker as pointing to the edge of the conjunct domain. However, it is worth noting that to a naïve learner who starts out by examining surface strings, the classifier is indeed often at the right edge of the conjunct, as in (128).

(128)  

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<tr>
<td>b.</td>
<td><em>nɪ</em>-cha ‘you cry’ (p. 61)</td>
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In the case of (128a), which is the 1SG counterpart of (127a), there is no overt classifier in the word because of a process that deletes the middle of three adjacent consonants in this position (in this example, *shldl → shdl*) (Faltz 1998). In the case of (128a), there is no overt classifier because this verb belongs to the category of verbs that is associated with the \(\emptyset\) classifier and for which no evidence of a positive element can be found in the patterns of the language. In this group of verbs, which constitutes 41% of the verb classifier-stem combinations (Young 2000, p. 29), the mode/person-of-subject marker will always occur at the right edge of the conjunct such that the position of the inflection marker offers further evidence for the existence of this boundary.

\(^{21}\) If one adopts McDonough’s (1990) analysis, then the classifier is part of the Vstem constituent and therefore the edge of the stem is also the position of the classifier.
Interestingly, the fact that the primary inflectional exponent occurs to the right edge of the conjunct boundary mirrors the fact that the most contentful part of the verb (i.e., the stem) occurs at the rightmost part of the verb, a detail that may also facilitate the acquisition of both.

Thus, we see a variety of patterns that mark the conjunct/stem boundary. Some patterns mark the left edge of the stem, such as the fact that this is where the contrasts in the language occur (cf. Section 3.1.3). Other patterns, such as those discussed in this section, mark the right edge of the conjunct. The fact that multiple distinct patterns rely on this boundary motivates the positing of both of these constituents for Navajo.

### 3.2.2. Motivation for the disjunct/conjunct boundary

Similar types of evidence for the conjunct/stem boundary also signal the disjunct/conjunct boundary: The disjunct/conjunct boundary also serves as the locus of more complex syllable structure, and it too is a position in the word where certain morphological exponents are expressed. One important difference between the conjunct/stem boundary and the disjunct stem/boundary is that the former can be identified in all verbs, which is not necessarily the case with the latter (e.g., yi-cha ‘he/she cries’ consists of a conjunct and a stem and represents the minimal possible verb). Another way of stating this is that the conjunct and the stem are obligatory in all verbs, but the disjunct is not.

As mentioned in Section 3.2.1 for the conjunct/stem boundary, the disjunct/conjunct boundary is one of a limited set of positions in the verb where clusters can be found; stated another way, the end of the disjunct is one of a limited set of positions where codas can appear, as in (129).

       b. *’azhoolzhish* ‘one will dance’ (Neundorf 2006, p. 70)

The clusters shown in bold in (129) indicate another morphologically relevant position in the word, what will be referred to as the disjunct/conjunct boundary. Admittedly, there are fewer instances of this kind of prosodic complexity (i.e., surface consonant clusters or closed syllables) at the
disjunct/conjunct boundary relative to the conjunct/stem boundary in large part because both
classifiers and person-of-subject markers can occupy this position and because person-of-subject
markers include more consonant-final exponents than do person-of-object markers. However, if
a learner is working under the assumption that codas mark morphological boundaries, as is
indicated by codas in conjuncts and stems, then the patterns of Navajo do offer some evidence that
this generalization applies to disjuncts as well.

In addition, this position in the verb is also where other morphological exponents occur, as
illustrated in (130).

(130)  a. *na’nishtin* ‘I teach (someone)’
b. *nanthinizhin* ‘I teach you (dual)’
c. *nda’nitin* ‘we (plural) teach (someone)’ (Wilson 1995, p. 103-105)
d. *nazh’nitin* ‘one teaches (someone)’
e. *ndazh’nitin* ‘several people teach (someone)’ (Young & Morgan 1987, p. d558-559)

Several types of morphological exponents occur at this position in the verb. For ease of exposition,
they will be referred to as the EDCB (exponents at the disjunct/conjunct boundary), and include
the following: direct objects, as in (130a,c-e) with the unspecified direct object ‘- and (130b) with
the 2DL direct object *nihi* - ; the distributive plural marker, in *da*- in (130c) and (130e); and the
fourth person subject marker *zh-lji* - (also known as the alternative 3rd person, often marking an
unspecified subject) (Faltz 1998, p 32) in (130d-e). As these examples also illustrate, when several
of the EDCB occur together, they occur in a fixed order relative to one another, with the
distributive plural *da*- , for example, occurring to the left of the other elements. In all cases, though,
the inflectional markers that occur at this junction always occur to the right of the *na-/n*- element
in this lexeme and always to the left of a *ni + person-of-subject element. It is important to note
that this insertion site of the EDCB is not determined prosodically, as can be seen in (131).

(131)  a. *nilį* ‘he/she is’
b. *daniɁi* ‘they are’ (Neundorf 2006, p. 14)
c. *naané* ‘he/she plays’
d. *niɗaané* ‘they play’ (p. 193)
e. *yidiyoɁhéél* ‘he/she will kill it’
f. *deɗiyoɁhéél* ‘they will kill it’ (p. 148)
g. *yihwiidoool’áɁl* ‘he/she will learn it’
h. *yidaɁwiidoool’áɁl* ‘they will learn it’ (p. 155)

In (131a) and (131b), the singular form is disyllabic and starts with *n*; when the distributive plural *da-* is inserted, in the former, (131b), it is inserted at the beginning of the word, and in the latter, (131d), it is inserted after the first syllable. Similarly, both (131e) and (131g) consist of singular forms with four syllables and an initial *y*; however, in the distributive plural form in the case of the former, (131f), the exponent is at the beginning of the word, but in the case of the latter, (131h), it is after the second syllable. In order to know the insertion site of the EDCB, therefore, a learner must be aware of the point that is referred to here as the disjunct/conjunct boundary, a position in the verb that is morphologically and not phonologically determined.

The elements that occur to the left of the insertion site of the EDCB are part of the disjunct and those to the right are part of the conjunct. The question then arises as to what constituent each of the EDCB is associated with. Following the conventions of the templatic approach, the distributive plural (in position III) is in the disjunct and both the object exponents (in position IV) and the fourth person subject exponent (in position V) are in the conjunct (Young 2000). Since the main argument of the dissertation is that this position is relevant for describing patterns of the language, specific details of which elements belong to which constituent are not as important as the fact that the elements consistently occur at this position in the word. However, it is important to note that the evidence presented in this section suggests that the disjunct/conjunct boundary is not necessarily consistent with a surface-true generalization that syllable boundaries always
coincide with morphological boundaries. This can be seen particularly with the fourth person subject exponent, *ji-*/*zh-*, illustrated in (132)

\[
\text{(132) a. } ha\text{jidzihi} \text{ ‘one makes a speech’}
\]
\[
\text{b. } hazh\text{oodzihi} \text{ ‘one will make a speech’ (Neundorf, p. 250)}
\]

The fourth person subject exponent surfaces as *ji-* in (132a) and as *zh-* in (132b), reflecting a morpho-phonological alternation that is conditioned in part by whether it occurs in the penultimate syllable or further left (Faltz 1998, p. 153). Based on the fact that the unspecified subject exponent patterns in many ways with the other subject exponents (e.g., it refers to subjects of the verb, it has the *Ci* structure of other subject prefixes), it is reasonable to place it in the conjunct domain, consistent with Young and Morgan (1987). On the other hand, the syllable structure of (132b) suggests that the unspecified subject exponent is in the disjunct, since it can serve as the coda. Overall, though, the more compelling claim is that, despite occasionally resulting in some morphological/phonological misalignment, the fourth person subject and, for the same reasons, the object markers are part of the conjunct, with the the distributive plural (which phonologically and semantically is less similar to the other exponents) in the disjunct.

Thus, the disjunct/conjunct boundary is motivated primarily for morphological reasons. That position in the verb is the locus of the varied EDCB and therefore a site in those words that the learner and analyst alike need to pay attention to.

3.2.3. Conjunct and disjunct as domains. With regard to the stem, evidence for it as a constituent comes from the fact that its boundaries are relevant for describing linguistic patterns in the language and from the fact that it serves as a domain for certain linguistic patterns. The arguments in Section 3.2.1 and 3.2.2 all pertain to the boundaries of the conjunct and the disjunct. We should also consider evidence that the conjunct and the disjunct serve as domains. Otherwise, it may be the case that though what has been called the disjunct/conjunct boundary is actually just
a point in the word rather than a boundary between constituents. This is indeed a plausible analysis, one that is worth further exploration. However, given that there are at least a few patterns in which more than just the boundaries of the conjunct and the disjunct are referenced, the claim of this dissertation is that these are in fact constituents.

Richness of phonemic contrasts serves as one type of evidence for a particular constituent, an argument that was introduced in Section 3.1.3. Of the three constituents motivated for Navajo, the stem is the one where the most contrasts occur, and the one with the fewest contrasts is the conjunct. To restate the point made in Section 3.1.3, in contrast to the verb stem’s 32 available phonemes, the conjunct expresses only 11 of those \( s, z, sh, d, n, y, h, l, j, b \), 4 of which are expressed in only one morph each \( l, l, j, b \) (McDonough 2003, p. 3, 7). The disjunct is also a site of a variety of potential phonemes, reflecting for the most part the same inventory available for the stem (Young 2000, p. 18-28). The precise count of phonemic contrasts in the disjunct depends on distinguishing conjunct elements that should be considered clitics from those that are part of the integral lexical representation of the verb.\(^{22}\) Even a cursory examination of Young and Morgan’s (1987) list of prefixes (p. 37-38, followed by detailed discussion on p. 39-136), however, supports the generalization that the conjunct serves as the domain of a much more limited set of contrasts than the disjunct.

The conjunct and the disjunct are also referenced in morpho-phonology. One process that makes reference to both the conjunct and the disjunct involves an alternation between two forms of the 2SG, (i) the more general form \( ni- \), and (ii) a high tone on an otherwise low toned vowel, both of which are shown in (133).

\[
(133) \quad a. \text{hi-tijih} \text{ ‘you carry/put them one after another’ (Young & Morgan 1987, p. d448)}
\]

\(^{22}\) As mentioned in Section 2.3, such a task is beyond the scope of the dissertation, though, to a first approximation, lexical elements correspond to those considered to be thematic by Young and Morgan (1987) and clitics are those that are treated as adverbial.
b.  *ha-ni-gééd* ‘you dug it up’ (p. d432)\(^{23}\)
c.  *ni-cha* ‘you cry’ (Faltz 1998, p. 55)

All of the forms in (133) express 2SG, and both Kari (1976) and McDonough (1990) posit an underlying *ni-* in all three as a result, with *hini-tįįh* as the underlying representation for (133a). Regardless of whether one relies on an analysis that utilizes this underlying representation for all 2SG verbs, though, we can observe a surface alternation, between the *ni-* and the high tone as the exponents of the 2SG, that can be described using the domain of the conjunct. The overt *ni-* form is found only when it occurs at the left edge of the conjunct, as in (133b) and (133c), regardless of what other constituents may be expressed in the word (McDonough 1990, p. 46). Thus, the expression of the grammatical feature 2SG is sensitive to the composition of the conjunct domain.

Therefore, taken together, the evidence for the relevance of the disjunct/conjunct boundary and the fact that the conjunct and the disjunct can both serve as domains indicates that both of these are motivated as constituents of the Navajo verb.

**3.3. Structural relationship of the word-internal constituents.** In addition to the claim that the stem, conjunct, and disjunct are the basic constituents of the verb in a tripartite structure, this dissertation also makes the claim that these sub-word constituents are in a non-hierarchical relationship to each other, as in Figure 9 (repeating Figure 8).

\[
\text{verb word} \\
\quad \text{[disj \ldots [conj \ldots [stem \ldots] \ldots]\ldots]}
\]

*Figure 9: Sub-word constituents in Navajo*

Another way of stating this might be that there is a flat structure below the level of the word. This claim is based on both the fact that no independent evidence exists that motivates hierarchy and

---

\(^{23}\) These two examples, (133a-b), follow those of Kari (1976, p. 41) and McDonough (1990, p. 46), but with orthographic differences and with glosses provided, such that the examples presented here follow the entries in Young and Morgan (1987).
the fact that in some ways the conjunct and the stem can be said to be connected in a ‘sister’ type of relationship (i.e., occupying the same level of hierarchy) and in some ways the disjunct and stem can be said to be in this relationship. Therefore, one of the word-internal constituents is dominated by any other word-internal constituent.24

It should be noted that the present analysis is similar to that of McDonough (1990), who also references these three units. It differs from her account in the way that disjunct is characterized. The present analysis places the disjunct as a main constituent of the verb, whereas McDonough treats it as clitic group. The main argument for considering the disjunct as an integral part of the verb comes from the lexical dependency of the stem and certain disjunct prefixes, discussed below in Section 3.3.2. Whereas McDonough’s bipartite approach treats thematic disjunct prefixes the same as adverbial disjunct prefixes, this dissertation treats the former as part of the disjunct and the latter as clitics (cf. Section 2.3).

3.3.1. Conjunct and stem on same level of hierarchy. One argument for the conjunct/stem relationship is that both of these elements carry the inflectional features for mode, as can be seen in (134), with person-of-subject exponent indicated in bold.

(134)  a. naash-né ‘I play’
    b. nisé-ne’ ‘I played’

Both of these forms are from the same lexeme, associated with the meaning PLAY, but from different sub-paradigms: (134a) is from the imperfective sub-paradigm and (134b) from the perfective. What these two forms illustrate is the fact that both the stem and the person-of-subject

24 In order for hierarchy to be motivated, another constituent would need to be motivated such that this constituent dominates (i.e., contains) or is dominated by (i.e., is contained by) one of the other three constituents motivated in this chapter. A candidate for such a constituent is the theme, which is defined as the disjunct and the stem together, discussed further in Section 3.3.2. Since a theme as a distinct constituent is not motivated by the patterns of the language, the strongest reason to posit a theme is to impose hierarchy on the system, which is not an a priori goal in a learning-based approach.
exponent co-vary with mode. In (134a), the imperfective mode is indicated by both the stem with the high tone and no coda and the sh- person-of-subject marker, and in (134b), the perfective mode is indicated by the stem with the low tone and final glottal stop as well as the sé- person-of-subject marker.

Certainly, it is possible for one to take a position a priori that the inflectional features of mode originate in one of the constituents (with a more compelling case able to be made for that constituent being the conjunct since some stems are invariant across modes) and spread to the other, which is unmarked for mode in an underlying representation. However, such an assumption is not necessary if one assumes that the basic unit is the word and that the extended exponence of mode does not need to be located in a single base morpheme. Therefore, though a hierarchical relationship can be motivated given the assumptions of a particular theory, the surface linguistic patterns, in which both the conjunct and stem bear inflectional features, do not themselves provide strong evidence that either the conjunct or the disjunct represents a deeper level of structure relative to the other.

3.3.2. Disjunct and stem on same level of hierarchy. With regard to the disjunct and the stem, the relationship between the two is based on the fact that some lexical entries require a reference to both constituents. In other words, the core semantic information is associated with exponents from both the disjunct and the stem, which necessitates them being linked at the most basic level.

This can be seen with lexemes in which the stem always co-occurs with a disjunct prefix (i.e., a morph that occurs to the left of the disjunct/conjunct boundary) (Speas 1987). Such elements are generally referred to as thematic elements in Young and Morgan (1987). This is illustrated with two sets of stem/prefix combinations in (135).
Both within a lexeme, as shown (135a-c), and between lexemes, as can be seen comparing (135a), (135d), and (135e), the disjunct prefix yá- occurs only with the stem set represented by -ti’. The semantic core of ‘speaking’ is, therefore, associated both with the disjunct prefix and with the stem. Any account that separates the two misses an important generalization about the fact that the pairing has to be included in some way in any kind of lexical entry for that verb. For instance, if one assigns the lexical meaning to only the stem, then one is left with a meaningless conjunct morph that serves no grammatical or phonological purpose and that must be co-indexed in some way that it is always associated with this particular stem set. The connection between the stem and the conjunct prefix is supported by evidence from language acquisition, as can be seen in Saville-Troike’s (1996) conclusion from her work in Navajo acquisition: “Based on differential productive with specific verb stems, it appears that thematic and modal conjugation prefixes [obligatory elements in the conjunct] are learned in relation to those stems and stored as single, complex lexical units” (p. 162). In cases where the verb exhibits thematic elements, the argument that these elements and stems both constitute lexical entries is compelling. Thus, the evidence indicates that the disjunct and the stem are both constituents at the same level of hierarchy in the lexicon.

This idea of thematic prefixes and stems belonging together in some way is the basis of the constituent of theme posited in some accounts, a relationship that is also supported by acquisition literature. The construct of the theme in the literature refers to a discontinuous constituent (an example of Sapir and Whorf’s notion of ‘interrupted synthesis’ (Kari 1989, p. 425) that includes the stem, the classifier, and thematic prefixes (Rice 1989, p. 425; Faltz 2000, p. 155)). The theme
serves as an intermediate level of structure necessary in a cyclically-derivational approach in which the stem (or the root, cf. Section 4.2) consists only of the final syllable of the word (since this is the only element that is consistently present across all the verbs of the language). If the stem is an autonomous unit at the deepest level of structure, then thematic prefixes such as.yyá- in (135) must be added at a level above the stem. However, these prefixes do not behave as adverbial elements such as.ch’i (associated with horizontal movement), which also occur in this position but which are actually compositionally related to the stem and the verb as a whole, as can be seen in (136).

(136)  

a. ch’ibiníyíl ‘I pushed it out horizontally’

b. ’abiíyíl ‘I pushed it out of sight’ (Young, Morgan, & Midgette 1992, p. 703)

The prefix in bold in (136a) can be said to contribute a meaning to the word, in contrast to the.yyá-of (135). Another way of stating this is that the prefix in (136a) is derivational (in the sense that it plays a role in lexeme-formation) whereas the one in (135) is not, hence a need for a term such as thematic in this approach. On the other hand, in a learning-based approach and others in which the morphological system is organized around words, a distinct level of derivation is not needed since building up from roots or stems is not the goal of analysis.

The relationship between the stem and the disjunct inherent to the notion of theme, therefore, supports the claim that the disjunct and the stem should not be considered different levels of structure. Combined with the connection of the stem and the conjunct with regard to the expression of inflectional features, both of these relationships support the notion that the disjunct, conjunct, and stem can be considered to be in a non-hierarchical relationship, barring compelling evidence to the contrary, which, to my knowledge, has not yet been offered.

4. Other morphological elements

As argued in Section 3, verbs in Navajo consist of three constituents, organized as follows: [word ([disjunct ....]) [ conjunct ....] [stem ....]]. This structure, which is motivated by various linguistic
patterns, applies to all verbs in the language and can be described as the morphological structure around which the verbs of the language are organized. This analysis does not include morphemes as basic constituents. However, the fact that the language is not organized around units such as morphemes does not entail that such units are not relevant for morphological analysis at all. Given that the focus of this dissertation is specifically on constituents that are motivated, other morphological elements of Navajo are not discussed extensively. However, a brief discussion of morphological elements that may be relevant for the language, even if not as basic constituents, is offered. Specifically, morphemes, roots, and paradigms is introduced.

4.1. Morphemes. As discussed in Section 1.2 of Chapter 1, the morpheme is defined as a non-decomposable form-meaning or form-function pairing. As such, elements across words that share a common form or that stand in a distributional relationship to other formal elements are considered morphemes only if they are also associated with a readily identifiable meaning or grammatical function. Otherwise, they are referred to as morphs (i.e., units of form). As noted in Section 2.2.1, the grammatical word, and not the morpheme, is the most reliable locus of semantic and grammatical features in Navajo. In many cases, what are conventionally called morphemes in Navajo are better termed morphs since they are reliable units of form but not reliable units of meaning or function (cf. discussion of units such as *ha-* in *hanilgeesh* ‘you cut it out’ in Section 2.2.1). However, the fact that many elements that are conventionally referred to as morphemes do not fit the definition of morpheme (i.e., minimal unit of meaning) does not preclude the possibility that at least some of those elements are in fact reliable units of meaning or grammatical function.

Some morphemes are indeed motivated by the patterns of the language. For example, the *da-* form introduced in (97) of Section 2.2.1 and repeated below as (137) is reliably associated with the notion of plural.
Comparing the clause without *da-* in (137a) with those with *da-* (with the lengthened vowel as a result of a morpho-phonological process) in (137b-c) demonstrates how the feature *PL* is consistently associated with *da-*; sometimes referring to plurality of objects as in (137b) and sometimes with plurality of subjects as in (137a), but always with the notion of plurality. Thus, the patterns of the language, in which the pairing of *PL* with *da-* is consistent across a wide variety of words, support the positing of *da-* as a morpheme as an element that speakers would be aware of.

A variety of other such elements can be identified for the language, ranging from those that can be referred to as grammatical to those that are have more concrete semantic values. Section 2.2.1 discusses the fact that even the stem is not always a reliable form-meaning pairing across lexemes (cf. multiple meanings associated with the stem set that includes *-geesh* in (105)), and Section 3.3.2 discusses how certain stems must co-occur with certain disjunct prefixes (cf. extended exponence of *ya-* and *-ti’* in (135)). However, it also the case that many stems can indeed be said to be morphemes. One such example is offered in (138).

(138) a. *hááchíil* ‘it starts to snow’
    b. *níchíil* ‘it is snowing’
    c. *yoo ‘ííchíil* ‘the snowstorm is over’ *(Young, Morgan, & Midgette 1992, p. d93)*

In this set of words and others associated with this stem set, the stem *-chíil* and only this form is reliably linked to the meaning SNOW(STORM). As such, the patterns of the language do seem to
justify considering this particular stem a morpheme. The same can be said of many other stems, but, crucially, not of all stems, which indicates that the stem as a morpheme may be recognized by speakers in certain cases but that such a construct is not critical to describing the patterns of the language.

Thus, a learning-based approach applied to Navajo indicates that morphemes can be considered morphological elements of the language, even if the patterns of the language do not motivate a linguistic system that is structured around these units.

4.2. Roots. Conventionally, the root is treated as a kind of morpheme, considered the semantic core of a word (cf. Section 3.1.1 in Chapter 2 on the Hebrew root). Though one could apply this perspective to roots in Navajo, this treatment of roots as the lexical formatives of the language is not particularly prominent in discussions of Navajo morphology relative to the treatment of roots in, for example, Hebrew or Spanish. Based on the patterns of the language discussed in this section, such a downplaying of the role of roots in the morphology of the language seems warranted. As argued below, the Navajo root is best viewed a meta-linguistic tool, more useful for linguists describing cross-linguistic or diachronic connections than for describing word-formation in the synchronic system.

Both the conventional view of the root as the basis of word formation and the view advanced in this dissertation of it as an abstract meta-linguistic tool are evident in a generally accepted characterization of the Navajo root, articulated by Young (2000): “The Verbal Root is a hypothetical element that embodies verbal meaning in abstract form, and that serves as the foundation upon which to derive the verbal stems” (p. 1). Young’s definition acknowledges that the root is hypothetical and abstract, the way that a purely metalinguistic tool might be; yet, this definition also expresses the belief that the root is a form from which stems can be derived. An
example of the type of evidence that has been marshalled in support of the argument that specific 
stems in a stem set can be derived from roots comes from the verbs of motion such as (117) in 
Section 3.1.2. Young (2000) offers another example of a set of verbs of motion that illustrate this 
pattern, represented in (139), where the stems are underlined and in bold.

(139)  a. naashˈá ‘I’m carrying it (SRO) around’
       b. bɪlɑ́kˈeeshˈɑːh ‘I’m in the act of handing it (SRO) to him’
       c. nɑhɑʃˈɑːh ‘I’m turning it (SRO) around’
       d. bɑ̥ hoʊoˈɑ ‘I made room for him’
       e. bɑ ɒ nɪˈɑ ‘I gave it (SRO) to him’
       f. yɪʃˈɑːɬ ‘I’m carrying it (SRO) along’
       g. ndeɛʃˈɑːɬ ‘I’ll carry it (SRO) around’ (Young 2000, p. 1)

Sets of words such as those in (139) are argued in some treatments to have a common root, ’a, 
which is associated with motion of solid roundish object (SRO). The fact that these words share 
formal and semantic connections is evident despite the diversity of expression. The similarities 
among these words are certainly what we would expect for a group of words built from a common 
root. One can imagine rules or processes that would generate the surface stems in (139) from the 
root ’a. For example, noting that the future form in (139g) is associated with ɬ in the coda, and 
oberving this in multiple future forms, one could posit a rule that suffixes ɬ to a root to produce 
the future form of the lexeme (Hardy 1979, p. 188). Thus, if one assumes roots are the basic, 
underdetermined forms from which surface words are ultimately derived (cf. view of roots in 
Hebrew in Chapter 2), then one can claim that such rules apply to roots to generate the stem sets 
of a lexeme.

The problem with this claim, however, is that the kinds of derivational rules such as the 
one described above for the future forms abound with exceptions. For example, the words in (140) 
are future forms that do not end in ɬ.

(140)  a. adeɛʃdloɬ ‘I will smile’ (Neundorf 2006, p. 247)
       b. deɛʃ ˈnɑh ‘I will crawl’ (p. 58)
c. *hadeesdzih* ‘I will speak’ (p. 250)

As Hardy (1979) recognizes, the generalization regarding final *l* with future forms works best for roots with open syllables, with another set of generalizations needed for roots with closed syllables. Indeed, as evidenced by Hardy’s (1979) work, if one were to describe all the patterns involving sets of related stems, it would result in a very complex set of descriptions involving multiple generalizations and multiple exceptions. Such a vast set of rules would require an intricate system of lexical indexation to indicate which rule would apply to each root and to specify exceptions.

This impression that the set of rules to describe the patterns among stems associated with a common root would not be particularly useful in capturing generalizations in Navajo is corroborated with evidence from computation. Eddington and Lachler (2006) analyzed 5890 individual stems and 437 stem sets using a machine learning program called C4.5 that is designed to determine the generalizations and relationships among these forms (p. 7). The results of their study do indicate that numerous generalizations, such as the aforementioned *l* in the future mode, are discernible among the patterns of stem sets in the language; however, such generalizations do not apply consistently across stem sets. For example, one of their models indicated that the perfective form can be predicted when given the future form with 70.0% accuracy. On the other hand, the converse, predicting the future when given the perfective, could be done with only 32.2% accuracy (p. 14). Eddington and Lachler’s (2006) computational modeling demonstrates that many patterns can in fact be reasonably generalized from the patterns involving stem sets. However, these generalizations are also limited with regard to how much they can predict about a form without extensive lexical indexation. Given a multitude of patterns and exceptions to those patterns, a great deal of information would need to be specified in the lexicon, such that a root-based model would suffer significantly in terms of parsimony. In addition, it is worth noting that
this discussion focused on the relationships among forms. Generating meanings from underspecified roots would lead to similar problems – some of which were introduced in Section 2.2.1 – that further challenge the notion of compositionality of stems vis-à-vis roots.

Given that roots can be used as abstract, hypothetical units to describe the kinds of patterns present among related lexemes, such as the verbs of motion in as (117) and (139), we want to be able to employ this construct in Navajo to describe such patterns. To do so, though, we should conceptualize the root not as a formative from which stems are derived but rather as an abstraction over stem sets (McDonough 2003) used to discuss stem sets that are formally and semantically related (Faltz 2000). In addition to reflecting synchronic connections among related lexemes, roots are also useful in making comparisons across languages and diachronically. Moreover, roots can also serve a pedagogical purpose, as demonstrated by the fact that a lexicon – Young, Morgan, and Midgette’s (1992) *Analytical Lexicon of Navajo* – is organized on the basis of roots. Therefore, we would expect speakers to be aware of some of the connections that are reflected by the notion of root. However, even if speakers do recognize some of the root-based patterns, they do not have enough evidence to conclude that stem sets are derived from roots in a consistent and reliable way across the system of the whole. Just as with morphemes, roots are useful for certain morphological descriptions, but they are not motivated as constituents of a word. Thus, the linguistic patterns of the language support Young’s (2000) description of the root as a hypothetical, abstract element that allows for the conceptualization the stem sets associated with a given lexeme or set of related lexemes. However, as illustrated by Eddington and Lachler’s (2006) computational analysis, deriving stems from roots cannot be done reliably on the basis of the synchronic linguistic patterns of Navajo.
4.3. Paradigms. Another element of the morphology of Navajo that merits mention, and, indeed, a much more extensive discussion aside from that which is presented in this dissertation, is the paradigm. Given that the focus of the dissertation is on constituents of words and that paradigms are morphological structures that are defined over sets of words, paradigms are beyond the scope of the present study. However, paradigms certainly do seem strongly motivated as morphologically relevant structures for Navajo (McDonough 2016).

The importance of paradigms for the description of linguistic patterns in the language is implicit in another constituent that has been posited for Navajo: the base. Faltz (2000) describes the base as the pre-inflection component of the word. His description of a base is essentially a listing of the various lexical and grammatical properties that a word expresses, to the exclusion of inflectional properties of person-of-subject and person of object, as illustrated in (141). These correspond to the surface words such as those in (142).

(141)  stem set
        root: ghaal
        stem-aspect: momentaneous
        classifier: l
        prefixes: ná, d
        conjugation pattern: YLV
        argument-structure: subject = agent, O=goal (reproduced from Faltz 2000, p. 155)

(142)  a. níidiilhaal  ‘you (sg.) (are about to) club him/her’
       b. náshdiidiílhaal  ‘he/she clubbed me’

The base as a morphological unit, therefore, would represent an intermediate stage in a derivational system that originates with the root. Such a system would take the features of the base in (141) and apply morphological processes. These features would then be combined with inflectional features, such as person-of-subject and person-of-object, to yield the surface forms in (142).\textsuperscript{25} If one were

\textsuperscript{25} This kind of analysis, using, for instance, a Distributed Morphology approach (following, e.g., Halle & Marantz 1994), has yet to be applied to Navajo. Such an exercise is beyond the scope of this dissertation,
to represent the form that the base would take for words such as *nidiilhaal* ‘you (sg.) (are about to) club him/her’ and *náshdidiiilhaal* ‘he/she clubbed me’, it could be represented as in (143).

(143) *ná_ dii__lhaal*

This underlined parts of this form would be places where inflectional material – such as the *sh* representing 1.SG.OBJ in (142b) – would be inserted. A structure such as (143) is actually not too dissimilar from that of other languages with more typologically common morphologies where inflection occurs at the beginning or end of the word (cf. Section 1.2 of Chapter 4 on Spanish). The main difference between Navajo inflection and that of a language such as Spanish and Navajo is that the attachment site of the inflectional affixes is inside the word rather than at an edge. As such, the Navajo system might be seen as similar to ablaut – as in English *sing, sang, sung* – or similar to a Semitic non-concatenative system (cf. Section 1.2 of Chapter 2 on Hebrew). However, as with ablaut in English, removing the part of the word that alternates based on tense does not result in what can properly be called a constituent. For example, *s_ng* in English is not a constituent: Its boundaries are not delineated by any other patterns and is not otherwise a salient, independent unit. One could conceivably also call this element in English a base, following the use of the term in Navajo. However, the motivation for this would be driven more by the exigencies of a particular theory than by the patterns of English. The same can be said of the base in Navajo: The patterns of the language themselves do not motivate the base as a constituent given the conjunct/stem and disjunct/conjunct boundaries, but if one needs to speak of a pre-inflection unit, then a base such as that in (143) can serve as that unit.

However, just because a base is not necessarily motivated as a morphological constituent does not mean the idea inherent in the construct of the base is not relevant for the morphology of

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and, in fact, would not be compatible with a learning-based framework. Such an analysis would have to resolve many of the issues raised in this chapter regarding the templatic approach.
the language. The base, in fact, corresponds to the paradigms of Navajo, which is reflected in part by the presence of information about conjugation class in Faltz’s (2000) list of features of the base. Indeed, the fact that conjugational classes are relevant for Navajo indicates that the paradigm is an important construct for the language. McDonough (2016) makes the argument that the importance of paradigms as word-formation elements can be seen in Young and Morgan’s (1987) treatment of paradigms, both by their discussion of paradigms in their grammatical description and by the fact that paradigms are interwoven through the dictionary as well. The organization of the Young and Morgan (1987) dictionary in particular, which is the preferred dictionary of Navajo speakers (McDonough 2015, p. 6), supports the claim that an effective word-formation model can be based on words as lexical entries and the paradigms that they are associated with. Especially under a learning-based framework where linguistic elements are motivated by patterns of interconnection, paradigms in Navajo certainly seem to be supported by the linguistic patterns of the language, even if not as a constituent of word. Therefore, a more in-depth exploration of the motivation for and precise nature of the paradigms in Navajo would be important for a comprehensive description of the morphology of the language under a learning-based framework. From the perspective of the present analysis, inflectional paradigms are very relevant with regard to the grammatical word. After all, an inflectional paradigm in Navajo is a construct that is generalized over sets of words (as opposed to stems or multi-word expressions, for example). Paradigms are therefore a morphological construct that is integral to understanding patterns of words in the language.

5. Summary

The first principal argument of this chapter is that grammatical words are indeed motivated for Navajo, the evidence for which comes from the fact that a phonological word is motivated and from the fact that this phonological unit generally aligns with a unit that is grammatically relevant,
that is, a grammatical word. The grammatical word, in turn, is argued to be the basis around which the morphological system is organized. With regard to word-internal constituency, this chapter offers evidence from a variety of linguistic domains in support of the claim that the disjunct, conjunct, and the stem, arranged non-hierarchically in a tripartite structure, are motivated for verbs. These are argued to be the primary morphological constituents in Navajo. Other morphological elements are also relevant for describing linguistic patterns in the language, including clitics, morphemes, roots, and paradigms; however, these are not treated as basic constituents of words. The present analysis offers a model for describing synchronic patterns in Navajo that does not rely on the template and that builds on the bipartite approach. Thus, it offers a model that can be tested with regard to how well it describes speakers’ knowledge. Moreover, it provides a description of morphological structure motivated by the patterns of the language rather by assumptions of universality. Therefore, the constituents posited for Navajo can be compared to those motivated for other languages in order to consider the question of what larger linguistic generalizations can be made regarding morphological structure. Such questions are addressed in Chapter 5.
Chapter 4: Motivating Morphological Constituents in Spanish

1. Background

Following the methodology of the two previous chapters, the present chapter offers a learning-based analysis of morphological constituents in Spanish. Background on the Spanish language is offered in Section 1, including a general overview and a concise discussion of how its morphology has been treated in other approaches. Section 2 presents evidence motivating the grammatical word as a constituent. Section 3 addresses the word-internal morphological constituents of Spanish. The analysis of this section addresses first verbs and then nominals\(^{26}\) (i.e., nouns, adjectives, and adverbs). One of the main claims of Section 3 is that one primary word-internal constituent is motivated for Spanish, a constituent that will be called the stem. Section 4 concludes the chapter.

1.1. General background. Spanish (WALS and ISO 639-3 codes: spa) is among the world’s most widely spoken languages. According to the Cervantes Institute, a Spain-based organization whose task is to promote Spanish language and culture, there are 470 million native speakers of Spanish, making it the second most widely spoken mother tongue after Mandarin Chinese. If we include the number of learners and speakers with more limited proficiency, the number rises to 559 million. The highest concentration of Spanish speakers is in Latin America and Spain, though speakers of the language can be found throughout the world, including over 40 million native speakers in the United States and over 11 million with more limited proficiency. The country with the largest number of speakers is Mexico, with over 121 million speakers, representing over 96.8% of the total population of the country (Instituto Cervantes 2015). Given the expansive number of speakers of the language, it is not surprising that there are numerous

\(^{26}\) As discussed in Section 3.2 in Chapter 2, the term nominal will be used as a cover term for nouns, adjectives, and adverbs, a usage also followed by Halliday and Matthiessen (2004).
dialectal varieties of Spanish. Despite the widespread regional and social variation, though, the diverse varieties retain a “fundamental cohesiveness throughout the world,” such that it is possible to speak of grammatical, lexical, and phonological features that are characteristic of the language as a whole (Lipski 2012, p. 1-2). Unless otherwise specified, the data for this dissertation are drawn from the variety of Spanish spoken in Mexico, specifically in the Northern states and among Mexican immigrants from those regions to the United States Southwest. However, given that the properties discussed are likely to apply to most other varieties, it is reasonable as a first approximation to assume that the analysis offered is also consistent with the Spanish language as a whole.

In terms of its relationship to other languages, Spanish is a Romance language of the Indo-European language family. It is therefore distantly related to languages such as Hindi, Russian, English, and Greek. Along with other languages in the Romance branch, such as Portuguese, French, Italian, and Catalan, Spanish is derived from vernacular varieties of Latin, whose widespread geographical distribution was made possible by the military advances of the Roman Empire. The Spanish Empire’s conquest of a significant part of the Americas then facilitated the spread of the Spanish language to what is now Latin America (Penny 2000). As previously suggested, Spanish is the most widespread of the Romance languages. Given the morphological relatedness of other Romance languages to Spanish, the present analysis of Spanish morphology may also serve as a starting point for similar analyses in related languages.

1.2. Overview of Spanish morphology. Unlike Hebrew or Navajo, the morphology of Spanish cannot be described as particularly distinctive among the world’s languages. In fact, depending on the level of detail one focuses on, it can be said to represent a system that is very common typologically with regard to inflection and derivation. In the words of J.P. Blevins (2016),
it has a “head-thorax-abdomen” morphology (p. 154), wherein the most contentful elements are followed by what are traditionally referred to as derivational elements, which are followed by inflectional elements. This kind of structure is illustrated in (144).

(144) a. niñ-it-os
    child-DIM-MASC.PL
    ‘little children’

In this example, the ‘head’ is the initial morph, which expresses the lexical meaning of CHILD (cf. niña ‘girl’, niñez ‘childhood’) and is the semantic core of the word. This is referred to in many accounts as the root. The ‘thorax’ consists of the derivational suffix, -it, which adds to the lexical core an additional connotation of affection and/or diminished size. Depending on the approach, the ‘head’ and ‘thorax’ together are typically referred to as the stem. Finally, the inflectional suffix, -os, provides information about gender and number and corresponds to the ‘abdomen’ of the word. All three elements together make up the word. Such a composition, where inflectional exponents of the word are farther from the semantic core than are derivational exponents, characterizes a wide range of the world’s languages, so much so that it is accepted as the canonical order characterizing the semantic core, the derivational exponents, and the inflectional exponents (Haspelmath & Sims 2010, p. 95). Regardless of its theoretical description, the morphological system of Spanish stands in contrast to the morphological systems of Semitic languages (cf. Section 1.2 of Chapter 2) and Athabaskan languages (cf. Section 1.2 of Chapter 3), and thus offers a fruitful counterpoint for the analyses offered in Chapters 2 and 3.

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27 The standard orthography of Spanish will be used throughout this chapter, unless a token requires a more explicit transcription, in which case IPA will be used.

As in the previous chapters, though morphological boundaries are indicated if it facilitates exposition, they are not always shown since decomposition into component morphemes is not a central characteristic of the present analysis.
The ready division of words into component morphs as illustrated above supports the common view of Spanish morphology as consisting of a semantic core upon which processes of derivation apply first, followed by processes of inflection in order to generate the surface word. Such an approach is fundamentally derivational in nature: Word formation consists of the application of rules or processes to morphemes, which are the basic lexical units. Analysis in this approach therefore takes as its goal segmentation of surface words into their component morphemes. The derivational approach represents the standard method of describing Spanish morphology, and, in fact, is based on patterns of the language that merit explanation. Therefore, though the deductive derivational approach stands in contrast to the inductive learning-based approach of this dissertation, the present section will discuss some of the key components of the derivational approach to Spanish morphology.

The derivational approach starts with the assumption that surface words are composed of core semantic elements (typically referred to as roots) to which are added first optional derivational elements (to form what are typically referred to as stems) and then obligatory inflectional elements (e.g., Haspelmath and Sims 2010; Mihalicek & Wilson 2011). This kind of model has informed a variety of analyses of Spanish morphology. Though most studies do not explicitly articulate the root-stem-word architecture, it is implicit in descriptions of morphological processes that refer to derivational or inflectional bases. For example, Pérez Saldanya (2012) refers to the derivational base as the root and the to the level above that as the thematic base. In his description, the thematic base is formed from the root and the theme vowel together, to which inflectional affixes attach. Indeed, the construct of theme vowels, which is discussed extensively below and which plays an important role in the present analysis, is a feature of the language that often serves to describe a distinction between the level of root and the level of stem. Notably, however, few analyses directly
address the motivation for these two levels. Though they may be implicit in descriptions of morphological processes, it is noteworthy that descriptions of this kind readily use the more general term *base* rather than root or stem. For example, Navalón (2011) describes instrumental verb formation in terms of affixation to a derivational base and Varela (2012) discusses derivational affixation and compounding in terms of bases. Similarly, Lang (1990) offers a comprehensive description of word-formation, ranging from derivational affixation to compounding to blends and clipping, using the term *base* rather than root or stem to present details of morphological processes. The distinction between derivational and inflectional bases is explicitly articulated by Bermúdez-Otero (2013) using the terms *root* and *stem*.

Therefore, to illustrate what Spanish morphology looks like viewed through this lens, we can consider the analysis of Bermúdez-Otero (2013), whose conceptualization of Spanish morphology is informed by principles from Stratal Optimality Theory (Bermúdez-Otero 1999) and Distributed Morphology (e.g., Halle & Marantz 1994). In this approach, which Bermúdez-Otero describes as being the traditional approach to Indo-European morphology (p. 4) (a point which is challenged by J.P. Blevins 2016, who describes the traditional approach as one organized around words and paradigms), three levels of structure characterize inflected words: the root, the stem, and the word, which are illustrated in Figure 10.
In this analysis, there are three types of morphological constituents, and every word can be decomposed into roots and stems. The root, which is “the smallest morphologically segmentable unit with lexical content” (p. 5), is the starting point of this model, and derivational and inflectional affixes are added to roots, yielding a surface word.

One can readily apply this kind of derivational analysis to a wide variety of words in Spanish, though doing so requires taking certain positions about the nature of the structure in Figure 10 in order to address issues raised by particular aspects of Spanish morphology. One of those aspects is exemplified by the word encuentros ‘meetings’ in Figure 10, namely its derivational affix, -o. Following the convention of traditional grammars, Bermúdez-Otero (2013) refers to this element as the theme vowel, and he argues that it is what gives the root its grammatical category (noun, in this case). The root and the theme vowel together produce a stem, and only a stem can be inflected; thus, the structure containing the theme vowel is a necessary intermediary level between that of the root and the word. This conceptualization is consistent with other theoretical descriptions of Spanish morphology, though at times other terminology is used. For example, Harris (1991) calls elements such as the o- of encuentros word markers, whose presence, in his view, marks a morphologically complete word (p. 30). In addition, what Bermúdez-Otero calls a root (e.g., encuentr- of encuentros ‘meetings’, encuentran ‘they find’, etc.), others
sometimes call a stem (e.g., Lang 1990). Many nouns, verbs, and adjectives in Spanish transparently fit this structure, such as those in (145), in which the theme vowels are indicated in bold.

(145)  

(a) \textit{libr-o-s} ‘books’  
(b) \textit{espir-it-u-s} ‘spirits’  
(c) \textit{pequeñ-a-s} ‘small (fem. pl.)’  
(d) \textit{verd-e-s} ‘green (pl.)’  
(e) \textit{recib-i-r} ‘to receive’

In all these words, which serve as canonical examples, the forms that do not include the theme vowels (i.e., \textit{libr-}, \textit{espir-}, etc.) cannot stand on their own as complete words. The theme vowels are readily identifiable, occurring in the expected position between the root and inflectional exponents. Moreover, they are an integral part of the words, providing little if any lexical content. The examples in (145), therefore, transparently reflect the structure in Figure 10.

Many other words in the language do not transparently reflect this structure, but can be readily analyzed in such a way that they do. In order to fit a greater number of words into the head-thorax-abdomen structure, null elements or zero morphs will sometimes be necessary. For example, an analysis that distinguishes inflected words from uninflected stems requires zero-morphs in cases where the stem and the word are identical. This can be seen in the singular counterparts of (145a-d) above, which can be analyzed as consisting of zero suffixes in order to fit the proposed structure, as in (146).

(146)  

(a) \textit{libr-o-∅} ‘book’  
(b) \textit{espir-it-u-∅} ‘spirit’  
(c) \textit{pequeñ-a-∅} ‘small (fem. sg.)’  
(d) \textit{verd-e-∅} ‘green (sg.)’

In all the examples in (146), which are parallel to those in (145), the element that takes the stem to a word is a zero-morph that indicates the grammatical feature of singular. It should be noted that zero-morphs are also posited in some analyses of verb forms, such that the zero-morph represents,
for instance, 3SG in the word *canta* ‘he/she sings’ (cf. Pérez Saldanya 2014, p. 231). In all these cases, the presence of the null marker is motivated not so much by surface patterns of the language (e.g., as would be the case if the null element surfaced when these words appear in other contexts) as by the desire for the root-stem-word structure to apply consistently to these words. Indeed, the designation of the theme vowels as derivational is also in large part motivated by the desire for such a structure.

Another perspective regarding theme vowels, particularly with nouns and adjectives, is to treat them as inflectional. Given that elements such as –a in (146c) mark gender, theme vowels can also be considered inflectional (e.g., Lang 1990, p. 19). Since gender marking fits many of the characteristics of canonical inflection (e.g., nouns and adjectives are obligatorily marked for gender, gender participates in syntactic relationships, it retains the same concept as the base, etc.) (e.g., Haspelmath & Sims 2010, p. 90), treating at least some theme vowels as inflectional is a reasonable analysis. As with the adoption of null inflectional elements, though, theoretical desiderata of a certain kind favor an analysis that is consistent with a structure such as that illustrated by Figure 10, in which all theme vowels are treated the same (i.e., as derivational elements) and in which all three levels of the word are represented with unique structures within every word, with the inclusion of null elements available to differentiate between levels. One of the attractions of this root-stem-word model in its application to Spanish is that it can be made to fit a wide variety of patterns in the language. Granting theoretical modifications such as null elements to the basic structure, the root-stem-word analysis can apply relatively straightforwardly to all contentful words (i.e., nouns, verbs, adjectives, and adverbs).

Though the derivational structure outlined above (or a related version) is commonplace in analyses of Spanish, it is built with certain assumptions whose validity is questionable. One such
assumption, which was called into question in the discussion above, is that null elements are desirable if they allow for a more uniform analysis for the theorist. Eddington (2004) points out another limitation of the conventional derivational approach. He argues that researchers working under frameworks with which the derivational structure is associated (e.g., generative approaches) use data that is limited, ignoring certain linguistic patterns that merit explanation. Because such models assume greater uniformity in the linguistic system than is attested in naturalistic speech, they fail to capture certain generalizations about linguistic patterns that are relevant with respect to their psychological reality. Eddington positions himself as a “left-field linguist” (p. xii), that is, one who is outside the mainstream and who uses more empirical methods rather than theoretical reasoning based primarily on speaker intuitions. Taking a more empirical approach, argues Eddington, results in findings that challenge many of the assumptions and conclusions of more mainstream linguists who adopt a strictly formal approach. Such a challenge, therefore, speaks in favor of adopting a learning-based approach in analyzing patterns in Spanish.

The general line of argument offered by Eddington against a strictly formal approach can be illustrated with how certain patterns in Spanish are treated in ways that overlook the linguistic behavior of speakers. One such pattern involves alternations of mid vowels and diphthongs (i.e., [e]~[ie] and [o]~[ue]). Such alternation patterns are exemplified in (147) and (148), in which the stressed syllable is indicated in bold.

(147)  

a. \textit{sentir} ‘to feel’  
b. \textit{siento} ‘I feel’

(148)  

a. \textit{dormir} ‘to sleep’  
b. \textit{duermo} ‘I sleep’

In both cases, what we can observe is that a mid vowel in an unstressed syllable alternates with a diphthong in a stressed syllable in morphologically related words. Though a significant number of
words participate in these patterns (including nouns, e.g., *bueno* ‘good’, *bondad* ‘goodness’), not all unstressed mid vowels alternate with diphthongs in stressed syllables. Lexemes that do not participate in this pattern are illustrated in (149) and (150).

(149)  
   a. *prender* ‘to turn on (e.g., an appliance)’
   b. *prendo* ‘I turn on’

(150)  
   a. *comprar* ‘to buy’
   b. *compro* ‘I buy’

The mid vowels in (149a) and (150a), unlike those in (147a) and (148a), do not alternate with diphthongs in their unstressed syllable counterparts. On the surface, nothing distinguishes (149a) and (150a) on the one hand from (147a) and (148a) on the other. A variety of solutions have been presented to distinguish alternating lexemes from non-alternating lexemes under a strictly formal approach; all such solutions refer to opaque structures. For instance, one solution is to mark the mid vowels in (147) and (148), but not those in (149) and (150), with a diacritic D that triggers diphthongization at some stage in the derivational process (e.g., Harris 1969, 1977). Another solution treats the underlying vowels in (147) and (148) as lax vowels and those in (149) and (150) as tense, a vowel quality distinction for which there is no surface evidence in other patterns of the language; underlying lax vowels undergo diphthongization whereas underlying tense vowels do not (St. Clair 1971, p. 421). Crucially for one of the main points that Eddington is making, patterns involving both kinds of vowels (*e~ie* in the case of (147)/(149) and *o~ue* in the case of (148)/(150) are treated the same in either solution. In other words, a single account addresses both types of alternations.

Embedded in a solution that does not distinguish between the alternation involving the mid front vowel and the alternation involving the mid back vowel is the assumption that the two alternations are fundamentally the same. At first glance, this would appear to be a reasonable claim.
To the extent that linguistic representations have psychological reality, a representation that treats the alternations involving the two vowels the same makes a prediction that they are treated the same by speakers. However, Eddington (2004) discusses findings from empirical work that demonstrate that the mid front vowel alternation and the mid back vowel alternation are not treated the same by speakers. For example, in generalization tasks involving nonce words with potentially alternating patterns, the mid front vowel pattern is more productive than the back front vowel pattern (Bybee & Pardo 1981; Eddington 1988). From this one can conclude that the two patterns are treated differently in speaker’s behavior, a conclusion that is not apparent if one looks only at static alternation patterns (i.e., ones that do not take usage or processing into account). An alternative account that takes into consideration cognition and usage would be better equipped to capture the observation that the two mid vowel alternations are not the same. The alternative that Eddington proposes is one in which patterns are explained via exemplars (an explanation that relates to memory and storage) and via analogy (an explanation that relates to processing and storage). Based in part on Albright, Andrade, and Hayes’ (2001) computational analysis of the diphthong alternations, Eddington concludes that the differences between the patterns can be predicted on the basis of frequencies and phonological similarity of words that are involved with the diphthong alternation patterns.

Given that Eddington relies on explanations involving exemplars and analogy, his approach is well aligned with the learning-based approach of this dissertation, in which explanations for linguistic patterns are linked to cognition (cf. Section 2.1 and 2.2 of Chapter 1). The fact that an approach such as his can capture generalizations about the treatment of linguistic processes in Spanish that are not captured by purely formal approaches that ignore learning, usage, and processing supports the notion that our understanding of Spanish morphology can benefit from
the application of learning-based principles. Moreover, since the structure of Spanish, traditionally encapsulated in a root-stem-word model, is similar to that posited for a wide variety of languages, the findings of this chapter would likely prove useful in better understanding other languages that are claimed to exhibit the same canonical type of structure.

1.3. Overview of the chapter. The remainder of this chapter focuses on the structures that are motivated by the patterns of Spanish using a learning-based approach. As with Hebrew and Navajo and consistent with the word-based approaches’ tenet of the primacy of the word, the grammatical word is indeed motivated for Spanish, through many of the same kinds of patterns discussed for Hebrew and Navajo. The Spanish-specific manifestation of those patterns is discussed in Section 2. In addition, word-internal structure is motivated for Spanish, even if a strict tri-level root-stem-word is not straightforwardly established. The argument made in this chapter is that one word-internal constituent (what will be called a stem) is motivated for Spanish, an argument that is elaborated in Section 3, which first addresses the word-internal structure of verbs and then that of nominals. Section 4 discusses non-constituent morphological elements that nevertheless are relevant for considering the structure of Spanish. The chapter concludes with Section 5, which summarizes the chapter’s main points.

2. Motivation for the grammatical word

The process for motivating the word outlined in Chapter 1 and applied to the linguistic patterns of Hebrew and Navajo is applied in this section to the linguistic patterns of Spanish. As with Hebrew and Navajo, phonological patterns, presented in Section 2.1, make the phonological word salient to learners, who would be expected to hypothesize that this phonologically salient form is also grammatically relevant. This hypothesis is borne out by additional patterns of the language, presented in Section 2.2, that demonstrate that phonological words regularly map onto
2.1. Phonological word. Among the criteria that signal phonological words in Spanish are the following: independence, internal cohesiveness, and involvement in phonological processes. Each of these criteria is elaborated upon in turn in this section.

2.1.1. Independence. The criterion of independence refers to the commonly cited characteristic of a phonological word that it can occur on its own. One diagnostic of the criterion of independence is whether an element can serve as the answer to a question. In Spanish, units larger than words can serve as responses, but the minimal unit that can play that role is the element that is treated as the phonological word by analysts. This is illustrated in (151) and (152).

(151) Question: ¿Quién vino a la fiesta? ‘Who came to the party?’
Answers: (a) Vinieron tres amigas buenas. ‘Three good friends came.’
(b) Tres amigas buenas. ‘Three good friends.’
(c) Amigas buenas. ‘Good friends.’
(d) Amigas. ‘Friends.’
(e) *Amig- FRIEND, *-as FEM.PL

(152) Question: ¿Qué hizo? ‘What did he do?’
Answers: (a) Desapareció de la ciudad. ‘He disappeared from the city.’
(b) Desapareció. ‘He disappeared.’
(c) *Desaparec- DISAPPEAR, *Aparec- APPEAR *-ó 3SG.PST, des- REVERSATIVE

In (151), we can see that, though a variety of constituents are possible as answers, ranging from a full clause to smaller syntactic constituents, the smallest possible nominal unit is a word, whose morphological components cannot stand on their own. This is true for verbal elements as well, shown in (152), where no morph smaller than a word can occur in isolation.

Given that elements such as (151d) and (152b) are phonologically independent, it is not surprising that their boundaries also serve as the locus of potential pause. For example, given a
sentence such as (153), a speaker who wishes to pause for effect or for clarity or who changes his mind and interrupts himself does so only in between words.

(153) *Yo no quiero hablar con esa gente.* ‘I don’t want to speak with those people.’

Pausing within words would sound very unnatural and would mostly likely be limited to metalinguistic contexts or to word play wherein sub-word components are targeted (e.g., a word game wherein a reduplicative fV is inserted after every syllable onset, as in *comer* → *cofomefer*). Not coincidentally, of course, the spaces in the standard written representation of the spoken language correspond relatively consistently with boundaries of phonological words. The written system captures the intuition that certain elements stand in isolation and others do not and the phonological unit that these elements correspond to is the phonological word, and not other prosodic elements such as syllables or feet.

2.1.2. Internal cohesiveness. If the criterion of independence helps to distinguish words from smaller components, the criterion of internal cohesiveness helps to distinguish words from larger units. Thus, a learner attempting to make sense of natural connected speech can ascertain that words are important units to attend to by observing that they can typically be uttered in isolation and/or by observing that meaningful or functional components of a word have a predictable and fixed relationship within the word.

Comparing the internal components of clauses and of words in Spanish, we can see that the former allows a certain degree of flexibility with regard to order that is not available with the latter, as illustrated by the clauses in (154) and the word in (155).

(154) a. *Yo camino cada día.* ‘I walk every day.’
    b. *Camino yo cada día.* ‘I walk every day.’
    c. *Cada día yo camino.* ‘I walk every day.’
    d. *Yo cada día camino.* ‘I walk every day.’
    e. *Cada día camino yo.* ‘I walk every day.’
Word order within clauses is somewhat free in Spanish, as can be seen by the fact that the clauses in (154), in which all orders are permissible as long as cada ‘each’ occurs before día ‘day’, are judged to be the same semantically by speakers. In contrast, the order of components within a word is invariant, as shown in (155). Moreover, the nature of the verb in Spanish allows for variants of clauses such as (154) to occur without a subject pronoun present, as in (156).

(156) a. Camino cada día. ‘I walk every day.’
    b. Cada día camino. ‘I walk every day.’

Thus, the clauses in (156) are judged by speakers to be the same semantically as those in (154). With regard to words, on the other hand, removing any of the components of a word results in a word that is judged to either not be a licit word in Spanish or a different word than the original, as illustrated by comparing (155) and (157). A learner attending to possible distributional relationships among different meaningful or grammatical elements in Spanish, therefore, has evidence for positing the construct phonological word as an integral unit.

2.1.3. Phonological patterns. In addition to distributional factors that support the notion of the phonological word in Spanish, a variety of phonological factors also indicate its relevance as a constituent in the language. Phonological patterns that refer to the phonological word include stress assignment, sandhi processes such as spirantization, and phonotactic restrictions.

With regard to stress assignment, learners can be expected to attend to the fact that some phonological units (i.e., syllables) are more prominent in the speech stream than others (Hualde
2005, p. 220), and that this prominence is in certain cases relevant for distinguishing meaning, as illustrated in (158-160), in which stressed syllables are indicated in bold.

(158)  a. *llamo* ‘I call’
        b. *llamó* ‘he called’

(159)  a. *jugo* ‘juice’
        b. *jugó* ‘he played’

(160)  a. *papa* ‘pope’, ‘potato’
        b. *papá* ‘dad’

This set of examples lists minimal pairs in which the single feature that distinguishes the words in each pair is stress. This demonstrates that stress is phonologically contrastive among both inflectionally related elements, as in (158), and among distinct lexemes, as in (159) and (160). Because the domain of stress is the syllable, contrastive stress in Spanish offers support for syllables, a unit that Eddington (2004) argues is also motivated by external evidence, including findings from several psycholinguistic experiments, such as those involving priming effects (p. 109). However, contrastive stress also supports the construct of the phonological word since lexical stress (which is certainly a property of words such as (159b) and (160)) is a property that applies to particular syllables in specific words. Thus, lexical stress takes both syllables and words as its domain. Moreover, restrictions regarding which syllable may potentially be stressed refer to the phonological word as a unit: Stress must fall on one of the last three syllables of a word (Hualde 2005, p. 220). Therefore, as in other languages, stress takes the word as a domain. The properties of stress in Spanish, therefore, further support the importance of the word in describing certain phonological patterns in the language.

Phonological words are also generalizable from the fact that different positions in the word respond differently to different phonological processes. Though it is not the case that the position in the word is a trigger for the process, the net effect of the process is that different parts of the
word are affected differently, thereby potentially drawing the learner’s attention. One such process is spirantization, which involves alternations between voiced stops ([b], [d], [g]) and their spirant counterparts ([β], [ð], [ɣ]), the latter of which occur intervocally (Hualde 2005, p. 140) illustrated in (161-163).

(161)  
   a. botón [boton] ‘button’
   b. abotonar [abotonar] ‘to button’

(162)  
   a. con gusto [kongusto] ‘with pleasure’
   b. a tu gusto [atuɣusto] ‘to your liking’

(163)  
   a. cuando [kuando] ‘when’
   b. cada [kaða] ‘each’

In (161), we can observe the alternation between related words. The spirant is found intervocally, (161a); otherwise, the phoneme occurs as a stop, (161b). Spirantization also occurs in sandhi, as illustrated in (162), where the word gusto ‘pleasure, liking, taste’ ([gusto] in isolation) is produced with an initial spirant when preceded by a vowel. On first glance, then, we might be tempted to conclude that spirantization does not serve as evidence for the phonological word since it seems to be insensitive to word boundaries. However, looked at from the perspective of the phonemes in particular lexical items, word boundaries are the only places where we will see alternations across tokens of single grammatical word; in other positions of the word, only a single allophone occurs across different tokens. In other words, a grammatical word such as cuando in (163a) consistently realizes the phoneme /d/ as [d] and a grammatical word such as cada in (163b) consistently realizes the same phoneme as [ð]. In words with these phonemes at word boundaries, on the other hand, the phoneme is realized variably as the spirant or the stop, as in gusto in (162).

The alternation for any given word type in its various realized tokens, therefore, is observed only at the word boundary. Thus, even a purely phonological process that can be expressed without
reference to morphological constituents has a distinctive effect when interacting with the boundaries of the word, indicating that the word is a distinct constituent with unique properties.

Phonological distributional patterns also have a distinctive expression at word boundaries, as evidenced by certain phonotactic constraints. Though many of the restrictions of the language involve syllable boundaries (e.g., codas in general are restricted to just a few consonants: /s/, /l/, /t/, and nasals homorganic with following consonants (Hualde 2005, p. 76)), certain sounds have restrictions that make reference to word boundaries. For example, the trill /t/ and the flap /ç/ are in complementary distribution in word-final and word-initial position, but not word-medially, as illustrated in (164).

(164) a. pero /pero/ ‘but’
    b. perro /pero/ ‘dog’
    c. rojo /roho/ ‘red’
    d. color /koloɾ/ ‘color’
    e. *#ɾ, *ɾ#

Though both rhotics can occur word-medially and are contrastive in that position, as seen in the minimal pairs in (164a) and (164b), only the trill can occur word-initially, as in (164c), and only the flap can occur word-finally, as in (164d).

In addition, word boundaries interact with phonotactics in other ways: In some cases, word boundaries permit sounds that would otherwise be prohibited, and in some cases they prohibit sounds that are otherwise allowed. With regard to the former, as stated above, coda consonants in general are fairly restricted, to sonorants and /s/. However, codas in word-final positions also allow /d/, as in ciudad ‘city’ or felicidad ‘happiness’. With regard to prohibitions specific to boundaries, we can observe that a sound such as the palatal nasal, /ɲ/ (orthographic ñ), which is found word-medially in words such as niño ‘child’ or cuñado ‘brother-in-law’, does not occur word-initially
(Green 1988). Thus, both types of sounds – those that occur only at word boundaries and those that occur elsewhere but not at word boundaries – offer evidence for the phonological word as a linguistic constituent in Spanish.

2.2. Alignment of phonological word and grammatical word. As mentioned in Section 4.1.1 in Chapter 1, the Grammatical Word – Phonological Word Congruency Principle guides the present analysis. Thus, the working assumption with regard to the alignment of the phonological and the morphological word is that leaners are expected to assume that, unless otherwise contradicted, the salient phonological constituent identified by the criteria discussed above (i.e., the phonological word) will also be grammatically and/or semantically relevant. This hypothesis would be confirmed for the learner if, for instance, the phonological word also consistently serves as a stable locus of semantic and grammatical features, serves as the basis for lexical classes, and serves as the base of compounding. Moreover, the validity of the grammatical word as a construct is confirmed by external evidence. This claim of this chapter is that it is indeed the case that phonological words typically align with grammatical words in Spanish, as will be demonstrated in this section.

2.2.1. Stable locus of semantic and grammatical features. As demonstrated for Hebrew and Navajo, the linguistic patterns of Spanish also indicate that the word is a more reliable carrier of meaning and grammatical function than the component morphs. Though the case against the morpheme as a consistent unit in the language may not be as strong in Spanish as it is in Hebrew and Navajo, the claim that Spanish words are a more stable locus of semantic and grammatical features than morphs is nevertheless supported by the evidence.

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28 Both of these generalizations are variable across different varieties of Spanish. For example, though in some varieties (such as that spoken by the author), the final $d$ in ciudad and felicidad is variably pronounced, in other varieties is consistently not pronounced. With regard to /ɲ/, some varieties do exhibit words with this sound in initial position, though they tend to be few and/or marginal words.
In order to examine this claim, we can compare two analyses of a sample Spanish word, one analysis which locates the semantic and grammatical features in the word as a whole and one in which it does so in the constituent morphs. Our sample word will be the relatively complex word in (165).

(165) *redescubrimientos* ‘rediscoveries’

This word may be found in a variety of contexts, in a multiplicity of phrases or clauses and in a variety of positions in those phrases or clauses, as illustrated in (166).

(166) a. *redescubrimientos importantes* ‘important rediscoveries’
    b. *con mis redescubrimientos* ‘with my rediscoveries’
    c. *Tuvo muchos redescubrimientos grandes*. ‘He/she had many big rediscoveries.’
    d. *Redescubrieron frecuentes son raros*. ‘Frequent rediscoveries are rare.’

However one thinks of the word syntactically – e.g., as a head of clause, (166a); the dependent element in a phrase, (166b); the subject of the clause (166c); or the object of the clause (166d) – the semantic and grammatical features of the word remain the same, as can be seen by the consistent gloss of the word *redescubrimientos* as ‘rediscoveries’.

The same, however, is more difficult to assert with regard to the individual components of the word. One possible decomposition of the word *redescubrimientos* is illustrated in (167).

(167) *re-des-cubri-mient-o-s*
    RPT-RVRS-cover-NMLZ-WDMRK-PL

This analysis is consistent with a variety of models of Spanish morphology, though some details may vary from analysis to analysis (e.g., the glossing of *-o* as WDMRK follows Harris’s (1991) designation of that exponent as a work marker; Bermúdez-Otero (2013), however, refers to it as a theme vowel). Support for some of these elements as morphemes can indeed be found by cross-lexeme comparisons. For example, the RPT (repetitive) prefix *re-* is found in *rehacer* ‘to redo’ and *reabrir* ‘to re-open’ and many other lexemes, and it functions in much the same way as in (167).
The same is true of the RVRS (reversative) des- in deshacer ‘undo’ and desenterrar ‘to dig up’. However, there is some idiosyncrasy involving both these derivational prefixes, as in (168) and (169).

(168)  a. repetir ‘to repeat’  
       b. representar ‘to represent’

In (168a), though the word as a whole does indeed have a repetitive meaning, since *petir is not attested as a Spanish word, it cannot be claimed that the repetitive sense of the word comes exclusively from the prefix re-, a claim that can be made about the other words with this prefix mentioned above. In contrast, in (168b), the element to which the suffix attaches is indeed a word on its own, presentar ‘to present’, yet the meaning of (168b) is not straightforwardly decomposable into the combination of a repetitive sense and ‘to present.’ The etymological relationship between presentar and representar may be potentially grasped by a speaker without too much difficulty; however, the sense contributed by the prefix re- in this word is not the same as that of, for instance, redescubrimientos, rehacer, and reabrir. The same can be said with the des-, which might be a treated as a morph indicating reversal or negation, illustrated in (169).

(169)  a. desparramar ‘to scatter’  
       b. desayunar ‘to have breakfast’

Though one can glean a connection between reversal or negation and the word in (169a) (e.g., the word has a sense of disorderliness associated with it), it is not clear what exactly is being undone. Moreover, a form of that word without the prefix, *parramar, is not attested synchronically. With regard to (169b), on the other hand, the basic form ayunar ‘to fast’ is attested, and, in the same manner as the English word breakfast, the etymological connection between desayunar and ayunar is available to many speakers once it is pointed out to them. However, it is also the case that desayunar has undergone semantic specialization (Bybee 2010, p. 50), such that it does not refer
to the breaking of any fast but specifically to the meal that (typically) breaks the fast that occurs as one sleeps.

Finally, even the morph that corresponds to the most semantically contentful component, what is often called the root, is not as stable a carrier of semantic features compared to the word. This element is *cubr*- in (167), glossed as ‘cover’. As in the English word *discover* there is a clear metaphorical connection between the literal sense of cover as the placement of something over an entity such that it is not directly observable and the sense of finding something or someone that was previously unknown to the agent. However, the word *descubrir* ‘discover’ cannot be used in the more literal sense, without conveying a sense of an agent that lacks knowledge. For example, the word for removing the cover off a pot when one knows its contents is *destapar* and that of exposing information known to the agent (as in a scandal or the revelation of a new product) is *revelar*.

All the examples of the morphs in (167) and their patterns across different lexemes help illustrate the main point of this section. Despite certain morphs having form-meaning correspondences across lexemes in Spanish, constituent morphs are not as reliable as carriers of semantic and grammatical features as the words as a whole.

**2.2.2. Basis for lexical classes.** Though decisively motivating lexical classes and their properties under a learning-based approach is beyond the scope of this dissertation, certain patterns in the language do seem to call for their validity as a construct. As demonstrated for Hebrew and Navajo in the previous chapters, a variety of distinct morphological, semantic, and morpo-syntactic properties converge on particular sets of forms in Spanish such that we can reasonably speak of a set of forms we can call nouns that is reliably distinct from a set of forms we can call verbs (Dryer 1997; Mithun 1999). Given that the specific forms in each of those sets correspond to words, the
The exploration of what precisely constitutes the lexical classes in Spanish is a worthwhile endeavor that would likely support the claim introduced in Chapter 1 that linguistic categories motivated under a learning-based framework would likely exhibit prototype effects and fuzzy boundaries between categories. More canonical instances of nouns and verbs, though, would certainly be expected to be determined by a convergence of properties on certain sets of forms. As discussed below, these sets of forms are congruent with grammatical words, thereby providing another kind of evidence in favor of positing grammatical words as relevant morphological constituents in the language. This section seeks to demonstrate how two kinds of lexical classes – nouns and verbs – are motivated using convergences from morphological, semantic, and morpho-syntactic criteria.
The morphological structure of a word is perhaps the best predictor of its lexical class. In particular, a word’s inflectional, suffixal morphology can decisively determine whether a word is nominal or verbal, as illustrated in (170) and (171).

(170)  
\begin{itemize}
  \item a. \textit{com-imos} ‘we ate’
    
    \begin{align*}
    \text{eat-1PL.PST}\textsuperscript{29} & \\
    \end{align*}
  \item b. \textit{habl-a} ‘he/she speaks’
    
    \begin{align*}
    \text{speak-3SG.PRS} & \\
    \end{align*}
  \item c. \textit{recib-ir} ‘to receive’
    
    \begin{align*}
    \text{receive-INF} & \\
    \end{align*}
  \item d. \textit{duerm-an} ‘(that) they sleep’
    
    \begin{align*}
    \text{sleep-3PL.SBJV} & \\
    \end{align*}
\end{itemize}

(171)  
\begin{itemize}
  \item a. \textit{doctor} ‘doctor’
    
    \begin{align*}
    \text{doctor.(M)} & \\
    \end{align*}
  \item b. \textit{doctor-a} ‘(female) doctor’
    
    \begin{align*}
    \text{doctor-F} & \\
    \end{align*}
  \item c. \textit{doctor-es} ‘doctors’
    
    \begin{align*}
    \text{doctor-PL} & \\
    \end{align*}
\end{itemize}

With regard to morphological features, verbs are inflected for person-of-subject\textsuperscript{30}, number-of-subject, and tense-aspect-mood, as in (170) and nouns are inflected for number and gender, as in (171). Except for non-finite verbs, such as (170c), all verbs bear inflectional morphology for tense and most do for person-of-subject. With regard to nouns, one can argue that forms such as (171a) are unmarked for gender, depending on one’s approach to morphological gender. However, the primary point remains: Nouns and adjectives but not verbs bear gender morphology.

\textsuperscript{29} Note that different analyses are available for the decomposition of these verbs. For example, the \textit{-i} could be considered \textit{PST} and the \textit{–mos 1PL}. Regardless of the specific details of the analysis, though, this type of morphology occurs only with verbs and the morphology in the next set of examples occurs only with nouns and adjectives.

\textsuperscript{30} As discussed in the footnote of Section 2.2.2 of Chapter 2, constructs such as \textit{noun} and \textit{verb} will be employed as a kind of shorthand, as will be constructs such as \textit{subject}, \textit{determiner}, and \textit{adjective}, with the openness to of a potentially different analysis should these constructs prove not to be motivated for the language.
Related to the kind of morphology nouns and verbs exhibit, semantic considerations further reinforce the distinction between these two lexical classes. As pointed out by Mithun (1999), we expect a class of forms that refers to entities to contrast with a class of forms that have event or stative interpretations. Indeed, such classes of forms in Spanish correspond to the class of forms that bears nominal morphology and the class of forms that bear verbal morphology, respectively. Since what constitutes an entity versus an event/stative reading can in some cases be open to interpretation, we cannot treat this criterion as a definitive determiner of nouns versus verbs. However, it is a relatively reliable generalization to say that elements that express exponents of person-of-subject, number-of-subject, and tense-aspect-mood are associated with event interpretations and those with nominal morphology of person and gender are associated with entity interpretations, as illustrated in (172).

(172)  

(a) *juegas* ‘you play’  
(b) *juegos* ‘games’

Both (172a) and (172b) pertain to the same semantic field, PLAY, which has the potential for both event and entity interpretations. The way to ensure one interpretation over another is through the morphology of the word. This, of course, is not a coincidence since notions of subject and tense-aspect-mood are precisely what we would expect to be associated with events. It is not the case, however, that these notions cannot also be associated with entities (cf. deverbal nouns in Navajo), and therefore semantics and morphology do not necessarily overlap. Therefore, the two serve to reinforce each other from the perspective of a learner seeking to make sense of the patterns of the language. Moreover, the fact that the semantic interpretation is associated with the whole word in (172) rather than with a component of the word (e.g., *jueg-* does not by itself have an inherent entity or event meaning) reinforces the construct of the grammatical word.
With regard to morpho-syntax, we can categorize nouns and verbs as different classes of linguistic forms based on the type of agreement relationships they participate in. Both nouns and verbs participate in agreement relationships (i.e., one in which two different forms have certain grammatical features in common), though the details of the relationship are distinct for the two classes. Nouns agree with modifiers such as adjectives and determiners with respect to the features of gender and number, as in (173). Verbs agree with subjects with respect to person and number of the subject, as in (174).

(173) a. el niño bueno
    DET.M.SG child.M.SG good.M.SG
    ‘the good boy’
b. la niña buena
    DET.F.SG child.F.SG good.F.SG
    ‘the good girl’
c. los niños buenos
    DET.(M)PL child.(M)PL good.(M)PL
    ‘the good children’
d. las niñas buenas
    DET.F.PL child.F.PL good.F.PL
    ‘the good girls’

(174) a. yo corrí
    1SG.NOM run.PST.1SG
    ‘I ran’
b. tú corríste
    2SG.NOM run.PST.2SG
    ‘you ran’
c. ellos corrieron
    3PL.NOM run.PST.3PL
    ‘they ran’

In (173), we can see that the morphological features, specifically number and gender, of the adjective and the determiner match those of the noun, and in (174), we can see that those of the verb, specifically person and number, match those of the noun. Importantly, the elements that agree are clear cases of grammatical words. In fact, agreement also serves as a criterion for distinguishing grammatical words from phonological words. Since one interpretation of determiners is that they
are not full phonological words, we can consider a phrase such as (175) to form a phonological word.

\[(175) \quad \text{la niña} \quad \text{DET.F.SG child.F.SG good-F.SG} \quad \text{‘the good girl’}\]

However, the two forms operate as independent grammatical words since the noun triggers agreement of the determiner. Clitic-group-internal agreement, therefore, serves as another kind of evidence for the grammatical word in Spanish.

All three of the criteria – morphological exponents, semantic factors, and agreement – point to classes of forms on which these criteria converge. These classes of forms are grammatical words. Therefore, the fact that classes of words can be formed is further evidence that words are relevant elements in Spanish.

### 2.2.3. Base of compounding.

Evidence for the grammatical word as a constituent of Spanish can also be found in patterns involving compounds. Two types of elements can be said to be the base of compound formation in Spanish, one of which is the grammatical word and the other of which is the stem (which is introduced here for the sake of describing the process of compounding, but which is more extensively motivated in Section 3). Examples of compounds formed from the combination of grammatical words are in (176).

\[(176) \quad \begin{align*}
\text{a. telaraña} & \quad \text{‘spider web’} < \text{tela} \quad \text{‘fabric, cloth’}, \text{araña} \quad \text{‘spider’} \\
\text{b. malgastar} & \quad \text{‘to waste’} < \text{mal} \quad \text{‘badly’}, \text{gastar} \quad \text{‘to spend’} \\
\text{c. sordomudo} & \quad \text{‘deaf-mute’} < \text{sordo} \quad \text{‘deaf’}, \text{mudo} \quad \text{‘mute’} \\
\text{d. abrelatas} & \quad \text{‘can opener’} < \text{abre} \quad \text{‘he/she/it opens’}, \text{latas} \quad \text{‘cans’}
\end{align*}\]

In (176), the compound is formed by straightforwardly adjoining the two component words – which can consist of nouns, verbs, adjectives, or adverbs – and applying necessary phonological patterns (e.g., degemination of aa since long vowels are not part of the inventory of Spanish, as in
In each of the cases, we can treat the compound as based on two words. This point is especially evident in (176d), in which the two forms are inflected grammatical words, confirmed by the fact that the verbal component of the word cannot be treated as a stem even if we define a stem as the element that contains a theme vowel since the theme vowel of *abrir* is *i* and not *e* (cf. discussions of theme vowels in Sections 1.2 and 3.2.1). This set of examples, therefore, demonstrates that the grammatical word can serve as the basis of compounding in Spanish, thereby offering support for the grammatical word as a constituent.

In certain cases, the argument could be made that the base of compounding is the stem, though not necessarily unambiguously so. Such examples can be seen in (177).

(177)  
\begin{enumerate}
\item \textit{pelirrojo} ‘red-headed’ < \textit{pelo} ‘hair’, \textit{red} ‘rojo’
\item \textit{agridulce} ‘bittersweet’ < \textit{agrio} ‘bitter’ \textit{dulce} ‘sweet’
\end{enumerate}

The question in each of these examples involves what can be constituted as the base of the first element of the compound: the word \textit{pelo} versus the stem \textit{pel-} in the case of (177a) and the word \textit{agrio} versus the stem \textit{agri-} in the case of (177b). Either analysis is viable. If the base is analyzed as a word, then these examples join the ones in (176) as evidence for the grammatical word as a constituent. If the base is analyzed as a stem, then these examples serve as evidence for the stem as a constituent. Since a wide variety of other patterns serve as evidence for both these constituents, the question of how to analyze (177) is left open. Regardless of the analysis of (177), however, because the grammatical word is the base of at least some compounds in Spanish, compounding serves as evidence for the grammatical word as a constituent.

\textbf{2.2.4. External evidence.} In addition to language-internal evidence that supports the positing of a grammatical word as a morphological constituent in Spanish, external evidence also indicates that it is psychologically real to speakers, which is consistent with the observations discussed throughout this section that the grammatical word is motivated by patterns in the
language. Though the studies mentioned below are not specifically oriented towards motivating the word as a construct, the findings fruitfully make use of the construct, thereby offering evidence for the word.

An exploration of the developmental patterns of both typically developing and atypically developing children reveals that the minimal unit expressed is the word. For instance, Mueller Gathercole, Sebastián, and Soto (1999) examine the speech patterns of two young children, collected at age 1;6 and 2;6 for one and 1;8 and 2;1 for the other, in order to learn about how they acquire the verbal inflectional patterns of the language. One of the findings of the study was that at the early stages of production, children produced only a single grammatical form for a given lexeme. Since that grammatical form was inconsistent (e.g., 3rd person preterit for one form, imperative for another, etc.), the researchers conclude that the children reveal a lack of sophisticated knowledge of the inflection system. Notably, though, despite the limited awareness of inflection, the children consistently produced a fully inflected word, as opposed to any sub-word component.

Similar patterns can also be observed with other types of speakers who do not exhibit mastery of the inflectional system of Spanish. For example, aphasic patients suffering from agrammatism, which is a simplification of grammatical structure, significantly reduce the number of inflected forms that they produce, reflecting the types of patterns of patterns observed in acquisition (Centeno & Obler 2001). Notably, just as with young children learning the language, patients with language impairment difficulties produce fully inflected words rather than sub-word components, even though the simplest form that would still convey the intended meaning would be an uninflected word-internal element (e.g., a stem). Similarly, aphasics exhibiting issues with phonological production (e.g., substitution or omission of sounds) nevertheless maintain the
integrity of the word (Ardila 2001). The same general observation about the integrity of the word is found with speakers suffering from other kinds of language impairments. For instance, Spanish-speaking children with Specific Language Impairment (SLI) exhibit inflectional simplification (e.g., using infinitive forms for finite forms, simpler singular forms for plural forms, etc.), yet do not exhibit any forms smaller than a word (Bedore & Leonard 2001). Both with regard to typical and atypical development, therefore, one constant that can be found is that simplification of the grammatical system does not result in the production of elements smaller than a word. Though not necessarily decisive on its own, this type of evidence complements other evidence that supports the positing of the word as a construct in Spanish.

2.3. Exceptions to alignment of phonological word and grammatical word. As discussed in Chapter 1 and demonstrated for Navajo and Hebrew, phonological words are not always perfectly aligned with grammatical words. In Spanish, as in other languages, both constructs are needed to describe the patterns of the language, one construct that is better suited for certain phonological patterns and the other for grammatical relationships. Nevertheless, the two are clearly related and the kind of phonological factors motivating the phonological word in Section 2.1 also help motivate the grammatical word since phonological words and grammatical words often do in fact align, demonstrating that the Grammatical Word – Phonological Word Congruency Principle regarding the relationship between form and meaning (cf. Section 4.1.1 of Chapter 1) does hold for the language. However, since the focus of the dissertation is on morphological constituents, it is important to clarify the distinction between phonological words and grammatical words, which necessitates addressing the issue of clitics in Spanish.

To recapitulate the definition introduced in previous chapters, a clitic is an element that has the grammatical properties of a grammatical word without the independence of a phonological
word. In Spanish, for example, pronominal clitics can be distinguished from what are referred to as strong pronouns, both of which are illustrated in (178).

(178) a. *Me compró un chocolate.
   OBL.1SG buy-3SG.PST a chocolate
   ‘He/she bought me a chocolate’
   b. Compró un chocolate para mí.
   buy-3SG.PST a chocolate for OBL.1SG
   ‘He/she bought a chocolate for me.’

Both me and mí in (178) exhibit the same grammatical features, namely 1SG. However, the former is considered a pronominal clitic and the latter a strong pronoun. The difference between the two is not primarily grammatical but rather phonological. Ordoñez (2012) outlines the diagnostic differences between pronominal clitics and strong pronouns. In contrast to strong pronouns, clitics cannot serve as the answer to a question, cannot be connected via coordination, cannot be modified, and cannot be in a position of emphasis (p. 423). Each of these criteria is illustrated in (179) through (182), respectively.

(179) a. ¿A quién vio? ‘Who did he see?’
   *Me
   OBQ.1SG
   ‘Me’
   b. ¿Quién lo hizo? ‘Who did it?’
   Yo
   NOM.1SG
   ‘Me (I did)’

(180) a. *Me y te conoció.
   OBQ.1SG and OBQ.2SG meet.3SG.PST
   ‘He/she met me and you.’
   b. Nos vio a mí y a ti.
   OBQ.1PL see.3SG.PST ACC OBQ.1SG and ACC OBQ.2SG
   ‘He/she saw me and you.’

(181) a. *Los todos llamé.
   OBQ.3PL all call.1SG.PST
   ‘I called them all.’
   b. Ellos todos fueron.
   NOM.3PL all go.3PL.PST
‘They all went.’

(182)  

a. *¡No TE escój! (with all capitals as prosodic emphasis)  
   NEG OBQ.2SG choose.1SG.PST  
   ‘I didn’t choose YOU!’

b. ¡No dijo nada de TI!  
   NEG say.3SG.PST nothing about OBQ.2SG  
   ‘He didn’t say anything about YOU!’

In these examples, the difference between first form in the pair and the second is not their grammatical features but rather their phonological properties. With regard to their phonological features, the clitics in the (a) positions resemble affixes, such as des- and re- shown above in (168) and (169), which, for instance, also cannot stand in isolation. However, clitics and affixes differ in the fact that clitics have reliable associations between their grammatical features and their properties, whereas affixes do not, as was discussed in Section 2.2.1.

In sum, clitics do indeed represent a misalignment of the grammatical and phonological word. However, this does not invalidate the hypothesis of speakers that phonologically salient elements will also be grammatically relevant. After all, by and large, there is a one-to-one mapping of phonological word onto grammatical word, as articulated in the Grammatical Word – Phonological Word Congruency Principle. Moreover, the other kinds of correspondences – those that are not one-to-one mappings – involve clitics, which consistently result in phonological words with more than one grammatical word and never the converse. Therefore, the assumption that a stable relationship exists between phonological word and semantic/grammatical properties remains intact, since clitic groups display that type of relationship. The fact that they display more reliable decomposition than words does not negate the fact that they also display a reliable form-meaning correspondence themselves.

3. Motivation for word-internal constituency
In addition to motivating the grammatical word, linguistic patterns in Spanish also offer evidence for word-internal constituency. As argued in the present section, one additional level of constituency below the level of the word is necessary for describing the patterns of the language. This level is referred to as the stem in this dissertation. The choice to call this sub-word unit a stem (as opposed to, for example, a root) is somewhat arbitrary if only one sub-word level is posited. Given the somewhat arbitrary nature of using this term, I will adopt it at the outset for the sake of ease of exposition and justify its selection, and the argument against other word-internal constituents, throughout the section. Morphological, semantic, phonological, and external evidence in support of the stem is discussed in Section 3.1. In Section 3.2, the structural properties of the stem in verbs is presented, and in Section 3.3, the structural properties of the stem in nouns and adjectives is presented.

3.1. Motivation for the stem. Both the claim that words are morphological units in Spanish and the claim that an additional morphological element exists below the level of the word are consistent with a wide diversity of treatments of Spanish morphology. Evidence for the grammatical word as a constituent is presented in Section 2, and evidence for structure below the level of the word is discussed in the present section. Such evidence includes the following: intra-lexeme paradigmatic relationships, cross-lexeme relationships, and morpho-phonological effects. The patterns of the language, as well as conventional definitions of the stem, motivate the claim that inflectional exponents occur outside of the stem, a claim that will be elaborated upon in Section 3.1.4.

3.1.1. Intra-lexeme paradigmatic relationships. One of the important characteristics of Spanish is its multi-faceted inflectional system, whereby one lexeme may consist of dozens of grammatical words that can be organized into paradigms. According to Pérez Saldanya (2012, p.
a verbal lexeme exhibits 62 different forms counting only the simple forms and up to 118 including the compound forms. This richness is particularly characteristic of verbs, though nouns and adjectives also participate in paradigms. For any given set of paradigms of a lexeme, a particular element – the stem – serves as the formal anchor for the various items within the lexeme.

Under a learning-based approach, we can start by observing that among the multitude of surface words that we encounter, certain words have a very close semantic and phonological relationship to other words, such as those shown in (183).

(183)  a. hablé ‘I spoke’  
       b. hablaste ‘you spoke’  
       c. habló ‘he/she spoke’  
       d. hablamos ‘we spoke’  
       e. hablan ‘they spoke’

What (183) shows is an inflectional paradigm, in this case for the lexeme corresponding to the citation form hablar ‘to speak’ in the preterit indicative. Since such relationships are widespread in the language, speakers are likely to recognize that inflectionally related words are organized into paradigms. In addition to a common semantic core, all the members of the paradigm in (183) also share a common form, in this case habl-. This form, in fact, is present throughout all paradigms associated with this lexeme, as can be seen in (184).

(184)  a. hablo ‘I speak’  
       b. hablabas ‘I used to speak’  
       c. hablarás ‘I will speak’

What the forms in (183) and (184) have in common is the semantic core SPEAK and phonological form habl-, the unit that corresponds to the stem. Given that a particular lexeme, such as that of hablar in (183) and (184), can be populated by 62 different simple forms (Pérez Saldanya 2012, p. 227), this offers a great deal of reinforcement for the stem.
Moreover, when one generalizes the structure of a given cell in a paradigm – a generalization that would allow learners to recognize the grammatical features of novel forms or produce the appropriate form for a given lexeme – one makes reference to the stem in one’s generalization. For example, a learner that observes the forms in (185) can posit the existence of a structure symbolized as in (186).

(185)  a. hablaste ‘you (sg.) spoke’  
b. mandaste ‘you (sg.) sent’  
c. cerraste ‘you (sg.) closed’  
d. comunicaste ‘you (sg.) communicated’

(186)  \( Xaste = 2SG.PST \) of lexeme associated with \( X \)

In the set of words in (185), the form \( -aste \) is the part of the word that indicates that the word belongs to the 2SG cell of the preterit paradigm. Thus, \( -aste \) indicates membership in a particular cell of a particular paradigm. Lexeme membership is indicated by the remnant of the word, which corresponds to the stem. Both elements must be present in order for the generalization to be drawn. After all, a form such as \( pastel \) ‘cake’ does not bear the grammatical feature of 2SG.PST simply by virtue of containing the sequence \( -aste \). As represented in (186), the sequence of sounds \( -aste \) corresponds to 2SG.PST only when it follows a stem. The stem, therefore, is a necessary variable in paradigm construction. As a result, verbal paradigms in particular serve as evidence for the stem, which would be expected to be salient to learners who consider the relationship of multiple forms within an inflectional paradigm.

Though the paradigms involving nouns and adjectives (discussed in greater detail in Section 3.3) are smaller than those of verbs, they too motivate the stem as element that unifies the forms within a paradigm. This is illustrated in (187) and (188).

(187)  a. doctor ‘doctor’  
b. doctor-a ‘doctor (female)’  
c. doctor-es ‘doctors’
d. doctor-as ‘doctors (female)’

(188)  a. bonit-o ‘pretty (masc. sing.)
       b. bonit-a ‘pretty (fem. sing.)
       c. bonit-os ‘pretty (masc. pl.)
       d. bonit-as ‘pretty (fem. pl.)

As these two lexemes demonstrate, nouns and adjectives can also be organized around paradigms, based on the features of gender and number. As with verbs, a common element, the stem, underlies all the forms within the paradigm (doctor- in (187) and bonit- (188)). Therefore, in the case both of verbs and of nouns and adjectives, intra-lexeme relationships motivate the conceptualization of the stem as the anchor in the inflectional system, which will serve as the basis for the argument that inflection occurs outside the domain of the stem, elaborated further in Section 3.2.1.

3.1.2. Cross-lexeme relationships. In addition to serving as the connection between forms within a lexeme, stems also serve to connect words across lexemes in Spanish, functioning similarly to the stem sets of Navajo or the roots of Hebrew. As with those two languages, semantic drift over time has the potential to make synchronic connections less salient in Spanish; however, speakers are also certainly likely to encounter many strong synchronic connections among lexemes that are linked by a stem, connections which would also serve as evidence for the unit.

The kinds of lexemes that can be connected via a stem include all types of content words (i.e., nouns, verbs, adjectives, adverbs), as illustrated in (189).

(189)  a. como ‘I eat’
       b. comiendo ‘eating’
       c. comida ‘food’
       d. comelón ‘big eater’
       e. comedor ‘dining room table’

All the words in this set have a common form, com-, and, to varying extents, are related to the common meaning of eat. Though the point made in Section 2.2.1 is worth reiterating – the semantic core of eat does not apply in the same way to all of the words in (189) since, for example,
the meaning of *comedor* in (189e) is not predictably decomposable into its component parts – the stem does serve to connect formally and semantically related lexemes. Thus, though the stem is not as reliable synchronically as the word as the locus of semantic features, plenty of patterns in Spanish similar to those in (189) make the stem salient to learners of the language as a relevant connector among different lexemes.

### 3.1.3. Morpho-phonological effects.

Moreover, the stem is also relevant with regard to morpho-phonological patterns. Two such patterns are monophthong/diphthong alternations, which take the stem as its domain, and insertions, which occur at stem boundaries.

With regard to monophthong/diphthong alternations, this process was introduced in Section 1.2. To briefly summarize, monophthong/diphthong alternations refer to the fact that certain morphologically related words exhibit an alternation between mid-vowels, *e* and *o*, in unstressed position and their diphthong counterparts, *ie* and *ue*, in stressed position (e.g., *sentir* ~ *siento*, *dormir* ~ *duermo*). Given the forms of the stem, these lexemes can be described as either exhibiting two stems or exhibiting allomorphs of a common stem (cf. a similar point in Hebrew in Section 3.1.2.1 in Chapter 2). In either case, these patterns take the stem as the domain, as illustrated with (190), with bold indicating stressed syllable.

(190) a. *pensar* ‘to think’
   b. *pienso* ‘I think’
   c. *pensé* ‘I thought’
   d. *piensé*

In this set of words, for example, we can observe that this lexeme participates in the expected alternation, as evidenced by (190a) and (190b), whereby the stressed stem shows a diphthong but the unstressed stem shows a monophthong. Notably, though, it is not the word that is the domain of the alternation but rather the stem, since (190c) shows a stressed mid vowel that does not exhibit the alternation. Occurring outside of the domain of the stem, inflectional elements would not be
expected to alternate, supporting the generalization that monophthong/diphthong alternations are
relevant for the stem and not for word as a whole.

The stem is also relevant in terms of morpho-phonological processes that affect consonant
alternations or epenthesis processes that can occur at stem boundaries. Eddington (2012) describes
how certain morphologically related lexemes exhibit these kinds of morpho-phonological
processes both at the beginning and the end of the stem. As with the monophthong/diphthong
alternations, these processes can also be seen as a type of fixed allomorphy that is not productive.
If viewed as a synchronic process, then it is notable that the locus of these processes is stem-final
position, examples of which can be seen in (191) and (192). If viewed as allomorphs, then we
would refer to the stem as the domain of allomorphy.31

(191)  a. *inyectar* [injek'tar] ‘to inject’
       b. *inyección* [injeksjón] ‘injection’

(192)  a. *distinguir* [distin'guir] ‘to distinguish’
       b. *distinción* [distinsjón] ‘distinction’

The pair of words in (191) shows an alternation between the voiceless alveolar stop t and the
voiceless alveolar fricative s, and the pair in (192) shows an alternation between the voiced velar
stop g and the voiceless alveolar fricative s. Eddington (2004, p. 46) subsumes both processes
under the category of velar and coronal softening. Neither process can be described as a general
phonological process (e.g., coronal softening is not triggered in words such as tío ‘uncle’ or
tiempo ‘time’) and descriptions of each must make reference to morphological structure.
Specifically, these descriptions must make reference to the final edge of the stem. If viewed as
allomorphs, then it is the stem that is the domain of allomorphy.

31 As an extreme case of allomorphy, suppletion also offers evidence for the stem, and, some cases, for
the grammatical word. In the case of ser ‘to be’, we can see suppletive stems (e.g., *era* ‘I was’, *éramos*
‘we were’, *eras* ‘you were’, etc., where *er-* is the stem) and suppletive words (e.g., *soy* ‘I am’ *somos* ‘we
are’, *es* ‘he/she/it is’).
In addition, other morpho-phonological processes also mark the final edge of the stem, including palatalization in (193) and (194), as well as more idiosyncratic alternations such as that of (195).

(193)  
a. *don* ‘Mr. (term of respect for a man)’
b. *doña* ‘Mrs.’ (term of respect for a woman)’

(194)  
a. *aquel* ‘that (masc.)’
b. *aquella* [akeja] ‘that (fem.)’

(195)  
a. *conocer* [konoser] ‘to know’
b. *conozco* [konosko] ‘I know’

The pair of words in (193) shows an alternation between an alveolar nasal, \( n \), and a palatal nasal, \( ñ \) (orthographic \( ñ \)), and the pair in (194) shows an alternation between an alveolar lateral, \( l \), and a palatal glide, \( j \) (orthographic \( ll \)). In (195), the epenthetic \( k \) marks only the 1SG.PRS form of the lexeme associated with *conocer*. As with the multiple alternations in (191) through (194), its locus is the final edge of the stem, or, depending on one’s analysis, the domain of allomorphy is the stem.

The initial edge of the stem is also marked by morpho-phonological processes that have fossilized in the synchronic grammar. Though these are less common among the patterns of the language and less frequently discussed (Eddington 2012, p. 193), evidence does exist for processes that refer to the initial boundary of the stem. One such alternation is offered in (196).

(196)  
a. *humo* [umo] ‘smoke’
b. *fumar* ‘to smoke’

The alternation in this example between \( \emptyset \) in (196a) and \( f \) in (196b) can be explained diachronically (with the silent orthographic \( h \) representative of an intermediate stage in the sound change). A speaker who notes the morphological relationship between the lexemes and who attends to the alternate forms would note that the initial stem boundary is marked. Taken together
with the patterns that make reference to the stem as a domain and to its final boundary as a locus of alternations, we can conclude that the stem as a morphological constituent is motivated by various morpho-phonological patterns in Spanish.

3.1.4. Stem as remnant of inflection. Based on the patterns described above and based on conventional definitions of the stem, we can describe the stem as an element that does not include inflectional features. This is consistent with the treatment of the stem in derivational approaches. In those approaches, the stem is considered the level that occurs before inflectional processes apply. Since a learning-based approach does not represent grammatical words as the culmination of morphological processes but rather as the starting point of analysis, the term pre-inflection is not particularly relevant. However, the same conclusion is reached for both approaches: Inflection is outside of the stem.

This was demonstrated in Section 3.1, in which it was shown that the stem is the anchor of the inflectional system (and serves as the anchor precisely because it does not contain inflectional information that characterizes the cells in a paradigm) and that the morpho-phonological processes that mark the final boundary of the stem separate exponents of semantic features from exponents of inflectional features. In addition, though patterns such as mid vowel/diphthong alternations are related to changes in inflection, it is not the inflection itself that causes the alternation but rather the phonological changes associated with the inflection (i.e., change in which a different syllable is stressed). All of this allows us to conclude that one of the properties of the stem is that it does not reflect any inflectional exponents.

3.2. Word-internal structure of verbs. The previous section demonstrates that, in order to describe a variety of patterns in Spanish, it is necessary to refer to a sub-word constituent, the stem. However, as suggested by the differences in the paradigms of verbs on the one hand and
those of nominals on the other (cf. Section 3.1.1), the nature of the stem is distinct for different lexical classes. This section focuses on the characteristics of word-internal structure for verbs, and Section 3.2 focuses on the structures of nominals.

3.2.1. Theme vowels as inflectional. Given that inflectional exponents are not part of the domain of the stem, stems are straightforwardly identified in cases where inflectional exponents and the stem are clearly distinguished. Thus, com- is straightforwardly the stem associated with EAT as in (189) and habl- with SPEAK as in (183) and (184). In these examples, the forms identified as the stem are the remnant of the word after inflectional exponents have been accounted for. One key in determining whether an element is part of the stem, therefore, is to determine whether that element is inflectional. If it is, then it is not part of the stem. As mentioned in Section 1.2, certain elements of words, namely theme vowels, are not straightforwardly demarcated as inflectional or derivational. As supported below, the claim of this dissertation is that verbal theme vowels in Spanish are indeed inflectional, and they are therefore outside of the stem.

The motivation for positing theme vowels as a construct in Spanish comes primarily from the verbal system, though the construct has since been expanded to apply to nouns and adjectives as well. Theme vowels for nominals which were introduced in Section 1.2 (as what Harris (1991) referred to as word markers), are discussed further in Section 3.3.1. With regard to verbs, theme vowels are elements that do not add any semantic features to words and, in addition, do not correspond to grammatical features. The set of words in (197) serve as an illustration.

(197) a. hablar ‘to speak’  
b. comer ‘to eat’  
c. vivir ‘to live’

The words in this set are infinitives, and the theme vowels are a, e, and i, in the three examples, respectively. One question that can be asked about the forms in (197) is what constitutes the
inflection that indicates that these forms are infinitives. Analyses assigned by generative models exemplified by Bermúdez-Otero (2013) treat the \( r \) as the \( \text{INF} \) marker and the theme vowel as a distinct, intermediary form occurring between the semantic core and the inflected word. In such an account, therefore, the theme vowel may be considered derivational since its addition is a necessary prerequisite for inflection. An alternative analysis is to represent the grammatical feature of \( \text{INF} \) as the exponent \( \text{Vr} \), where \( V \) may be \( a, e, \) or \( i \). In this account, the theme vowel is part of the inflectional exponent. It is not a distinct entity but rather is reflective of inflectional affix allomorphy. The latter analysis is the one adopted by this dissertation.

In a derivational model such as that of Bermúdez-Otero (2013), roots become stems by the addition of a theme vowel (which might then be deleted at a later stage of the derivation), and stems are a necessary stage before inflectional processes apply to yield a surface grammatical word. (Note the difference in use of the term \( \text{stem} \) from that adopted in this chapter) Thus, the structure of a form such as \( \text{hablar} \) ‘to speak’ would be represented as in (198).

\[
(198) \quad [\text{word} \ [\text{stem} \ [\text{root} \ habl] \ a] \ r ]
\]

Therefore, theme vowels are an integral part of the system in such a model. Because this approach is relatively tolerant of structures that are not necessarily evident on the surface, theme vowels do not have to be abundant in the surface patterns of the language in order for one to posit their existence in all verbs.\(^{32}\)

In contrast, the argument of this dissertation is that theme vowels are subsumed in the inflectional system, given their connection to canonical inflectional elements that are arranged into inflectional paradigms. A primary motivation for treating theme vowels as inflectional exponents

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\(^{32}\) The discussion of theme vowels in Spanish illustrates a case of Spencer’s (2012) Segmentation Problem, since theme vowels neither express canonical derivational nor inflectional properties and the language does not provide compelling cues for their analysis.
is the fact that their primary role is not altering the semantics or the argument structure of the verb (as would be expected if they were derivational). Instead, they serve to identify the conjugation class of the verb. The role of the theme vowel as an indicator of conjugation class can be seen by comparing the INF forms in (197) to their 3PL.PRS counterparts in (199) and their SBJV counterparts in (200).

(199)  a. hablamos ‘we speak’  
       b. comemos ‘we eat’  
       c. vivimos ‘we live’

(200)  a. habe ‘(that) I speak’  
       b. coma ‘(that) I eat’  
       c. viva ‘(that) I live’

The same theme vowels are present in the matched pairs in (197) and (199), occurring in all cases after the stems habl-, com-, and viv-. Even in verbal forms in which a theme vowel is not present, a relationship to a theme vowel can be determined. For example, the forms in (200) do not reflect the theme vowels the way their counterparts in (197) and (199) do. However, the identity of the subjunctive exponents in (200) is correlated to the theme vowels associated with those lexemes. For example, infinitives with $a$ are associated with subjunctives with $e$, and infinitives with $e$ and $i$ are associated with subjunctives with $a$. The stronger indicator of the conjugation class of a given verb is its theme vowel.

As noted above, another piece of evidence in support of treating theme vowels as inflectional rather than derivational is the fact that no semantic or functional properties are associated with theme vowels or conjugation classes. If conjugation class did correlate with grammatical features, then the argument could be made that theme vowels play both a derivational and an inflectional role. This, in fact, is the case in Hebrew, where certain binyanim are associated with derivational patterns (Aronoff 1994) and in Navajo, where certain conjugation classes can be
associated to aspectual features (Young 2000). In Spanish, however, conjugation class is independent of any semantic or functional associations. Taking a stem and changing its theme vowel (and therefore its conjugation class) does not lead to a related lexeme. All instances of common stems with theme vowels, such as (201), are homonymous.

\[(201)\]
\[
a. \textit{sentir} \ ‘\text{to feel}’ \\
b. \textit{sentar} \ ‘\text{to sit}’
\]

This pair of words is identical in form except for the theme vowel. Their stems, therefore, have a common form. However, the \textit{sent-} of each of the two words does not have a semantic relationship, either synchronically or historically. The theme vowel’s only function is to point to the conjugation class of each of the words.

In short, from a learning-based perspective, the inflectional patterns of the language offer evidence that theme vowels play a role in the inflectional system rather than the derivational system. Since, as discussed in Section 3.2.1, inflectional information occurs outside of the stem, the methodology for operationalizing a stem is the removal of all inflectional elements. For verbs, this includes the removal of theme vowels, which should be considered as inflectional elements.

\textbf{3.2.2. No additional domains motivated.} If theme vowels are inflectional, as argued above, then their removal, along with that of other inflectional information, from a verb yields a stem. Consequently, the stems in verbs such as \textit{hablaríamos} ‘we would speak’, \textit{comieron} ‘they ate’, and \textit{vivir} ‘to live’ are \textit{habl-}, \textit{com-}, and \textit{viv-}, respectively. Referring to this unit as the stem is consistent with most general (i.e., non-theoretical) treatments (e.g., de Bruyne 1995; Green 1998; Hualde 2005) though, in generative approaches, such a unit has also been called a root (e.g., Bermúdez-Otero 2013). Once one level of structure is determined for Spanish, we can then ask whether an additional level of structure is also motivated. In principle, there could be a domain smaller than that of \textit{habl-}, \textit{com-}, and \textit{viv-}. However, such an analysis has not been posited by anyone and no
evidence has been found in the course of the present investigation in support of a conclusion that an additional level exists below the stem. With respect to a level above the stem, though, such a possibility merits further investigation, especially given that certain models (e.g., Harris 1991; Bermúdez-Otero 2013) posit at least one level above the level of elements such as habl-, com-, and viv-

The root-stem-word analysis discussed in Section 2.1 and exemplified using Bermúdez-Otero’s (2013) model separates the theme vowel from other inflectional exponents. It was argued in Section 3.2.1 that the theme vowel should be viewed as an inflectional element and not a derivational element. It is possible, though, that a level exists that includes the theme vowel but not other inflectional information. If such a level is motivated, then we could posit two different levels of inflection, necessitating a domain above the stem and below the word (and supporting a change in terminology for its being called a stem in this chapter). In order to draw this conclusion, we should see evidence that theme vowels can be separated from other inflectional elements.

One piece of evidence that would support the separation of the theme vowel from other inflectional exponents would be a unique and consistent function for the theme vowel. As presented in Section 3.2.1, the primary role of the theme vowel is as a predictor of conjugation class. This role, however, is neither consistent across all forms nor is it unique to theme vowels. To begin with, a theme vowel does not appear in an all paradigms associated with a given lexeme, as illustrated in (202).

(202)  a. hablo ‘I speak’
       b. como ‘I eat’
       c. vivo ‘I live’

The set of words in (202) contains the 1SG.PRS counterparts of the set of words in (197), (199), and (200). In contrast to the INF forms (197) and the 3PL.PRS of (199), the 1SG.PRS forms of (202) do
not show any evidence of a theme vowel. The inflectional exponent is straightforwardly -o in all three cases. Certainly, one could argue that the theme vowels are present underlyingly and are deleted. One problem with this, though, is that such an analysis is based more on the desire for a uniform analysis of grammatical words with theme vowels and those without rather than on surface evidence. In addition, such a claim would require positing relatively idiosyncratic deletion rules since theme vowels appear in some parts of the paradigm and not others, without a clear phonological motivation for this. For instance, one might initially be tempted to argue that the theme vowel is deleted when adjacent to another vowel to account for the forms in (202). However, other patterns demonstrate that theme vowels can indeed occur adjacent to other vowels, as in the two examples in (203), which contrast with (202c).

(203)  a. vivió ‘he/she lived (preterit)’
       b. vivía ‘he/she lived (imperfect)’

In addition, comparing (203a) and (203b) further shows that theme vowels can occur with or without stress. Therefore, the presence or absence of a theme vowel for a given part of a paradigm is not phonologically motivated. Indeed, whether or not a form of a verb has a theme vowel is relatively idiosyncratic. In verbal forms such as the infinitives in (197), a theme vowel is an integral part of the inflectional form. In other verbal forms, such as those of the 1SG.PRS forms in (202), the theme vowel plays no role in the form.

Moreover, theme vowels are not the only elements that can serve as predictors of conjugation class membership. For example, though membership in what is commonly referred to as the -ar conjugation class is indeed indicated by the presence of a theme vowel in the infinitive form of a verb, as in hablar in (197a), membership in that conjugation class is also indicated by other exponents. One such exponent that was mentioned previously is -e directly after the stem in
the subjunctive form, as in (200a). Another perfectly reliable indicator of that conjugation class is exhibiting an imperfect form with -aba directly after the stem, as in (204a).

(204)  a. hablaba ‘I used to speak’  
b. comía ‘I used to eat’  
c. vivía ‘I used to live’

This particular form is found only in the -ar conjugation class, and contrasts with the -ía form that corresponds to the other two conjugation classes. Therefore, the imperfect exponent -aba is just as much an indicator of the -ar conjugational class as is the theme vowel a in the infinitive (what, in the classical tradition would be treated as a principal part, cf. J.P. Blevins 2016). Thus, the role of indicator of conjugational class is played by several kinds of morphological exponents. Though the theme vowel is more widespread throughout the paradigm than other elements that predict conjugation class, it is not different in type from other inflectional exponents.

Another observation that supports the notion that theme vowels are subsumed under the broad category of inflection with no need to posit a significant distinction between theme vowels and other inflectional exponents is the fact that no phonological or morphological processes or constraints make reference to a boundary between theme vowels and other inflectional exponents. In contrast to the boundary effects described in Section 3.1.3 that occur at the final edge of the stem or the phonotactic restrictions of domain edges in Navajo (cf. Sections 3.2.1 and 3.2.2 in Chapter 3), no such patterns can be found that indicate a domain boundary following the theme vowel.

In sum, the morphological patterns of Spanish suggest that, on the one hand, theme vowels in verbs are independent of the lexical core (i.e., the stem) and that, on the other hand, they are not distinct from other types of inflectional exponents. Therefore, the evidence presented so far
suggests that no other morphological level apart from the stem is strongly motivated as a basic constituent of Spanish verbs.

3.2.3. Interaction of stem with derivational elements. The argument that theme vowels are inflectional informs the conclusion that in verbs such as hablar ‘to speak’, comer ‘to eat’, and vivir ‘to eat’, only two levels of structure are motivated: the stems habl-, com-, and viv- and the surface grammatical words. The majority of verbs exhibit this kind of structure; therefore, the majority of words exhibit only two levels of structure. In verbs of this type, a learner would not be motivated to generalize further internal structure. However, certain verbs, those that are related to other verbs via derivation, complicate the two-level relationship. As discussed below, though some may argue that such verbs motivate an additional level of structure, positing another constituent is not necessary in describing the patterns involved with derivationally complex verbs.

The types of verbs that might motivate additional structure would be those that seem clearly connected to other lexemes via derivation. The term derivation as used in this dissertation refers to relationships across lexemes, without necessarily implying that a derived lexeme must be built from a more basic lexeme. Thus, in English, atrocity and atrocious can be said to be reflect a cross-lexeme, derivational relationship without necessitating a claim that one is derived from another or from a third abstract form. From the perspective of the learner, derivational relationships are those in which two distinct lexemes bear compelling formal and semantic resemblances. Such resemblances would indeed be strong motivation for generalizing a representational connection between the lexemes. The question is whether such a representational connection would occur via a shared constituent.
In Spanish, derivationally-related lexemes typically exhibit derivational morphology in the form of affixes. Examples of pairs of verbs that are derivationally-related are offered in (205), (206), and (207).

(205) a. abrir ‘to open’
     b. reabrir ‘to reopen’

(206) a. conectar ‘to connect’
     b. desconectar ‘to disconnect’

(207) a. oscuro ‘dark’
     b. oscurecer ‘to darken’

In each of these pairs, the two forms clearly share a common phonological form and a common semantic core. A learner would be strongly motivated to view the forms in each pair as morphologically related. In all three cases, the first member of each pair is likely viewed as the more basic of the two, reflecting an intuition that generally accords with the historical relationship and that is encapsulated in typical linguistic descriptions (e.g., in (207) the second form is called a deadjectival verb since it is said to come from the first form, which is an adjective). In some linguistic analyses, the former is referred to as the basic and the latter as the derived form (e.g., Bybee 1995). The term that will be used in this dissertation for the latter is complex, which is a notion that will be more formally explored in Section 3.3.2.

With regard to the internal structure of the complex forms, if one examines them on their own terms, without reference to the related basic forms, then the stem in each is straightforwardly determined. If stems are the elements that serve as the anchors of the paradigms of the lexeme, then the stems in the forms in (205b), (206b), and (207b) are reabr-, desconect-, and oscurec-, respectively. Thus, a word such as reabrir has a different stem from that of abrir since each lexeme is associated with a different set of paradigms. In order to more fully understand the patterns of the language, though, two observations should be accounted for: the fact that forms such as re-
and des- are likely to be recognized as grammatically relevant elements and the fact that words in (205b) and (206b) are clearly related to their counterparts in (205a) and (206a). As discussed in greater detail in Section 2.2.1, forms such as re- and des- are typically associated with grammatical features (repetitive and reversative aspect, respectively), which are potentially reinforced as distinct elements by phonetic features such as secondary stress. Though exceptions can be found, learners are likely to recognize that elements such as these tend to contribute relatively reliable semantic information to the words they are associated with. For instance, reabrir can be straightforwardly analyzed as OPEN plus RPT. Given this, a strong relationship between reabrir and abrir is likely to be evident to most speakers.

The question, though, is whether this relationship is best represented via a common element, such as abr- in the case of reabrir and abrir, which is shared by both forms. One reason to support an analysis in which the two lexemes are connected via abr- is the fact that this is the only form that is shared by all paradigms of the two lexemes. Following the conventions of other morphological analyses involving formal constituents shared by morphologically related lexemes, we can call the element abr- a root (though doing so would introduce the complication that the root would be identical to a stem, a point to be developed further in Section 3.3.2.2). If we adopt an analysis that treats the root as a constituent, then the structure of a word such as reabrir might be rendered as in (208), which treats abr- as a root, in contrast with the terminology adopted in this dissertation.

(208) \[ \text{word} \left[ \text{stem} \left[ \text{root} \ abr \right] \ ir \right] \]

Unlike the root-stem-analysis of (198), which follows that of Bermúdez-Otero (2013), the analysis in (208) does not separate the theme vowel from other inflectional exponents. It does, however, separate the derivational affix re- from the semantic core abr-, thereby generating a new level of
structure. Given that re- is relatively reliable as form-meaning pairing, and that a form such as abr-
is motivated as an independent constituent for a word such as abrir, this analysis is certainly viable.

A few observations, however, speak against an adoption of an analysis in which a root is necessary as an additional constituent in the morphological hierarchy. For one, such an analysis is not necessary. If we wish to draw the connection between abrir and reabrir, it is not clear that the best way to do so is by invoking a relatively abstract element such as a root. From a learning-based perspective, connections between forms are more clearly motivated by surface relationships (cf. Section 2.4 and Section 4.1 in Chapter 1). The generalization of a constituent would be motivated only if there is evidence that this constituent is useful in describing linguistic patterns in the language. A root is in fact a useful way of describing the connection between derivationally related lexemes. However, the putative root in Spanish (as distinct from what has already been proposed to be a stem in the present analysis) does not participate in any other linguistic patterns. In contrast to the case of a Hebrew root (cf. Chapter 2), the Spanish root does not participate in any other morphological processes, phonological constraints, or other linguistic patterns that cannot otherwise be attributed to a stem.

In fact, the distinction between a root and a stem is not readily determined. In the analysis that treats abr- as a stem in abrir following Sections 3.2.1 and 3.2.2 and as a root in reabrir as in (208), the identity of the form abr- is strictly determined by whether we are referring to a simple or a complex verb. Thus, in a form where it is not clear whether the word is simple or complex, determining whether one should posit a root or not is not straightforward. For example, as mentioned in Section 2.2.1, a word such as representar ‘to represent’ in (168a) is not straightforwardly analyzed as a complex form since it is not straightforwardly decomposed in re-RPT and presentar ‘to present’, a point supported by the fact that such re- in this word is less likely
to bear secondary stress than \textit{re-} in words such as \textit{reabrir}. Therefore, the form \textit{present-} may or may not be a root in \textit{representar}, though it would be a stem in \textit{presentar}. If it is analyzed as a root in \textit{representar}, then we would have to consider whether it occurs as a root in \textit{presentar}, a root that has a more abstract meaning than does the stem \textit{present-} in \textit{presentar}. Analyzing a root \textit{present-} in \textit{presentar} would then motivate us to claim that the structure of \textit{presentar} is as in (209).

\begin{equation}
\text{(209) } [\text{word } \text{stem } \text{re[root present]} ] \text{ ar }]
\end{equation}

Such an analysis would bring it in line with the analysis of \textit{reabrir} in (208). However, it would also necessitate the positing of a zero-morph, a claim that is not supported by independent evidence, and which would need to be done for most verbs in the language. The primary motivation for such an analysis, which creates more complex theoretical machinery, is a theory-internal desire to establish a constituent structure that applies to all the lexical words in the language.

Moreover, though speakers are likely to construct a mechanism whereby a new verb is generated via a derivational affix added to an existing verb, it is not necessary to do so via a root. In other words, a learner who understands that \textit{re-} corresponds to RPT would also readily be able to apply that knowledge to a form such as \textit{cliqué} [klike] ‘I clicked (as on a website)’ (a new vernacular form whose source is English \textit{to click}) to produce the novel form \textit{recliqué} ‘I reclicked’. Certainly, one can argue that this process proceeds by extraction of a root \textit{clic-} from \textit{clicar} [klikar] to which the affix \textit{re-} is added to make the stem \textit{clic-}, which is then inflected to yield the surface form. However, it is equally likely that this process proceeds via the surface word itself, as presented in, for example, connectionist models (e.g., Bybee 1995). In other words, the \textit{re-} may be argued to apply directly to \textit{cliqué}. Ultimately, the question as to whether a new word is generated via an abstract constituent or via a more concrete surface word is an empirical question that can be answered with psycholinguistic experiments that measure how speakers process word
formation. For the purposes of the present study, though, the main point to be made is that a root is not necessary to describe relationships among derivationally related words.

Therefore, a root as distinct from a stem is not strongly motivated by the linguistic patterns of Spanish. What has been termed a root in other models is called a stem in the present learning-based model, and compelling evidence for additional levels beyond this unit has not been identified for Spanish, though a distinction between simple and complex stems seems to be relevant, as will be discussed further in Section 3.3.2.2 when the notion of complexity is introduced.

3.3. Word-internal structure of nominals. The previous section described the structure of verbs: The word-internal constituent posited for verbs is the stem, with theme vowels argued to be inflectional. Derivational elements present some complications, though derivational patterns do not strongly motivate the addition of another word-internal constituent. The present section presents a similar analysis of nominal elements (i.e., nouns, adjectives, and adverbs): The stem is the only word-internal constituent that is strongly motivated. In addition, this section will elaborate on the notion of complexity introduced above.

3.3.1. Certain word markers as inflectional. In the case of verbs, all theme vowels are treated as inflectional elements. This claim is supported by the fact that theme vowels are not common to all cells of a paradigm (i.e., they are not part of the anchors of the paradigm) but instead are strongly associated with other exponents that clearly indicate inflectional properties (e.g., tense, person, number). As a result, theme vowels in verbs do not participate independently of inflectional relationships and are therefore outside of the stem. In the case of nominals, the same may be argued about certain elements that can similarly be treated as verbal theme vowels. Consequently, in the case of these kinds of nominals, their structure resembles that of verbs.
Though the notion of *theme vowel* is primarily motivated by the verbal system, the concept has also been applied to the nominal system (e.g., Bermúdez-Otero 2013), as discussed in Section 1.2. Harris (1991) refers to these elements not as theme vowels but rather as word markers. Theme vowels in verbs resemble theme vowels/word markers in nominals; however, given that the differences between verbs and nominals are significant for the arguments of this dissertation, the term *word marker* will be used for nominals, with the term *theme vowel* reserved for verbs. The primary resemblance between theme vowels and word markers is that neither contributes semantic features to the lexical core and that the choice of one theme vowel or word marker over another is relatively idiosyncratic. Thus, the difference between *sentir* ‘to feel’ and *sentar* ‘to sit’ (introduced in (201)) is indeed the theme vowel; however, the choice of one theme vowel over another predicts the conjugation class of the lexeme but no evidence has been found in Spanish that connects this choice to the semantic or functional features of the lexeme. The same point is less clearly made with word markers in nouns, since the presence of one word marker over another can sometimes suggest biological sex and, typically, grammatical gender, as exemplified in (210) and (211).

(210)  
\begin{itemize}
  \item a. *gato* ‘tomcat’
  \item b. *gata* ‘female cat’
\end{itemize}

(211)  
\begin{itemize}
  \item a. *el libro* ‘the book’
  \item b. *la mesa* ‘the table’
\end{itemize}

In (210), the word marker -o is associated with the male sex and -a with female sex. In (211), those same word markers are associated with grammatical gender, as can be seen by the accompanying article, which agrees in grammatical gender with its associated noun. The associations of gender with these two work markers are prevalent in the language but not categorical (Harris 1991, 1992), as can be seen in (212).

(212)  
\begin{itemize}
  \item a. *el día* ‘the day’
  \item b. *la mano* ‘the hand’
\end{itemize}
In this set of examples, unlike those in (210) and (211), the word marker -a is not associated with feminine grammatical gender in (212a), nor -o with masculine grammatical gender in (212b). Overall, then, some word markers are as arbitrary as theme vowels in verbs and some are associated with semantic or functional features.

The analysis of nominal word markers that are reliably associated with functional features is the same as that of theme vowels in verbs, and therefore the structure of the two types of word classes is the same. Such nominals are those that can be regularly organized into inflectional paradigms, as exemplified by the adjectival lexeme in (213).

(213)  a. bello ‘beautiful (masc. sg.)’  
       b. bella ‘beautiful (fem. sg.)’  
       c. bellos ‘beautiful (masc. pl.)’  
       d. bellas ‘beautiful (fem. pl.)’

As with the verbs in Section 3.2.1, the nominal lexeme in (213) has forms that are organized into a paradigm based on gender and number features. The formal anchor to this paradigm is the form bell-, which, following the treatment of such elements in verbs, is also considered a stem. Many adjectives participate in patterns similar to that of (213). To a lesser extent, certain nouns can also be organized into paradigms in a similar way, as in (214).

(214)  a. niñ-o ‘boy’  
       b. niñ-a ‘girl’  
       c. niñ-os ‘boys (or children)’  
       d. niñ-as ‘girls’

As with the adjective paradigm of (213), a stem can be readily identified in the noun paradigm of (214), namely niñ-. In both examples, the stem of the lexeme also participates in cross-lexeme relationships. For instance, the stem bell- of (213) is also found in belleza ‘beauty’, and the stem niñ- is also found in niñez ‘childhood’ and niñera ‘nanny’. The analysis of nominals in which inflectional features can be readily identified and organized into paradigms, therefore, is the same.
as the analysis of verbs in Section 3.2.1: Only one word-internal constituent, the stem, is
generalizable from the patterns involved with these words such as these.

### 3.3.2. Other nominal exponents.

Some types of nominals in Spanish, then, have a straightforward analysis along the lines of the verbs in the language. However, other types of nominals present additional complications. An issue that should be addressed when considering the internal morphological structure of nominals involves word markers that cannot readily be analyzed as inflectional or derivational affixes (an issue raised in Section 3.2.3 for derivational affixes in verbs). One solution to be presented involves making a distinction between basic and complex constituents, where complex constituents are those in which another constituent of the same type can be identified (e.g., where a word can be identified within another word, or a stem within another stem).

#### 3.3.2.1. Non-inflectional word markers.

Not all word markers can be readily identified as inflectional. Many word markers do not play a grammatical or semantic role in words. Harris (1991) observes, “The primary morphological property of word markers is that their appearance marks a derivationally and inflectionally complete word” (p. 30). Thus, word markers as a class are an indispensable component of words, yet they do not necessarily have a readily identifiable semantic or grammatical role (at least not one that is not motivated by theory-internal considerations). Though he leaves open the possibility for more, Harris offers at least seven classes of word markers: -o, -a, -u, -i, -s, -e, -Vs. All word markers are vowels, with the exception of -s, which can be a word marker in and of itself or in conjunction with a vowel. Notably, Harris further posits that certain words (e.g., sol ‘sun’, mártir ‘martyr’) do not have word markers. Given this diversity of expression of word markers and their lack of a reliable semantic or grammatical
function, we would want to be cautious under a learning-based approach about claiming that word markers are an integral and pervasive component of the morphological system of Spanish.

The primary goal of the present analysis is not to determine the precise nature of word markers, but rather to ascertain whether or not they motivate additional constituency. To this end, one question that should be answered is whether they should be associated with the stem. As argued in Section 3.3.1, word markers that reflect inflectional features and participate in paradigms are not part of the stem and they also do not motivate an intermediate constituent between the stem and grammatical word. In the case of word markers that are not clearly inflectional, learners would need evidence to posit that a surface word possesses internal structure. With regard to words without word markers, (e.g., árbol in (215)), such evidence is lacking. A similar claim can be made for words with non-inflectional word markers, such as (216).

\[
\begin{align*}
(215) & \quad \text{a. árbol ‘tree’} \\
& \quad \text{b. árboles ‘trees’}
\end{align*}
\]

\[
\begin{align*}
(216) & \quad \text{a. grande ‘big (sg.)’} \\
& \quad \text{b. grandes ‘big (pl.)’}
\end{align*}
\]

If a learner is looking to posit a stem based on the common element of the paradigm, which in this case consists of just a pair of forms, then in both sets of examples, the unmarked form (i.e., arbol in (215) and grande in (216)) is motivated as the common element of the paradigm.

However, upon encountering additional data in the form of morphologically related lexemes, a learner could then observe that in some cases it is indeed useful to posit a stem that connects lexemes. Specifically, these cases would be the ones that contain one of the various word markers that Harris (1991) posits, as can be seen by comparing (216) and (218).

\[
\begin{align*}
(217) & \quad \text{a. árbol-eda ‘grove’} \\
& \quad \text{b. árbol-ado ‘wooded’}
\end{align*}
\]

\[
\begin{align*}
(218) & \quad \text{a. grand-ísimo ‘very big’}
\end{align*}
\]
b. grand-ote ‘huge’
c. grand-ulón ‘big guy’

In contrast to (217) in which the unmarked form árbol occurs in all related lexemes, the lexemes in (218) share what is better described as a stem, grand-. In an account in which structure does not need to be uniform for all words of the same class, it is reasonable to posit that a word such as grande is not analyzed as consisting of a stem until it is necessary to do so. Because uniformity across all words is not a basic tenet of a learning-based approach, not all words for which internal hierarchy can be posited need to be analyzed as having internal hierarchy. This is especially true for Spanish, where words such as sol, mártir, and árbol (i.e., those that Harris considers to have no word markers) resist subdivision.

The question remains as to how speakers treat word markers such as the -e in grande. Structurally, they pattern with inflectional elements, resembling the inflectional word markers discussed in Section 3.3.1 in every way except for association with grammatical gender. Such elements also seem to play a phonological role. As noted in Section 2.1.3, codas in Spanish are restricted to /s/, /l/, /ɾ/, and nasals homorganic with following consonants (Hualde 2005, p. 76). Word markers such as the -e in grande, therefore, serve to maintain phonotactic patterns in the language. A learning-based analysis of the various kinds of word markers in Spanish and how they are treated by speakers merits further investigation. Though the answer as to whether these kind of word markers should be considered inflectional, derivational, or simply thematic (cf. thematic elements in Navajo, as in Section 3.3.2 in Chapter 3) is ultimately beyond the scope of the dissertation, the preliminary analysis offered in this section suggests that the differences among word markers in Spanish nominals will be a fruitful phenomenon to consider in motivating the difference between derivation and inflection in the language.
3.3.2.2. Complex versus basic constituents. In addition to word markers, another type of affix that complicates an analysis of nominals along the lines of the analysis of verbs is the derivational affix. In contrast to word markers, in which their status as derivational is not straightforward, other affixes in Spanish do have a function that can clearly be considered derivational. The situation with nominals is similar to that discussed for verbs in Section 3.2.3, and the analysis of the present section helps clarify some of the issues introduced in the previous section. The solution that will be presented is to distinguish between complex and basic constituents, both for verbs and for nominals. The introduction of this distinction also allows for a means of describing the observation in Section 3.3.1 that the anchor of certain kinds of nominal paradigms (e.g., árbol in (215)) is best described as a surface word rather than as a word-internal stem.

The issue to be resolved regarding derivational affixes and nominals without word markers has to do with the fact that a single form may be ambiguously treated as more than one type of constituent. For example, to revisit an issue introduced in Section 3.2.3, in the case of abrir ‘to open’ and reabrir ‘to reopen’, introduced as (205), the form abr- can be identified in each of the two morphologically related lexemes. To reiterate the previous discussion, if one follows a root-stem-word analysis, and not the learning-based analysis of this dissertation, then the stem of abrir is the root of reabrir, unless one posits a zero-morph, in which case abrir would be treated as having a root abr- and a stem abr- (or abrØ), with the zero-morph motivated not by surface patterns by theoretical desiderata. From a learning-based perspective, on the other hand, if an isomorphic root and stem is not motivated by patterns observable to the learner, then there is no compelling reason to posit an additional level of structure (i.e., a root). The issue remains, though, that reabr- and abr-, though they may be two distinct stems, are also clearly related, a relationship
which it would be desirable to be able to describe given that learners are likely to be aware of it. 

This issue is resolved below.

Similarly, in the case of nominal lexemes without word markers, such as árbol and árboles in (215), in a root-stem-word analysis that posits the same constituent structure in all surface words, the form árbol is a word in the former and a stem in the latter, with a stipulation that árbol ‘tree’ contains a zero-morph indicating the inflectional feature $SG$. In fact, both surface forms contain at least one-zero morph that takes the root árbol to the stem árbol$\emptyset$, which is then inflected to either árbol$\emptyset\emptyset$ or árbol$\emptyset$es. On the other hand, in a learning-based analysis in which zero-morphs are posited only via compelling evidence from surface patterns (e.g., if a set of patterns can be described only if a distinction is made between a form X and a form X$\emptyset$), we must confront the observation that the form that connects the two members of the paradigms is one of the two surface forms of that paradigm.

The question that arises then is how to represent the constituent structure of a word such as árboles. Several options are available for addressing this observation: (1) positing a zero-morph; (2) treating the form árbol in árbol ‘tree’ and the form árbol in árboles ‘trees’ as two distinct but isomorphic types of constituents, a word in the former and a stem in the latter; (3) treating the form árbol as a stem in both, and accounting for its non-stem-like behavior in the singular form; (4) treating the form árbol as a word in both, and accounting for why a word is found inside a word in the plural form. The fourth option is the one that is favored in the present analysis. The problem with the first option is that, as previously mentioned, zero-morphs do not seem to be motivated by patterns of the language. Evidence in favor of this option would include psycholinguistic findings that speakers treat surface forms such árbol differently from the stem árbol in its plural inflected form. Absent linguistic or extra-linguistic patterns in support of a zero-morph, this option will be
rejected. The problem with the second option is that the form árbol functions identically in both surface words. For instance, the meaning of is the same (treating árbol ‘tree’ as unmarked for number rather than zero-marked for singular). Moreover, when informally asked about their intuitions regarding the form árbol in the singular and the plural forms, native speakers expressed that they consider árbol to the identical in both the simple and the complex form. The benefit of the third option is that it is in accordance with the use of the term stem to indicate the anchor of a paradigm. However, calling árbol a stem in the singular surface form is problematic for both theoretical and empirical reasons. Since the learning-based approach starts with surface words and posits additional structures only when word-internal constituency is motivated, a learner would have no reason to call the singular surface form árbol a stem if no word-internal division is called for. Empirically, when speakers were asked informally about what they thought the form árbol is in árboles, they were very comfortable saying it was a word within a word. Indeed, if we consider the criteria for the grammatical word established in Section 2 (e.g., independence, internal cohesiveness, locus of semantic and grammatical features, etc.), the form árbol straightforwardly meets those criteria. Therefore, the fourth option is the one that is preferred: árbol in árboles is a word.

If an analysis of inflected nominal forms without word markers treats such forms as consisting of words within words, then we should have a way of describing them. The characteristic that is proposed to describe this phenomenon is complexity. A complex form is one in which we can identify a component form of the same type. For example, the component árbol of árboles is a word by the criteria described in Section 2 (i.e., it is found in isolation, it is a reliable

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33 Though it is also reasonable to use the term complex to describe any surface form in which another form can be identified, it is reserved here for use when the component form is of the same type (e.g., a word within a word) since the situation where a form is of a different type (e.g., a stem within a word) would represent conventional hierarchical structure.
locus of semantic and grammatical features, etc.). A similar description (i.e., as a stem within a stem) can be applied to the form *abr-* in *reabrir*. As discussed above, the stem of *reabrir* is *reabr-*. To the extent that a speaker would recognize *abr-* in the stem *reabr-*, the form *abr-* would be considered a stem (cf. *abrir*) within a stem. If forms such as *reabr-* and *arboles* are termed *complex*, then forms such as *abr-* and *árbol* can be termed *basic*, since the former are appropriately treated as based on the latter for a variety of reasons: synchronically, new complex forms are most commonly created from basic forms (backformations being a notable exception); diachronically, the typical pattern proceeds in the direction of basic to complex; and in terms of speaker intuitions, complex forms are perceived as based on basic forms. An analysis relying on the construct of complexity, therefore, posits the typology reflected in Table 2. With the aim of facilitating visualization of stems versus words, stems are enclosed in square brackets and words in curly brackets.

*Table 2: Typology of word and stem types in Spanish*

<table>
<thead>
<tr>
<th>Constituent</th>
<th>Complex/simple</th>
<th>With/without word-internal hierarchy</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Word</td>
<td>Simple</td>
<td>Without</td>
<td>*{árbol}*word ‘tree’</td>
</tr>
<tr>
<td>Word</td>
<td>Complex</td>
<td>Without</td>
<td>*{{árbol}word es}word ‘trees’</td>
</tr>
<tr>
<td>Word</td>
<td>Simple</td>
<td>With</td>
<td>*{[habl]stem o}word ‘I speak’</td>
</tr>
<tr>
<td>Word</td>
<td>Complex</td>
<td>With</td>
<td>*{[habl]stem ador}word es}word ‘talkative ones’</td>
</tr>
<tr>
<td>Stem (in bold)</td>
<td>Simple</td>
<td>n/a</td>
<td>*{[abr]stem o}word ‘I open’</td>
</tr>
<tr>
<td>Stem (in bold)</td>
<td>Complex</td>
<td>n/a</td>
<td>*{{re[abr]stem o}word ‘I reopen’}</td>
</tr>
</tbody>
</table>

Constituents are viewed as complex if they contain another constituent of the same type; constituents are viewed as having hierarchy if they contain a constituent of a different type (since no constituent smaller than a stem is posited in the present analysis, it is not possible for a stem to have internal hierarchy).
The concept of complexity discussed above offers several advantages to an analysis that posits an additional distinct constituent. For one, an additional distinct constituent is not strongly motivated by data in the language. The kinds of patterns presented in Section 2 as motivation for the grammatical word and those presented in Section 3.1 as motivation for the stem have not been identified for additional constituents. Though the observations that have been used in other analyses in support of additional constituents do indicate that connections between lexemes are not always straightforwardly described via a stem (connections that are very likely to be salient to speakers and therefore worthy of a means to describe them), the concept of complexity as a means of describing these intuitions allows for an account that captures these intuitions without unnecessarily complicating the grammar. The fact that complexity is not a particularly precise concept fits well with cognitively-oriented approaches that assume that linguistic structure bears similar properties to other cognitive structures (cf. Section 2.2 in Chapter 1). Indeed, the kinds of connections that motivate the notion of complexity are those are predicted to vary among speakers. Thus, the two-level constituent structure proposed in the present chapter is motivated by a variety of surface patterns in the language. These patterns do not motivate additional constituents; however, they do motivate a relatively flexible treatment of the two constituents, a flexibility encapsulated in the concept of complexity.

4. Other morphological elements

A primary argument of Section 3 is that words in Spanish consist of one word-internal constituent: the stem. The stem is the element that serves as the anchor to paradigms within a lexeme and that also connects certain derivationally related words. Theme vowels in Spanish and some word markers are treated as inflectional, which locates them outside of the stem. Though derivational affixes and certain word markers (which may be called thematic, following the Navajo
literature) introduce complexity to the analysis, they do not motivate a new level of structure. The notion of complexity is introduced to account for the patterns that involve these elements. The discussions in Sections 2 and 3, therefore, address the question of morphological constituent structure in Spanish. These discussions also introduce the idea that morphological exponents such as theme vowels, derivational affixes, and word markers constitute important elements in the morphological system of Spanish, even if they do not motivate additional constituents. The present section offers two types of morphological elements that are not fundamental constituents in the language but that are constructs relevant for describing the patterns of the language, particularly with regard to theme vowels, derivational affixes, and word markers.

4.1. Morphemes. As mentioned in Section 2.2.1, morphs in Spanish are not as reliable as a locus of semantic and grammatical features as are words. However, this does not negate the possibility that morphemes are indeed useful morphological constructs in the language. In fact, linguistic patterns of Spanish do motivate morphemes in certain cases, including many of the types of derivational exponents that have been referenced throughout the chapter.

Many of these morphs can indeed be considered morphemes since a consistent meaning and/or grammatical function can be associated with a particular form across lexemes. For instance, certain morphs are reliably associated with grammatical functions, such as those that indicate the lexical category of a word and that therefore can be utilized in word formation to create a related lexeme of a different lexical class. Examples of such forms are verbalizers as shown in (219), nominalizers as in (220), and adjectivizers as in (221).

(219) a. suavizar ‘to soften’ (cf. suave ‘soft’)
    b. modernizar ‘to modernize’ (cf. moderno ‘modern’)
    c. tranquilizar ‘to calm’ (cf. tranquilo ‘calm’)

(220) a. sentimiento ‘feeling’ (cf. sentir ‘to feel’)
    b. acontecimiento ‘occurrence’ (cf. acontecer ‘to occur’)

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c. descubrimiento ‘discovery’ (cf. descubrir ‘to discover’)

(221)  
  a. semanal ‘weekly’ (cf. semana ‘week’)  
  b. central ‘central’ (cf. centro ‘center’)  
  c. residencial ‘residential’ (cf. residencia ‘residence’)

The form -iz in (219) can be used to formally and semantically connect a verb to an adjective. This knowledge can be used by speakers to understand the meaning of an unknown verb with -iz in the position right before the inflectional morpheme and it can be used to create a novel verb from a known adjective. Similarly, the suffix -miento in (220) reliably indicates that a word is a noun and it reliably indicates that it is the nominal form of a verb whose stem precedes the suffix. In the case of (221), a learner can observe that the suffix -al, when found at the end of word is likely to mean that the word is an adjective whose meaning is related to a morphologically related noun. Therefore, forms such as -iz, -miento, and -al are justifiably treated as morphemes since the learner can reasonably treat these as pairings of a linguistic form with a linguistic function.

In addition, as discussed in Section 2.2.1, certain evidence exists to support the claim that forms such as re- and des- are morphemes associated with a readily identifiable meaning across distinct lexemes, as in (222) and (223).

(222)  
  a. rehacer ‘to redo’ (cf. hacer ‘to do’)  
  b. reabrir ‘to reopen’ (cf. abrir ‘to open’)  
  c. retomar ‘to retake (cf. tomar ‘to take)

(223)  
  a. deshacer ‘to undo’  
  b. desenterrar ‘to dig up’ (cf. enterrar ‘to bury’)  
  c. desaparecer ‘to disappear’ (cf. aparecer ‘to appear’)

In the case of re- in (222), each word with that morph has a repetitive meaning that is readily determined by comparing each lexeme to its related lexeme without the derivational exponent. Similarly, in (223), des- is associated with a reversative meaning. Such patterns are reinforced by a multitude of similar relationships in the language.
However, since such exponents are not treated as the basic semantic or grammatical units of the system, it is not necessary for such morphs to carry consistent features across different lexemes, thereby allowing for semantic drift that results in opacity across lexemes. This can be seen in the words in (224) and (225) (repeated from (168) and (169)).

(224)  
a. repetir ‘to repeat’  
b. representar ‘to represent’

(225)  
a. desparramar ‘to scatter’  
b. desayunar ‘to have breakfast’

As argued in Section 2.2.1, these lexemes illustrate how the forms re- and des- in some historically related lexemes are no longer transparently connected to other lexemes with those forms. This may be, for instance, because the meaning of the morph is no longer a component of the semantics of the word (as in (224b) where a representation does not signify that a second presentation is occurring) or because the remnant of the word without the morph is not associated with an existing related lexeme (as in (224a) and (225a)). Such exceptions may be problematic for a morphological system that is built around these units as consistent constituents of all content words, but it is not problematic if morphemes are units that are generalized on a case-by-case basis as a learner experiences evidence to motivate them.

4.2. Paradigms. Just as the construct of the morpheme is useful in describing patterns involving derivational exponents, the construct of the paradigm is useful in understanding patterns involving theme vowels and inflectional word markers. As discussed in Section 3.1.1, verbs, nouns, and adjectives participate in paradigms based on inflectional features. In the case of verbs, those features are tense-aspect-mood, person-of-subject, and number-of-subject, and in the case of nouns and adjectives those features are number and gender. The specific exponents of a given verbal lexeme, which include theme vowels, are determined by that lexeme’s conjugation class, a
property of the verb that is independent of semantics. Therefore, in order to account for inflectional exponents we need the construct of the paradigm.

Because paradigms would not be considered morphological constituents, they are not the primary focus of this dissertation. However, they do merit at least a brief discussion since paradigms and their organization into, for example, verbal conjugation classes are important for understanding Spanish morphology and therefore represent the kind of knowledge that learners would construct in the process of acquiring the language. Paradigms, for instance, are useful in understanding the role of theme vowels in Spanish. Given that theme vowels are salient in the verbal patterns of the language, it is desirable to account for them in any analysis of Spanish morphology. Yet, as argued in Section 3.2.1, making theme vowels a fundamental part of word formation necessitates a variety of descriptive mechanisms that are not motivated by surface patterns of the language. Including the construct of the paradigm in a grammatical description of the language allows us to account for theme vowels without separating them from the rest of the inflectional system by treating them as morphemes.

The patterns of verbs, therefore, can be straightforwardly accounted for with a constituent structure that consists of words and stems and with the positing of inflectional exponents determined by conjugation class, a property of the lexeme. All these morphological elements can be ascertained by a learner on the basis of surface patterns. This process of determining paradigms can be illustrated with the sets of words in (226) through (229).

(226)  a. hablaste ‘you spoke’
       b. hablan ‘they speak’
       c. hablo ‘I speak’

(227)  a. cantaste ‘you sang’
       b. cantan ‘they sing’
       c. canto ‘I sing’
In these sets of words, the stem is motivated by fact that in each set, one form unites all the words in the set (namely, habl-, cant- com-, and beb-). The construct of the paradigm is motivated by the fact that certain lexemes share the same sets of inflectional markers. For instance, in (226) and (227), the 2SG.PST endings are -aste, 1PL.PRS endings are -amos, and 1SG.PRS endings are -o. The construct of the conjugation class is motivated by the fact that not all verbs share the same exponents for given inflectional features. Instead, groups of verbs pattern similarly to each other. Thus, (226) and (227) exhibit the same inflectional exponents, and (228) and (229) exhibit the same inflectional exponents as each other, which are different from those of (226) and (227).

Theme vowels are simply one component of those paradigms; they are identifiable in certain forms (e.g., -a in (226a-b) and (227a-b), -e in (228a-b) and (229a-b)) but not consistently within all forms of a lexeme (e.g., (226c), (227c) (228c), (229c)). All these constructs — stem, paradigm, conjugation class — are directly motivated by surface patterns, and together they account for the multiplicity of observations that can be made with regard to the morphology of verbs in Spanish.

5. Summary

As with Navajo and Hebrew, the grammatical word is motivated via the phonological word by the linguistic patterns of Spanish, consistent with the premises of word-based approaches to morphology. Under a learning-based approach, the grammatical word, rather than the morpheme, is treated as the basis of the morphological system. In terms of word-internal constituency, one unit is motivated, what is referred to as the stem (but which is called a root in some accounts). This
position stands in contrast with the root-stem-word structure of many generative models. Theme vowels and word markers do not motivate additional structure. Patterns involving these elements can be accounted for using the notion of complexity and by appealing to other morphological elements, namely morphemes and paradigms, which are also important for understanding the morphological patterns of the language without being basic constituents of words. Complex constituents in the present analysis are those for which another constituent of the same type can be identified with them. As mentioned in Chapter 1, Spanish represents a morphological system that is typologically common. Therefore, the analysis of the present chapter serves as an example of how similar languages may be reanalyzed under a learning based approach. Moreover, this analysis of Spanish serves as a valuable comparison point for those of Hebrew and Navajo, a topic which is taken up in the following chapter, which serves as the conclusion of the dissertation.
Chapter 5: Conclusions

1. Synthesis

The present chapter concludes the dissertation. Its goal is two-fold: to offer a synthesis of the conclusions reached in Chapters 2 through 4 and to discuss theoretical implications of the present study. The former is presented in Section 1 and the latter in Section 2. Section 3 offers a summary of the chapter.

In the present section, Section 1, the results of applying a learning-based approach to morphological constituents in Hebrew, Navajo, and Spanish are summarized and synthesized. Several important points emerge from comparing the constituent structure of the three languages: grammatical words are motivated for each language; word-internal constituents are motivated for all three languages, though the number of constituents is different in each language; each language exhibits lack of uniformity with regard to word-internal constituents among different classes of words; the construct of complexity can be used to classify constituents; and morphological constituents are language-specific categories. Each of these points is discussed in turn.

1.1. Grammatical words motivated for each language. Under a learning-based approach, the grammatical word is motivated as a morphological constituent in Hebrew, Navajo, and Spanish. Consistent with the Grammatical Word – Phonological Word Congruency Principle (introduced in Section 4.1.1 of Chapter 1), grammatical words generally align with phonological words in each of the languages. In all three languages, for instance, the phonological word is motivated by the criteria of independence, internal cohesiveness, and domain of phonological processes, and this phonologically salient element in turn proves to be grammatically relevant since it serves as the most stable locus of semantic and grammatical features, as the basis of
compounding, and as the basis of lexical classes (e.g., nouns and verbs), which themselves can be identified through a convergence of linguistic properties.

Consistent with the notion that linguistic categories under a learning-based approach need not exhibit boundaries determined by necessary and sufficient properties, the Grammatical Word – Phonological Word Congruency Principle need not involve a perfect one-to-one alignment between phonological word and grammatical word. Though it would not be unexpected to find a language where each phonological word maps onto one and only one grammatical word, Hebrew, Navajo, and Spanish are not examples of such a language. In each case, we find instances where a one-to-one correspondence does not hold. Notably, the cases where this alignment does not occur are the same in each language: Phonological words may consist of more than one grammatical word. Thus, the learner’s assumptions that the most phonologically salient unit reflects a stable semantic and grammatical unit is affirmed, since having two grammatical words in one phonological word also results in a semantically and grammatically stable unit across different contexts.

The differences in the criteria that motivate these factors relate to language-specific manifestations. For example, though all three languages mark the phonological word as a domain of phonological processes, stress assignment motivates the phonological word in Hebrew and Spanish, but not in Navajo because stress does not seem to be significant in the same way in Navajo (McDonough 2003, p. 107, cf. Section 3.1.3 in Chapter 3). Such differences are not necessarily sufficiently large to make a strong claim that these are in fact distinct entities for each language. Thus, the grammatical word is the constituent that is best supported as a common morphological structure for the three languages, a point that is discussed further in Section 2.1, where qualifications about the universality of the grammatical word are noted.
1.2. Different numbers of word-internal constituents motivated for each language. In addition to the grammatical word, word-internal constituents are also motivated for all three of the languages focused on in this dissertation. In Navajo, three constituents are motivated: the stem, the conjunct, and the disjunct. In Hebrew, two are motivated: the stem and the root. In Spanish, only one word-internal constituent – the stem – is motivated. We should keep in mind the caveat introduced in Section 4.1.2 of Chapter 1: For the sake of convenience and of fostering dialogue with other work in these languages, overlapping terminology is used to describe the constituents in each of the languages. For instance, since the term stem is used in the literature discussing Semitic, Athabaskan, and Indo-European languages, it is also a term that is employed in the present dissertation. However, commonality of terminology does not imply that a stem as discussed in one language is the same as a stem discussed in another. In fact, as discussed in greater detail below in Section 1.5, the structures in Hebrew, Navajo, and Spanish that are referred to as stems are not the same type of entity across the three languages. Even prior to entering into a discussion of whether the word-internal constituents in the three languages should be thought of as cross-linguistic categories, though, we can observe that at the minimum, languages differ with regard to the number of word-internal constituents that characterize the morphological structure of the language.

1.3. Lack of uniformity with regard to constituent structure within each language. As mentioned in the previous section, Navajo exhibits three word-internal constituents, Hebrew two, and Spanish one. In all three cases, though, such a statement masks the fact that the constituent structure is asymmetrical across different lexical classes in the word. Generally, the constituent structure applies only to content words (i.e., nouns, verbs, adjectives, etc., as opposed to prepositions, complementizers, determiners, etc.). Moreover, the morphological architecture is not uniform even within the set of words that can all be considered content words. Though the precise
details differ for each language, it is generally the case that verbs display deeper structures (i.e., more word-internal constituents) than nouns.34

In Navajo, the distinction among lexical classes with regard to morphological structure is the most extreme. For one, the distinction is essentially between verbs and all other elements (with the exception of nouns derived from verbs). In addition, whereas verbs typically exhibit three word-internal constituents and minimally two, all other elements typically exhibit no word-internal constituents and maximally one (in the case of deverbal nouns). Thus, though Navajo exhibits the greatest number of constituents for the three languages, this is essentially only the case for verbs in the language.

In Hebrew, the deeper constituent structure is also a property of verbs. Though stems and roots are motivated for the language, only the internal structure of verbs consistently exhibits a hierarchy that includes both a root and a stem. On the other hand, for nominal elements such as nouns and adjectives, only stems are consistently motivated. One can make the case that certain nominal elements can also be characterized as consisting of roots; however, unlike verbs, where a root can always be identified, roots characterize the structure of only some nominal lexemes.

The difference between verbs and nominals in Spanish is also evident, though to a lesser extent than in the other two languages. In Spanish, only one word-internal element is motivated, and it is motivated for both nominals and verbs. The difference between the two types of lexical classes, though, is that this element is always identifiable in verbs, but, similar to the Hebrew root, it is only sometimes evident in nominals. We can therefore note that one characteristic shared by all three languages is a lack of uniformity regarding constituent structure depending on the lexical

34 None of the three languages studied in this dissertation exhibit widespread nominal case patterns. The prediction is that languages that do would likely have more complex constituents structures for nominals than is reflected in Hebrew, Navajo, and Spanish.
class. In addition, in all three cases, the verbs display the deepest structures of the languages. This lack of uniformity, though, also exhibits language-specific characteristics.

1.4. Complexity as a classifying construct. As elaborated upon in Section 4 of Chapter 1, under a learning-based approach, a constituent is motivated on the basis of whether linguistic generalizations are better stated with that constituent than without it. Thus, a new constituent is motivated only if a particular description cannot be elegantly made with a previously motivated constituent. However, in some cases, though a new constituent may not be called for, it would be appropriate to say that a previously motivated constituent can be thought of as exhibiting two different types. This is the case with Spanish, where we can speak of two types of words and two types of stem: simple versus complex. Thus, the construct of complexity, rather than a new constituent, is introduced to account for certain patterns.

To reiterate the argument from Section 3.3.2.2 in Chapter 4, in Spanish, only one element – the stem – is motivated. In both nominals and verbs, the stem is the base of inflection, though it is not necessarily the case that all elements that serve as the base of inflection should be treated as stems. This difference arises from the difference in inflection between nominals and verbs. In the case of verbs, all lexemes are arranged into paradigms wherein the common denominator is an element that does not occur as an independent element in any of the cells of a paradigm, with the exception of suppletive forms. This element is straightforwardly analyzed as a stem. In the case of nominals, on the other hand, though some paradigms can be straightforwardly analyzed in this way (e.g., bonit-o ‘pretty (masc. sg.)’, bonit-a ‘pretty (fem. sg.)’, bonit-os ‘pretty (masc. pl.)’, and bonit-as ‘pretty’ (fem. pl.’), where the stem is bonit-), the paradigms of other nominals take as their base one of the members of the paradigm, which has all the characteristics of a word (e.g., fácil ‘easy (sg.)’ fácil-es ‘easy (pl.)’, where the common element is fácil). Such an analysis results
in word (e.g., fácil) serving as the base of inflection in another word (e.g., fáciles) consisting of more than one word. The construct of complexity describes this difference: The former is a simple word and the latter a complex word. Stems can also be described along this dimension. Complex stems result from derivation (e.g., in abrir ‘to open’ the stem abr- is simple and in reabrir ‘to re-open’ the stem reabr- is complex). If a constituent can be identified inside another constituent of its own type, then the former is simple and the latter is complex.

The construct of complexity, motivated in this dissertation for Spanish, can also potentially be applied to Hebrew. In Hebrew, just as in Spanish, the anchor to the paradigms of certain nominals can be described as a stem (e.g., mor- in mor-e ‘teacher (masc. sg.)’, mor-a ‘teacher (fem. sg.)’, mor-im ‘teachers (masc. pl.)’, mor-ot ‘teachers (fem. pl.)’) and the anchor of certain other nominals can be described as a word (e.g., χaver in χaver ‘friend (masc. sg.)’, χaver-a ‘friend (fem. sg.)’, χaver-im ‘friends (masc. pl.)’, χaver-ot ‘friends (fem. pl.)’). In the latter case, the anchor of the paradigm is one of the members of the paradigm. Thus, a word such as χaverim can be analyzed as a complex word with the word χaver as the base of inflection and no stem. Such an analysis is plausible. However, this analysis is ultimately not adopted by this dissertation. As discussed in Section 3.2.1 of Chapter 2, the analysis of the present study treats a word such as χaverim ‘friends (masc. pl.) as consisting of a stem χaver and a word such as χaver ‘friend (masc. sg.) as consisting of the stem χaver, which is isomorphic with the word. The argument for the construct of complexity in the nominal system is stronger for Spanish than for Hebrew in part because of the rest of the patterns in each of the languages. For example, in Spanish verbs, the stem cannot stand on its own, whereas in Hebrew verbs, certain stems do stand on their own (e.g., gadal-ti ‘I grew’, gadal-ta ‘you (masc.) grew’, gadal-t you (fem.) grew’, gadal ‘he grew’, etc., where the stem is gadal is isomorphic with the 3SG.MASC.PST form). Therefore, if stems can be
isomorphic with words in the Hebrew verbal system, then that supports an analysis of isomorphic stems and words in the Hebrew nominal system. In Spanish, in contrast, verbal stems occur only in bound form. The argument for stems as elements that cannot stand alone and word as elements that can, therefore, is much better supported in Spanish. The concept of complexity, therefore, is available for both languages but is strongly motivated for only one of the languages.

Thus, though the nominal inflectional systems of Spanish and Hebrew can in principle be analyzed in the same way, two distinct analyses are presented because the overall particular patterns of each of the languages favor a different analysis for each language. This demonstrates that in a learning-based analysis, it is the language-specific patterns that drive the analysis rather than a desire for uniformity across languages.

1.5. Morphological constituents as language-specific categories. With the exception of the grammatical word (which is discussed further in Section 2.1 below), all the other morphological constituents motivated in this dissertation cannot be considered cross-linguistic categories, in the way that Dryer (1997) uses the term to describe categories that can be determined independently of any particular language with criteria that apply across unrelated languages. The criteria that motivate each of the constituents are distinct in each of the languages, such that no set of properties can be found that identifies a common constituent cross-linguistically. Each constituent, therefore, needs to be thought of in language-specific terms and not as a cross-linguistic category.

To illustrate, we can consider the element that is called the stem in each of the languages. As motivated under a learning-based framework, the Hebrew stem, the Navajo stem, and the Spanish stems are identified using distinct properties, despite some overlap in the properties. In all three cases, the stem serves as a common element to at least some paradigms within a lexeme.
However, the relationship between inflectional features and conjugation class is distinct for all three. In Spanish, the shape of the stem is typically invariant throughout the lexeme, such that in the most common case, a single stem shape characterizes all the forms of a lexeme. The exception to this invariance is certain types of allomorphy, which in the case of Spanish are typically phonologically-based. An example of this allomorphy is the diphthong alternations discussed in Sections 1.2 and 3.1.3 of Chapter 4, which are influenced by stress. Another property of Spanish stems is that they are independent of conjugation class. Knowing a lexeme’s conjugation class offers no predictive information about its stem. In Hebrew, on the other hand, the stem is dependent on both conjugation class and tense. In some conjugation classes in Hebrew, the paradigm for each tense is associated with distinct stem allomorphs, which means that a Hebrew verbal lexeme can have up to three stem allomorphs associated with it. Therefore, stem allomorphy in Hebrew is tense- and conjugation class-based. In Navajo, inflectional features are shared by both the stem and the conjunct (as discussed in Section 3.3.1 of Chapter 3), and therefore the Navajo stem shape is determined by inflectional features. It is, however, independent of conjugation class, which affects the form of the conjunct instead. Therefore, the Spanish stem can be said to be the remnant of the word after conjugation class and inflectional features are removed, whereas the shape of the Hebrew stem and the Navajo the stem depend in part on inflectional features, with the Hebrew additionally depending on conjugation class features.

Though the entities referred to as stems should be considered distinct in the three languages, the possibility exists that a stem in one language corresponds to a different constituent in another language, which is a possibility worthy of consideration. For instance, it could be the case that a Hebrew root maps onto either a Navajo stem or a Spanish stem, in which case we can still speak of cross-linguistic categories and would then be compelled to modify the terminology
accordingly. Indeed, Hebrew roots do have properties that overlap with Navajo stems and Spanish stems. However, the overlapping properties are not sufficient to overcome the differences among the constituents.

In the case of the Hebrew root and the Spanish stem, one characteristic they share is that they are both anchors of all the paradigmatically related forms of a given verbal lexeme. Unlike Hebrew stems, for which there can be up to three for a lexeme as noted above, only one Hebrew root and only one Spanish stem can be identified for a given verbal lexeme. Moreover, these same elements – the Hebrew root and the Spanish stem – are what we identify when we look across morphologically related lexemes (e.g., Spanish com- in comer ‘to eat’ and comida ‘food’ and Hebrew ʔ-χ-1 in leʔeχol ‘to eat’ and ʔoxel ‘food’). The Hebrew root and the Spanish stem, however, differ in their hierarchical relationship to the word since the Hebrew root is two levels removed from the grammatical word and the Spanish stem only one. Related to this, their role with respect to inflection of person, number, and gender is also different, with such processes applying directly to the Spanish stem but not to the Hebrew root. Thus, the Spanish stem shares properties with both the Hebrew stem and the Hebrew root.

Similarly, the Hebrew root also bears some resemblances to the Navajo stem, though the two should nevertheless be thought of as distinct entities. Navajo stems and Hebrew roots have both been used to connect morphologically related lexemes, which is a property they both share with Spanish stems. It should be noted, however, that this property is not consistent. In all three languages, the element in question does not consistently or reliably connect morphologically related elements, which can sometimes have opaque or non-existent relationships (cf. Sections 2.2.1 and 3.2.2 in Chapter 2; Sections 2.2.1 and 3.1.2 in Chapter 3; and Sections 2.2.1 and 3.1.2 in Chapter 4). Indeed, in none of these cases is cross-lexeme connection the primary property that
defines the constituent. Given that this property is what the Hebrew root shares with the Navajo stem and the Spanish stem, we cannot treat any of the three constituents as manifestations of a single cross-linguistic category.

Another difference among the three languages is that the hierarchical relationship of the word-internal constituents is distinct. To begin with, Spanish, with only one word-internal constituent motivated, differs from Hebrew and Navajo in that the word-internal constituent exhibits a hierarchical relationship to the word only. The Hebrew stem and the Navajo stem both have relationships to other constituents, though the relationships are different in each language. In the case of Hebrew, the hierarchical relationship follows a canonical pattern, whereby the word dominates the stem, which dominates the root: \[\text{word} \ [\text{stem} \ [\text{root} \ldots] \ldots] \ldots\]. In contrast, in Navajo, though the stem, the conjunct, and the disjunct are all dominated by the word, these three elements occur at the same level of hierarchy as one another: \[\text{word} \ [\text{disjunct} \ldots][\text{conjunct} \ldots][\text{stem} \ldots]\]. With respect to the relationships among word-internal constituents, therefore, hierarchy is not always motivated. Despite overlapping properties of some word-internal constituents across the three languages, they cannot be described cross-linguistically using criteria that reliably identify them, even across two different languages. Therefore, word-internal constituents should be considered on language-specific terms.

2. Theoretical implications

The results summarized and synthesized in Section 1 have implications for broader issues in linguistic theory. For instance, the findings from applying a learning-based approach to morphological constituents in Hebrew, Navajo, and Spanish speak to the status of elements such as words, morphemes, and paradigms in the morphological system, thereby offering conclusions contributing to current debates in the field of morphology. The present section addresses certain
implications of the present study. Among the theoretical claims of this dissertation are the following: Words are the basis of the morphological system; morphemes are morphological elements that should be considered part of the linguistic system, though as occasionally motivated structures and not as basic constituents; and paradigms should also be treated as significant morphological elements. In addition, another significant theoretical implication of this work is that morphological constituents are not universal. Finally, a learning-based analysis of linguistic elements offers empirical predictions, a point that is further discussed below.

2.1. Word as basis of morphological system. As alluded to in the Sections 2.2.1 of Chapters 2-4, a current issue in the field of morphology involves the question of which unit should be treated as the basis of the grammatical system, the word or the morpheme (Stewart 2008; Haspelmath & Sims 2010). Following previous work arguing that the word is a more fruitful unit to treat as the basic constituent (Robins 1959; Anderson 1992; Aronoff 1994; J.P. Blevins 2006), the present study adopted the initial hypothesis that the grammatical word would be one of the morphological constituents motivated under a learning-based approach. This hypothesis was borne out by the evidence. In all three languages, the grammatical word is motivated.

In addition, the viability of the word as a linguistic unit is supported by the fact that of all the morphological constituents it is the one that is the best candidate to be a cross-linguistic category. In contrast to the stem, the criteria for identifying a word are relatively similar across the three languages and are a subset of the criteria that have been posited as potentially universal criteria (Robins 1959; Dixon & Aikhenvald 2002; Haspelmath 2011; also, cf. Section 4.1.1 in Chapter 1). For example, in all three languages in the present study, the phonological word can be identified by the criteria of independence, internal cohesiveness and, in accordance with the Phonological Word – Grammatical Word Congruence Principle, the phonological word generally
maps onto the grammatical word, which is the element that is the locus of semantic and grammatical features, serves as the basis of lexical classes, and serves as a base of compounding. Based on this work alone, we would want to explore the hypothesis that the grammatical word is a universal category. Of course, as discussed in Section 4.1.1 in Chapter 1, other work demonstrates that the criteria common to Hebrew, Navajo, and Spanish cannot reliably be extended to all languages. However, the fact that the evidence from these three languages present the word and only the word as a potential cross-linguistic morphological constituent does support the notion that the word can be more profitably treated as the basic unit of the morphological system than the morpheme. This work, therefore, joins the work of other morphologists in giving preeminence to the word.

2.2. Morpheme as a non-constituent morphological element. The learning-based approach, therefore, supports the grammatical word as the basic unit of the morphological system rather than the morpheme, which does not have a consistent place in the hierarchy of words in Hebrew, Navajo, or Spanish, contra analytical approaches in which words are built from and decomposable into morphemes (e.g., McCarthy 1981; Harris 1991; Halle & Marantz 1994; Arad 2005; Mihalicek & Wilson 2011). The learning-based approach, however, does acknowledge that the morpheme can play a role in the morphological system, even if it is not a basic constituent. In all three languages, morphemes – which are treated as minimal units of form that are paired with a meaning, smaller than and distinct from a word – can be identified. Many inflectional elements (e.g., Hebrew -nu 1PL, Navajo da- DISTR PL, Spanish -ar INF) have a reliable grammatical function across different contexts. The same can be argued of certain word-internal elements that have a common semantic function across different contexts. Some Hebrew roots, for example, can be identified that have a common meaning across multiple lexemes. In the case of inflectional
morphemes, like the former, they cannot be considered constituents since they do not participate in the hierarchy (i.e., they do not dominate any elements nor are other constituents built upon them). They are more appropriately treated as exponents in the paradigmatic patterns of the lexeme. As for semantic morphemes such as the Hebrew root, the reason that these are not treated as formatives is because, as discussed in Section 2.2.1 of Chapter 2, not all Hebrew roots can be considered morphemes – pairings of form and meaning – when we look across lexemes since the form-meaning connection is not consistently discernible in a cross-lexeme context (e.g., Aronoff 2007). Therefore, though the Hebrew root is a part of the constituent structure of the verbal morphological system, the Hebrew root as a cross-lexeme morpheme is not.

In this way, morphemes resemble phonaesthemes. Phonaesthemes are sound-meaning pairings that cannot be treated as traditional compositional morphemes. In English, these include gl-, which is relatively infrequent but which occurs with greater than expected frequency with words whose meanings are related to VISION or LIGHT, as in glow, glimmer, glitter, gleam, etc.; another such unit is sn-, which is found in words associated with MOUTH or NOSE, as in snout, snore, sneeze, sniff, etc. Given that they are not reliable carriers of meaning but occur only in limited contexts, they cannot be treated as consistent and reliable units in the linguistic system. Yet, they do seem to play some role in the linguistic system, as evidenced by the fact that they are involved with neologisms and that they exhibit some priming effects similar to those described in Section 3.1.1.5 of Chapter 2 for Semitic roots (Bergen 2004). Bergen’s attempts to account for the role of phonaesthemes in the linguistic system lead him to a theoretical orientation that is akin to the learning-based approach: “While compositional morphologies have very little to say about the mechanisms by which phonaesthemes might be learned and represented, usage-based views of morphology predict the occurrence of phonaesthemes as a
natural product of generalization over the lexicon” (p. 304). Both Bergen’s account of phonaesthemes and the analysis of the present dissertation eschew a deductive approach to morphology in favor of an inductive approach in which linguistic units are emergent: “Acquiring phonaesthemes, like all other form-meaning pairings… is accounted for in network models as the emergent product of implicit abstraction over specific lexical representations” (p. 304). Phonaesthemes and morphemes, therefore, should be part of the linguistic system since they both help account for certain linguistic patterns. However, even though we treat them as linguistic elements, they are not treated as constituents. They are real to speakers and useful in describing linguistic generalizations, but they do not form a part of the basic architecture of the languages in which they have been discussed (phonaesthemes in English in the case of Bergen 2004, and morphemes in Hebrew, Navajo, and Spanish in the case of the present study).

2.3. Paradigms as non-constituent morphological elements. Another morphological element that is motivated by the patterns of each of the three languages is the paradigm. Though paradigms are not constituents and are therefore not the focus of the present study, they are morphological structures that are useful in describing linguistic generalizations. In all three languages, the inflectional patterns of verbs in particular can be organized around paradigms. For example, all three languages exhibit conjugation classes that emerge from classes of verbs that share the same inflectional markers. (A similar pattern is predicted for the nominals of languages with rich inflectional nominal patterns involving, for instance, case.) A learner seeking to organize the patterns of the language is expected to observe that within a lexeme are exhibited predictable relationships between form and inflectional properties that can be encapsulated in a schematic structure that we would call a paradigm. From sets of shared inflectional markers among lexemes, therefore, emerges the construct of the paradigm as an organizing unit.
As with the morphological constituents motivated for the three languages, paradigms should most likely be thought of in language-specific terms. For example, verbal paradigms based on conjugation class are associated with different morphological constituents in Hebrew, Navajo, and Spanish. In Hebrew, the shape of the stem reliably identifies the conjugation class of a verb, whereas in Navajo the conjunct bears the markers of conjugation class. In Spanish, in contrast, conjugation class is a property of the lexeme as a whole, and therefore associated with the grammatical word. Paradigms, therefore, are like other structures in that they should be explored on a language-specific basis. Given that paradigms are relevant for each of the three languages studied in this dissertation, the present work confirms the importance of exploring the properties of paradigms in different languages (Robins 1959; Matthews 1991; J.P. Blevins 2014, 2016).

Given the importance of paradigms in the learning-based analysis and given that words rather than morphemes are the basis of the grammatical system, the results of the present study favor a Word and Paradigm (WP) model of morphological representation. Indeed, compared with Item and Arrangement (IA) or Item and Process (IP) models, in which the primary unit is the morpheme, a WP model can be thought of as “an exemplar-based perspective” (J.P. Blevins 2016, p. 8) and therefore consistent with an analytical approach that treats surface patterns as primary and that posits internal structure based on patterns of emergence. Thus, the analysis of this dissertation is aligned with a WP orientation by the fact that in a learning-based analysis, words are primary and that paradigms are schemas that emerge over sets of morphologically related words. This observation holds true for the three languages on which this dissertation has focused. Notably, though, these three languages are classified as synthetic languages, for which a WP orientation may be particularly suitable (Robins 1959). An interesting point of comparison, therefore, would be a learning-based motivation of morphological constituents in an agglutinating
language, such as Turkish, or in an isolating language, such as Mandarin Chinese. For languages in the Athabaskan, Romance, and Semitic language families, though, the present analysis favors a WP model.

2.4. Challenge to universality of morphological structure. As mentioned in Section 2.3.2 of Chapter 1, the notion of universality is not a basic assumption of a learning-based approach. It is not, however, ruled out in principle. For instance, we can imagine a situation where we find that a similar set of criteria motivate a morphological constituent in many different languages. Such a constituent would be a candidate for universality. The explanation for why such a constituent is universal would not then necessarily lend support to an innatist view of language since functional explanations could also likely account for why a constituent can be found cross-linguistically. For example, in the domain of phonology, the construct *segment* has been profitably applied to all spoken languages and may therefore be argued to be motivated as universal for spoken languages. This universality can be accounted for functionally since it has been demonstrated that, based on an experimental iterated learning model whereby participants learn and then reproduce a set of signals, the most efficient way for humans to organize a complex acoustic signal such as speech is through a limited number of building blocks that can combine into larger structures, akin to the way speech can be said to be organized around segments as building blocks (Verhoef, Kirby, & de Boer 2014). As mentioned in Section 2.1, the only morphological candidate for universality that emerges from the present study is the grammatical word, which, as has been noted, previous work has yet to successfully determine a common set of criteria to identify it across all languages.

In addition, with regard to word-internal morphological constituents, the present study indicates that these should not be considered universal structures, as discussed in greater detail in
Section 1.5. Thus, a strong version of the claim of universality – that a given morphological constituent such as a stem or a root is a part of the structure of all languages – is strongly challenged on the basis of the results of the present study. One possible response to this challenge of universality is that what is universal is an inventory of potential constituents and that individual languages select different constituents from that inventory. Given the fact that no two word-internal constituents of the six in total that are motivated for the three languages can be considered the same type of entity, such a response would lead one to conclude that these three languages coincidentally happen to share no constituents in common. Adding to this complication is the fact that these six constituents have overlapping properties, which is problematic for defining a constituent in terms of necessary and sufficient features. Such a lack of features to clearly distinguish, for instance, a Hebrew stem from a Navajo stem is not at all problematic if these are treated as language-specific cognitive categories.

Given the functionalist orientation of the approach, under a learning-based approach, an investigation involving a much larger selection of languages would be required to consider notions of universality. The results of the present investigation of three representative languages of three distinct language families indicate that the pursuit of universal word-internal morphological constituents is likely to support the conclusion that they are not universal structures.

2.5. Alignment with empirical studies. One of the significant advantages of adopting a learning-based approach is that the conclusions that it produces lend themselves well to empirical verification. Indeed, psycholinguistic and other external work informs the positing of morphological constituents that are proposed in Chapters 2 through 4. For example, psycholinguistic findings discussed in Section 3.1.1.5 in Chapter 2 offers evidence that the Hebrew root is at least in some sense psychologically real to speakers. The utility of describing acquisition
patterns in Navajo with the stem, as discussed in Section 3.1.4 of Chapter 3, offer evidence for the Navajo stem as a constituent in the language. In Spanish, external work corroborates the positing of the word as a constituent in the language, as discussed in Section 2.2.4 in Chapter 4. In addition, given that the morphological constituents in the present dissertation are claimed to be psychologically real to speakers, the findings of this study make predictions that can be used to verify the claims made regarding morphological constituents in Hebrew, Navajo, and Spanish.

Though the goal of the dissertation is to offer a theoretical analysis based on internal patterns, we can briefly consider examples of the kind of empirical work that can be conducted to demonstrate that the morphological constituents posited in the present study are indeed psychologically real to speakers. For instance, a variety of psycholinguistic methodologies – such as eye-tracking, nonce-formation, similarity judgments, etc. – have been used to verify predictions made by theoretical work. To illustrate how psycholinguistic work can be used in the service of verifying the claims of the present work, we can consider how priming effects can be used to test the prediction that the grammar of speakers of Hebrew, Navajo, and Spanish exhibits the morphological constituents that are claimed in the present study to be part of the knowledge of speakers.

As an experimental measure, priming allows us to consider whether the activation of a given linguistic structure (the prime) facilitates an activity involving another linguistic structure (the target). One conclusion that can be drawn from one structure priming another is that these two items are related structurally. For instance, as discussed in Section 3.1.1.5 of Chapter 2, Frost, Forster, and Deutsch (1997) use a masked priming experimental paradigm to show that lexical decisions and naming of target words both are facilitated by primes with a root in common with the target as compared to orthographically or semantically related primes. Thus, elements that are
categorized as the same type of constituent prime each other. Such an experimental paradigm could be used to test whether certain items are treated by speakers as the same type of constituent in the target languages. What follows is a sketch of how priming experiments might be used to verify some of the predictions of this dissertation. The sketches are intended to give only a rudimentary general sense of how empirical studies could work in conjunction with the analysis offered in the dissertation.

With regard to Hebrew, one prediction that could be tested using psycholinguistic experiments is that there are expected to be differences in speaker reactions with regard to roots in verbs versus nominals since the analysis of Chapter 2 posits that roots are part of the morphological hierarchy of verbs but not nominals. In addition, the analysis posits that roots as morphemes emerge for some nominals but not for others. Both predictions could be tested using the types of priming experiments discussed in Section 3.1.1.4 of Chapter 2. For example, we could conduct priming experiments with four classes of Hebrew words: verbs with roots that span multiple lexemes, verbs with roots that do not span lexemes (i.e., those can be identified for only a single verbal lexeme), nouns where roots as morphemes are expected to emerge (i.e., those with semantically related verbs in their word family), and nouns that show no evidence for a root as a morpheme. The prediction of the analysis of this dissertation is that verbs as a class would be primed by roots more often than nouns as a class and that, focusing on just nouns as a class, those associated with a root as a morpheme would be expected to be primed more than those not associated with a root as a morpheme. Thus, based on the present model, Hebrew speakers are expected to attend to roots, but to differing levels, with greater attention to roots as constituents (i.e., in verbs) than to roots as morphemes (i.e., in some nominals).
Similar work can be conducted with Navajo speakers. One of the main predictions made in Chapter 3 is that speakers recognize three constituents in Navajo verbs: the disjunct, the conjunct, and the stem. Therefore, speakers are expected to attend to those components of the verb. One experiment following the priming paradigm that could be conducted for Navajo would present speakers with primes that are strings of sounds that either consist of one of the aforementioned constituents or that consist of strings of sounds that are found in a word but that do not coincide with a constituent. For example, if the target word is *na-nihinish-tin* ‘I teach you (dual)’, a priming experiment could be conducted to see if there is a difference in priming effects for *nihinish*, which is the conjunct, and *hinishtin*, which spans the stem and part of conjunct. The former is expected to prime under the present analysis but not the latter. The overall principle at work is that speakers are expected to break up Navajo verbs on the basis of their constituent structure.

The model proposed in this dissertation for Spanish is not necessarily remarkably different from other models, especially since many of them only somewhat loosely distinguish between stems and roots (cf. Section 1.2). Moreover, the constituent structure for Spanish is posited to be simpler than for Hebrew or Navajo. Therefore, the type of priming effects that have been observed in previous research with regard to Hebrew roots and that are proposed above for Hebrew and Navajo constituents are not expected to be as salient for Spanish. Nevertheless, we can consider what predictions would be made for this model, either in case the priming effects are significantly large enough to show a positive result or in case a more sensitive experimental paradigm is determined. A similar experimental paradigm to that discussed above could be employed for Spanish, whereby an experiment could be conducted to see whether stems in particular prime words that contain those stems relative to strings of sounds that are contained by target words but that do not form a stem. In addition, as with Hebrew, the present model predicts that verbs and
nominals have different hierarchical structures. Therefore, whatever priming effects are evident for stems in Spanish should be stronger for verbs than for nominals.

The overall goal of psycholinguistic work testing the predictions of the models set forth for the constituent structure of Hebrew, Navajo, and Spanish is to show that the constituents proposed for each language play a role in speakers’ linguistic behavior. Therefore, other types of external evidence can also be marshalled to show this, including work in first language acquisition, second language acquisition, language change, and processing. Indeed, given that external factors play a role in the motivation of the morphological constituents posited for these three languages, additional external evidence has the potential both to validate the claims made in this dissertation and to improve upon them. In other words, though the present model posits, for example, no word-internal hierarchy in Navajo nor roots in Spanish, the model is open to the possibility of both if patterns in the respective languages are found that can be better described with such a constituent or construct than without it. Therefore, given its empirical basis, the present study can would be further refined – potentially even leading to the positing of a new constituent or a different understanding of those constituents that are currently posited for these three languages – through additional empirical work on the linguistic patterns, both internal and external, of these three languages.

3. Summary

In conclusion, the learning-based approach offers valuable insights into linguistic structure. Consistent with empirical approaches to linguistic theory, it demonstrates how morphological constituents can be motivated on the basis of the linguistic patterns a learner directly encounters in the linguistic input. In the three languages that are the focus of the present study, the grammatical word is motivated for each and word-internal structures are motivated for each: the root and stem
for Hebrew; the disjunct, conjunct, and stem for Navajo; and the stem for Spanish. In all cases, these constituents represent a convergence of different generalizations from morphological and other patterns in each of the three languages. These constituents therefore are linguistic categories that serve learners in their attempts to organize the linguistic input into a cohesive grammatical system and that serve analysts in their attempts to describe the patterns of a given language.

As shown by a comparison of the results for Hebrew, Navajo, and Spanish, the linguistic structures motivated in this way are best thought of in language-specific terms. Though there is overlap in the criteria used to motivate constituents across different languages, it should not be assumed that constituents that conventionally bear the same name across different language families are manifestations of the same linguistic unit. The present analysis, therefore, supports models that consider individual languages on their own terms.

Moreover, the fact that the linguistic categories that emerge from this process exhibit the properties of other cognitive categories suggests that linguistic analysis should be informed by general cognitive models of memory, categorization, analogical reasoning, and other such cognitive mechanisms. In this way, the results of a study such as the present dissertation produce conclusions that lend themselves to empirically testable predictions and the model itself lends itself well to modification based on the results of empirical work such as the kind of priming studies detailed above. Thus, a theoretical model based on a learning-based approach can be said to be in productive dialogue with many different kinds of empirical work.
References


Aronoff, M. (2007). In the beginning was the word. Language, 803-830.


Robins, R. H. (1959). In defence of WP. *Transactions of the Philological Society*, 58(1), 116-144.


