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Coordinate systems in Gã

Kurt Erbach
The University of Montana

COORDINATE SYSTEMS IN GÃ

By

KURT FASSL ERBACH

B.A. in English, Illinois State University, Normal, Illinois, 2011
B.A. in Economics, University of Illinois, Urbana, Illinois, 2009

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Coordinate Systems in Gã

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This thesis presents a comprehensive description and analysis of Gã coordinate systems. Gã is spoken primarily in Accra, the capital of Ghana, and no previous research on Gã has addressed the specific type of locative language described as coordinate systems (Lewis, Simmons, & Fennig, 2013). The current study is based on a corpus of Gã locative descriptions collected through interview-style elicitation sessions with a Gã speaker. Analysis of this corpus has revealed coordinate system morphemes *ŋwɛ̃ĩ̃* 'up', *shĩshĩ̃* 'down', *hĩɛ̃ 'front'*, *sɛ̀ɛ̀* 'back', *nĩ̃nɛ̀-j^{w}urɔ̃* 'right', and *àbɛ̀kú* 'left'. In describing the use of these morphemes I use Levinson's (2003) framework of locative language and coordinate systems. I propose that Gã uses the Intrinsic and Relative Frame of Reference types of coordinate systems. Additional characteristics of Gã coordinate systems include the use of intrinsic systems based on an entity's functional characteristics and occasionally on fixed armatures, and the use of 'left' and 'right' in conceptual areas, an extension from the names of hands to relative space in a visual field. My analysis of the Gã data also reveals weaknesses in parts of Levinson's framework—i.e., subtypes of the Relative Frame of Reference cannot be disambiguated, and deictic locative descriptions cannot be considered entirely separate from the Relative Frame of Reference. This analysis contributes to theories of locative language and also contributes to documentation of Gã.

Acknowledgements

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I owe a great deal of thanks to Benedicta Lomotey, the Gã language speaker to whom I was introduced by Dr. Bar-el's Field Methods class. Benedicta's endurance and enthusiasm in the elicitation sessions made the very tedious work of discerning distinct coordinate systems possible.

Additionally, Dr. Tully Thibeau deserves a great deal of thanks for contributing his experience with cognitive and conceptual frameworks of language. The models of language

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Abbreviations

2	second person
3	third person
INT	intensifier
DET	determiner

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1 Introduction

The only evidence for how people learn, conceive of, and discuss spatial relationships is in the language used to describe the locations of objects. Though individual academic disciplines often have different ways of discussing how people understand spatial relationships, the true variability in spatial relationships is in the language that people use to describe the locations of objects. Levinson (2003) provides a framework for understanding and categorizing spatial language which brings together the theories and models discussed in a number of disciplines including developmental psychology, cognitive science, and linguistics. Spatial language and descriptions of object locations are described by Levinson as belonging to the semantic class LOCATION.

The language of location is divided by Levinson into a number of categories depending on the type of spatial relationship being described. These relationships can be described in terms of specific three-dimensional angles, as is the case in locative descriptions using coordinate systems. Spatial relationships can rely entirely on two objects/entities existing proximally or distally from one another, as is the case in locative descriptions using coincidence. Any description of how a given language describes spatial relationships can potentially shed light on how people learn and conceive of spatial relationships.

In this thesis I describe the way the Gã language is used to create locative descriptions, focusing on descriptions using coordinate systems, but also addressing general preferences for locative descriptions. This description is based on a corpus of Gã locative descriptions that I collected during 9 elicitation sessions with a speaker of Gã. Analysis of these locative descriptions reveals preferential use of the Gã coordinate system morphemes *ŋwɛ̃ĩ̃* 'up', *shĩ̃shĩ̃* 'down', *hĩ̃ɛ̃ 'front'*, *sɛ̀ɛ̀* 'back', *nĩ̃nɛ̀-j^{w}urɔ̃* 'right', and *àbɛ̀kú* 'left'. The use of these morphemes

allows Gã to be classified in regards to the types of coordinate systems preferred by the Gã speaker: the Intrinsic Frame of Reference and the Relative Frame of Reference. Other patterns of Gã locative language include the use of one locative verb across many types of locative descriptions as well as person-marking on coordinate system morphemes.

By using the framework of locative language established in Levinson (2003), the analysis of Gã has revealed two parts of Levinson's framework that are problematic for definitive language categorization: (i) different subtypes of coordinate systems often cannot be disambiguated, and (ii) coordinate systems are not as distinct from deictic systems as Levinson would suggest. Ambiguity of coordinate systems occurs because of use of the same morphology in multiple types of coordinate systems. The relevance of deixis in coordinate systems stems from Hanks's (1992) description of deictic forms as referential indexicals. I argue that certain types of coordinate systems described in the current study fit Hanks's (1992) description of deixis implicating coordinate systems and deixis.

I defend the claims of this thesis by first presenting a brief background of the Gã language in Chapter 2, including its history, relevant features, and studies of coordinate systems in related languages. In Chapter 3, I review Levinson's (2003) framework for discussing locative descriptions. Chapter 4 is a description of the types of coordinate systems that are used in Gã, and Chapter 5 analyzes the data and provides evidence for claims about how Gã can be categorized among the world's languages in terms of coordinate systems. In Chapter 6, I classify Gã according to how it uses coordinate systems and I discuss the implications of this research in regards to frameworks of spatial language.

2 Review of literature on Gã and related languages

This chapter reviews details about Gã and related languages that may impact the extent to which coordinate systems are manifest in Gã. Section 2.1 provides a brief history of Gã language use. Section 2.2 establishes linguistic features of Gã, and Section 2.3 describes research on coordinate systems in Éwé, a language related to Gã. This review of literature on Gã and related languages provides background knowledge helpful for understanding coordinate systems in Gã.

2.1 Gã language use

Gã is a Niger-Congo language descendant of Ga-Dengme, Nyo, Kwa, Volta-Congo, and Atlantic-Congo in chronological order of respective parent language. It is spoken primarily in Accra, the capital of Ghana. The language has been written in the Latin alphabet since 1975 and the most recent estimates place the number of speakers at 600,000 (Lewis, Simmons, & Fennig, 2013). The pre-colonial period (1529-1925) saw the introduction of colonial languages into classrooms in Ghana. Danish, Dutch, English, and Portuguese have all been widely spoken in Ghana depending on who claimed to be in power. Policy regarding the use of colonial versus indigenous languages in the classroom has waffled in Ghana during the past five centuries, though recent language policy has shifted in favor of English for elementary education with indigenous languages only being taught in high schools (Owu-Ewie, 2006). The introduction of trade and colonial powers along the African Gold Coast, of which Ghana is a part, saw the rise of pidgin languages that were used by locals and colonials alike to conduct trade and missionary work (Huber 1999). Recently, the number of Gã speakers has been decreasing as people in communities that traditionally speak Gã encourage their children to speak English or Twi, a dialect of Akan, which is descendent of Kwa (Akpanglo-Nartey 2012). This history of extensive language contact certainly raises the possibility of language change due to contact. However, it

seems that no research has investigated the extent to which Danish, Dutch, English, and Portuguese may have influenced the native languages of Ghana such as Gã. Despite this intense language contact, the current study describes and analyzes Gã coordinate systems as independent of outside influence from contact languages.

2.2 Linguistic features of Gã

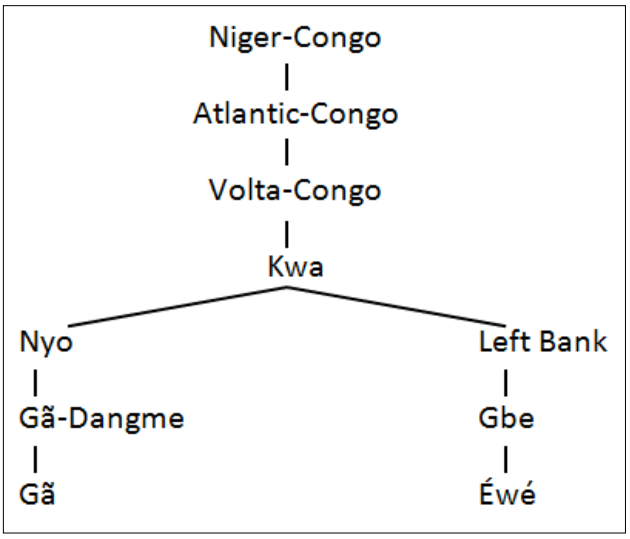
Gã has a number of linguistic features that are different from those of its colonial contact languages. It has been reported that Gã does not make many modifications to verb roots. Instead, it uses a series of verbs and marks each with pronouns to indicate grammatical relationships (Zimmerman 1858). Aside from the use of pronouns and roots to express grammatical relationships, there is little inflection in Gã. This lack of inflection suggests that Gã is perhaps a largely isolating language - words are inflected very little and it has a low morpheme per word ratio (Bybee, Perkins & Pagliuca 1994). Aside from verb-roots and pronouns, the class of Gã words that can be called nominal and compared to English nouns, are grammatically used in ways that resemble English subjects and objects (Zimmerman 1858).

2.3 Previous linguistic research on Gã and related languages

The earliest known work on Gã is a mid-1800s grammar of the language (Zimmerman 1858). Since then, a number of other works describing the grammar, function, and phonology of Gã have been produced (Bannerman 1948; Kropp Dakubu 1999, 1992). Regarding coordinate systems and frames of reference specifically, no previous work is known to have been conducted. However, coordinate systems and frames of reference have been investigated in Éwé. Like Gã, Éwé is descendent of Kwa in the Niger-Congo family and is spoken in Ghana (Lewis, Simmons, & Fennig, 2013). The ways that Éwé speakers express locative descriptions may be similar to those used by speakers of Gã.

Éwé has been shown to use all three frames of reference—absolute, intrinsic, and relative (Majid et al 2004)—though details about the subtypes of each frame of reference, preferences, or contexts of use could not be found. In Éwé, locative descriptions containing frames of reference require positional verbs and adpositions, which have developed from names for body parts (Levinson and Meira 2003). Positional verbs express characteristics of an object's position, orientation, and possibly shape (Lillehaugen and Foreman 2013). Adpositions are often used to express spatial and other types of relationships between entities (Svenonius 2007). Éwé can thus be said to create locative descriptions within verb phrases that indicate object position, orientation, and/or shape on the verb as well as with an adposition. Though Éwé and Gã are not immediate sisters—they share a common great-grandmother in Kwa (depicted in Figure 1)—it is still possible that the way Éwé speakers use coordinate systems is common to Gã speakers as well.

Figure 1: Gã Éwé Relationship



Because of the ways that coordinate systems are manifest in Éwé, we can hypothesize that Gã might also use a number of locative verbs and have adposition coordinates. However, Gã may

have changed over time and may use coordinate systems differently than Éwé. A description of Gã coordinate systems will illustrate how these two languages are similar or different. Such a description will also reflect the structure of coordinate systems established in Levinson (2003) and reveal implications for this structure.

3 Review of coordinate systems in language

Levinson (2003) proposes a categorical hierarchy of spatial language in which all locative descriptions involving angular specification are known as coordinate systems. For Levinson, a coordinate system is an abstract set of vectors that is often determined by the sides of an object. These vectors can be used to describe regions of space immediate to the distinct sides of an object, thus creating locative descriptions involving angular specifications. For example, in English, my *front* is the coordinate projecting from the plane of my body on which my face is located. A ball located in the region of space corresponding to my immediate *front* can be said to be *in front of* me. A clockwise rotation from my *front* will locate my *right*, *back*, and *left* sides at 90-degree intervals, which can then be used to describe where objects are located around me. Each of these sides is determined by a specific angle—or coordinate—and can be combined into two axes: a LEFT/RIGHT axis and a FRONT/BACK axis[1]. These two axes, when perpendicularly crossed make up a coordinate system. Any locative description that makes use of angular coordinates such as these can be said to be using a coordinate system.

Levinson's hierarchy of spatial language, more generally, distinguishes locative descriptions and motion descriptions. Locative descriptions in turn are divided into those involving specific coordinate systems as described above, and non-angular descriptions which Levinson calls COINCIDENCE. Coincidence is further broken down into deixis, topology, and toponymy. Coordinate systems are described as either of the vertical or horizontal plane. In either of these planes, coordinate systems are determined by the same set of characteristics and can be categorized as one of three frames of reference. In Section 3.1, I briefly discuss coincidence; in Section 3.2, I discuss coordinate systems; and Section 3.3 details the three frames of reference as they are conceptualized in the horizontal plane. The vertical plane is discussed in

[1] Here and throughout the thesis, I use small capital letters to indicate conceptual categories..

Section 3.4. The ways that frames of reference are used in the world's languages is discussed in Section 3.5; Section 3.6 summarizes the characteristics of coordinate systems relevant to this current study.

3.1 Locative descriptions of coincidence

Locative descriptions of coincidence are categorized by Levinson (2003) as involving either regions or places. A locative description of coincidence that involves a region is manifest in spatial deixis. In response to the question *where is the page number?* a locative description using spatial deixis could be *the page number is there*, if accompanied by a gesture pointing to the region indicated by the deictic form *there*. A deictic form in turn is one that references a specific entity in the universe—in this case, a page number's location—but only in conjunction with some other part of the speech event—in this case, the pointing gesture that accompanies the utterance of *there* (Hanks 1992).

The second subtype of locative description of coincidence involves place. A locative description of coincidence that involves a place is manifest in either toponymy or topology. A locative description with toponymy involves the name of a place. In response to the question *where is the page number?* a locative description using toponymy could be *the page number is in the footer,* since *footer* is the name of the bottom of the page. A locative description with topology involves proximity to another entity. This domain of spatial language is manifest in English by prepositions like *at, between, in, near*, etc. In response to the question *where is the page number?* a locative description using topology would be *it is on the page*. The crucial difference between coincidence and coordinate systems is that coincidence does not use vectors to describe where entities are located.

3.2 Locative descriptions using coordinate systems

There are different ways of using coordinate systems to create locative descriptions and these are known as frames of reference. There are distinct types of frames of reference, each having defining characteristics, and also sharing traits with the other frames of reference. Every frame of reference requires at least two entities: a referent and a relatum. The referent is the object being located, the object whose position is being described. The relatum is the object being used to locate the referent; it is the object whose coordinate system is providing the vector used to describe the referent's location. For example, in the locative description *the page number is in the footer,* the referent is *the page numbe*r and the relatum is *the* footer. The frames of reference that make use of only these two entities—the referent and the relatum—are said to be binary. However, some frames of reference make use of a third entity, a viewpoint, in addition to the referent and relatum. Such frames of reference are said to be ternary. The viewpoint is a location/entity that is external to the referent and relatum, and its coordinate system is used to determine the coordinate system of the relatum. Like the binary frame of reference, in a ternary frame of reference, the coordinate system of the relatum is used to describe the location of the referent. A ternary frame of reference is different because the relatum's coordinate system is determined by the relative location of the viewpoint. Examples of a ternary frame of reference are provided in Section 3.3.3 Relative Frames of Reference.

Another characteristic that distinguishes frames of reference is the source of the coordinate system. On the one hand, the coordinate system will always be fixed to the relatum, but the relatum itself may or may not be the source of the coordinates. The source of a relatum's coordinates can be discussed in terms of two sets of categories: (i) absolute, intrinsic, or relative, and (ii) egocentric or allocentric. Levinson proposes absolute, intrinsic, and relative as different

types of frame of reference, each distinguished by the source of the relatum's coordinate system. In an Absolute Frame of Reference, the source of the coordinate system is a set of fixed axes in the world, such as English's cardinal directions *north, south, east,* and *west*. The relatum of an Absolute Frame of Reference is thus given the coordinate system that originates from the magnetic poles of the earth. For example, *you are north of me* uses the earth's axes to determine the vector between the referent *you* and the relatum *me*. In an Intrinsic Frame of Reference, the relatum itself is the origin of the coordinate system. For example, when an English speaker says *you are in front of me,* the vector providing the coordinate *front* originates from the speaker's front. Lastly, in a ternary system—i.e., a Relative Frame of Reference—the viewpoint is the source of the coordinate system: The relatum of a Relative Frame of Reference is thus given a coordinate system that originates from the entity at the viewpoint. For example, when an English speaker says *you are in front of the ball*, the speaker's viewpoint is determining which side of the ball is the *front*.

Each of these frames of reference can be further categorized as egocentric and allocentric according to the source of a relatum's coordinate system. A frame of reference can be said to be egocentric if the speaker is the source of the coordinate system. If the speaker is standing at the viewpoint of a Relative Frame of Reference or if the speaker is the relatum of an Intrinsic Frame of Reference, then the coordinate system is egocentric. A coordinate system is allocentric if an entity other than the speaker is the relatum of a binary coordinate system or the viewpoint of a ternary coordinate system.

Any locative description using a coordinate system can be discussed in terms of the number of entities involved and the source of the relatum's coordinate system. The number of entities will be either binary or ternary, and the source of the relatum's coordinate system will be

either egocentric or allocentric. A more detailed description of each frame of reference in terms of these characteristics is provided in the following Section.

3.3 Frames of reference in the horizontal plane

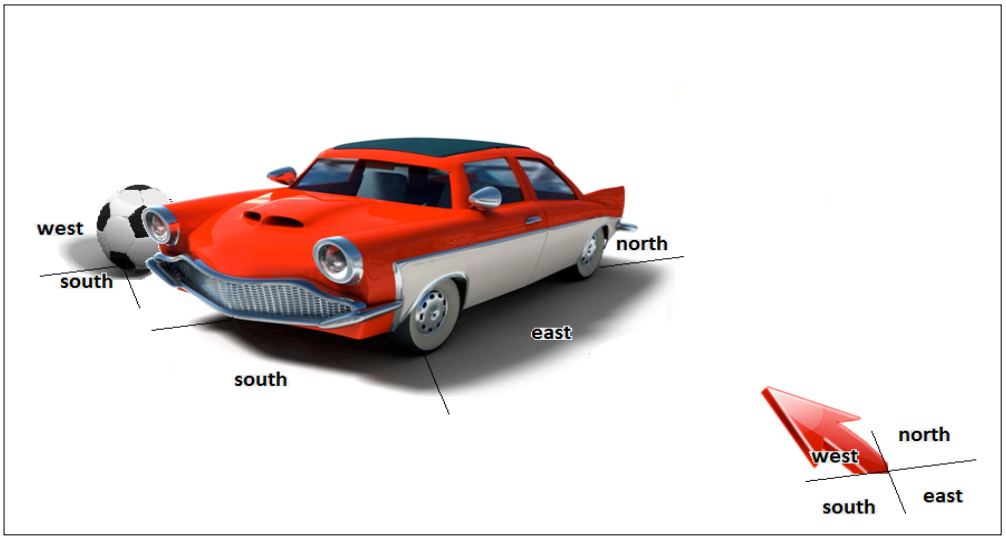
The characteristics of coordinate systems—having a particular source and being binary or ternary—determine whether the coordinate system is an Absolute, Intrinsic, or Relative Frame of Reference. The Absolute Frame of Reference described in Section 3.3.1 is binary and its source of coordinates is a set of points fixed on the earth. The Intrinsic Frame of Reference described in Section 3.3.2 is binary and its source of coordinates is the relatum's intrinsic system. The Relative Frame of Reference described in Section 3.3.3 is ternary and its source of coordinates is the viewpoint from which the relatum and referent are observed. The descriptions in each of these subsections specifically address the horizontal plane.

3.3.1 Absolute Frame of Reference

An Absolute Frame of Reference is binary and allocentric. This means that an Absolute Frame of Reference will always involve only a referent and a relatum—i.e., a viewpoint does not impact an Absolute Frame of Reference. The relatum can be any entity, but in an Absolute Frame of Reference, the source of the relatum's coordinates is a set of fixed points in the universe, such as the cardinal directions in English. Some languages use fixed points such as mountains, water-flows, and prominent winds to determine a set of absolute coordinates. These may or may not correlate with north, south, east, and west. For example, the Hanunóo have six absolute coordinates *ʔamīhan*, *tīmug, salātan, ʔabāgat babāyi, ʔabāgat lalāki,* and *kanāway*, which are based on wind directions that do not coincide with north, south, east, and west (Harrison 2007).

An example of entities each having a coordinate system based on English's Absolute Frame of Reference is illustrated in Figure 2, which contains a ball, a car, and an arrow indicating a viewpoint from which a speaker could be standing.

Figure 2: Absolute Frame of Reference



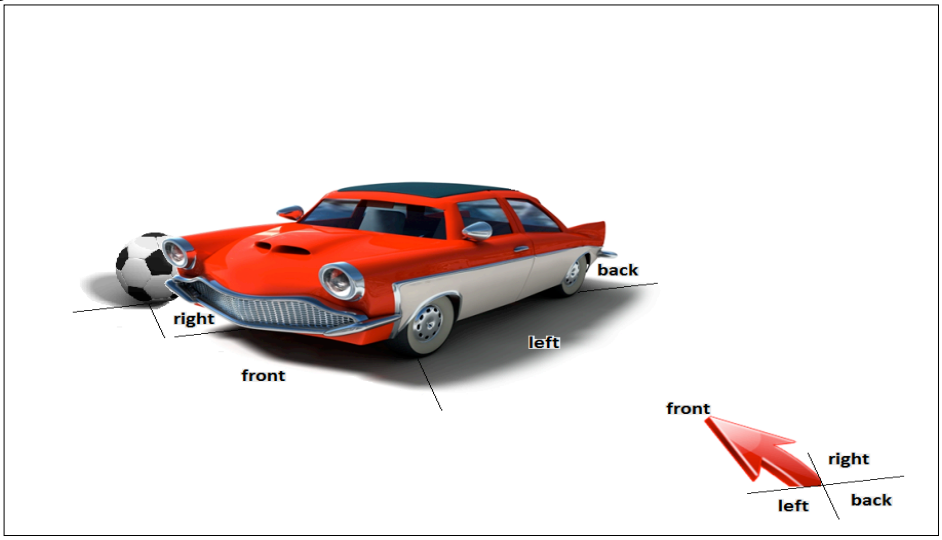
The ball, car, and viewpoint each have a set of coordinates determined by an Absolute Frame of Reference. In Figure 2 and the other illustrations in Section 3, coordinates are not represented as vectors, rather they are represented as regions of space bounded by vectors. Each such region of space represents a given coordinate. Specifically, the coordinates in Figure 2 are determined by the cardinal directions north, south, east, and west. Many locative descriptions can be derived from Figure 2. For example, a speaker at the viewpoint could say *the car is west of me*, or *the ball is west of the car.* The Absolute Frame of Reference is the only frame of reference in which locative descriptions are transitive. From the aforementioned examples, *the car is west of the viewpoint* and *the ball is west of the car*, it follows that *the ball is west of the viewpoint*.

3.3.2 Intrinsic Frames of Reference

An Intrinsic Frame of Reference is binary and can be either egocentric or allocentric. This means that an Intrinsic Frame of Reference will only ever involve a referent and a relatum, and that the source of the relatum's coordinates is always the relatum's own intrinsic system.

In English, a person such as a viewer/speaker has an egocentric intrinsic system in which his/her *front, back, left,* and *right* are determined by their anatomical namesakes—i.e., a person's physical front determines the vector they can call *front* and use in locative descriptions. A car has an allocentric intrinsic system in which its intrinsic front corresponds to the direction passengers face when seated inside the car, and the car's intrinsic back, left, and right also correspond to those sides of the passengers seated inside the car. These intrinsic systems are depicted as the coordinates in Figure 3. Many locative descriptions can be created from the Intrinsic Frames of Reference in Figure 3. An egocentric Intrinsic Frame of Reference could be made by a speaker who is the relatum standing at the viewpoint depicted by the arrow, saying *the car is in front of me* or *the ball is in front of me*.

Figure 3: Intrinsic Frame of Reference



An allocentric Intrinsic Frame of Reference could be made using the car as the relatum: *the ball is to the car's right* and *the viewpoint is to the car's left.*

Though one is egocentric and the other is allocentric, both intrinsic systems in the above examples are said to be determined by functional characteristics. The functional characteristics of a person's anatomical parts determine the coordinates of his/her intrinsic system. Similarly, the functional characteristics of the car as it contains passengers determine the coordinates of its intrinsic system.

An intrinsic system based on functional characteristics is only one of three types of intrinsic systems. The other two are based on object-centered geometry or on a fixed armature. In an intrinsic system based on object-centered geometry, an object's volumetric properties determine the axes of the coordinate system. In an intrinsic system based on a fixed armature, the *top, bottom,* and *sides* of an object are determined by gravitational orientation—i.e., the *bottom* of an intrinsic system based on a fixed armature is whichever side is touching or facing the ground. Despite these three intrinsic systems existing conceptually, not every object will have an intrinsic system. Just because an object has a functionally characteristic front does not mean it will have a left, right, or even a back. Whenever a speech community does not assign an intrinsic system in one of these three ways—functional characteristics, object-centered geometry, or a fixed armature—then the Relative Frame of Reference will be used to assign sides (that is, if the language uses the Relative Frame of Reference).

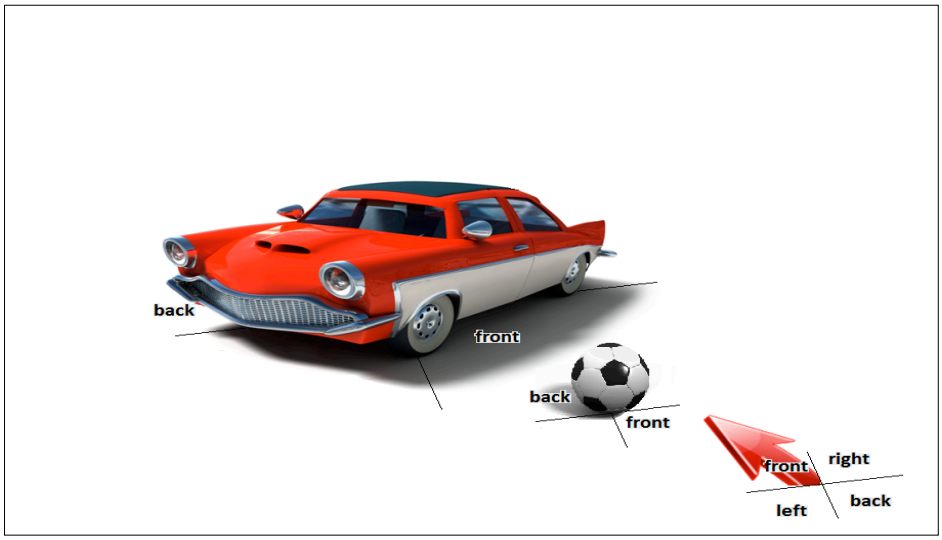
In sum, an Intrinsic Frame of Reference is a binary system in which the relatum's intrinsic system is the source of the coordinate system used to describe where a referent is. This contrasts with an Absolute Frame of Reference, which is also a binary system, but which uses fixed points in the universe as the source of the coordinate system for locating a referent.

3.3.3 Relative Frames of Reference

A Relative Frame of Reference is ternary and can be either egocentric or allocentric. This means that a Relative Frame of Reference must involve a viewpoint from which a referent and relatum are observed, and that the viewpoint can be either the speaker or another entity. What distinguishes the Relative Frame of Reference is the fact that the source of the relatum's coordinate system is an entity at the viewpoint from which the relatum and referent are observed.

It is important to note that the relatum of a Relative Frame of Reference may or may not have an intrinsic system. Though an entity may have an intrinsic system that can be used in an Intrinsic Frame of Reference, this does not preclude the entity from being used as the relatum in a Relative Frame of Reference. When this is the case—when an entity with an intrinsic system is being given a set of coordinates relative to where the viewpoint is—the relatum's intrinsic system may or may not align with the coordinate system given by the viewpoint to the relatum. Consider, for example, Figure 3, in which both the car and the ball are assigned a front and a back relative to the viewpoint. Even though the car was seen to have an intrinsic system that was the source of coordinates for an Intrinsic Frame of Reference in Figure 3, it is possible that the car is given a coordinate system by a viewpoint in a Relative Frame of Reference as well.

Figure 4: Relative Frame of Reference 1

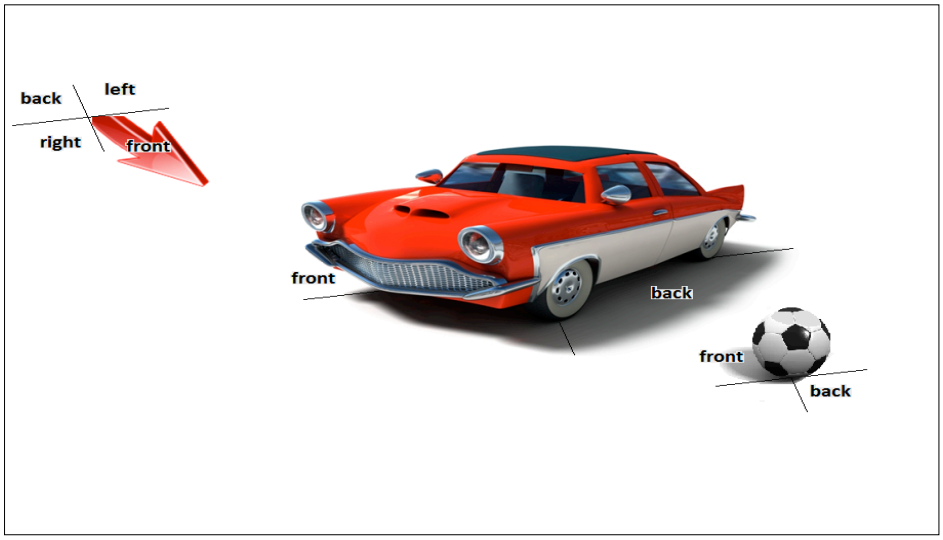


Unlike the car, in English, a generic ball does not have an intrinsic system that assigns a FRONT or BACK and so a Relative Frame of Reference is necessary to provide them.

In the Relative Frame of Reference in Figure 4, the FRONT of the relatum is the side closest to the viewpoint, and the BACK of the relatum is the side furthest from the viewpoint. These respective sides could also be BACK and FRONT respectively depending on the type of analysis of the Relative Frame of Reference is being used. Examples of locative descriptions that can be derived from the Relative Frame of Reference in Figure 3 are *the ball is in front of the car* and *the car is behind the ball*.

Crucially, in a Relative Frame of Reference, if the position of the viewpoint changes, then the coordinate system of the relatum also changes. In Figure 5, the viewpoint has changed. Although the car and ball have not moved, relative to the viewpoint, the ball is now on the opposite side of the car. In Figure 5, the coordinate system given to the car and the ball again depend on the location of the viewpoint.

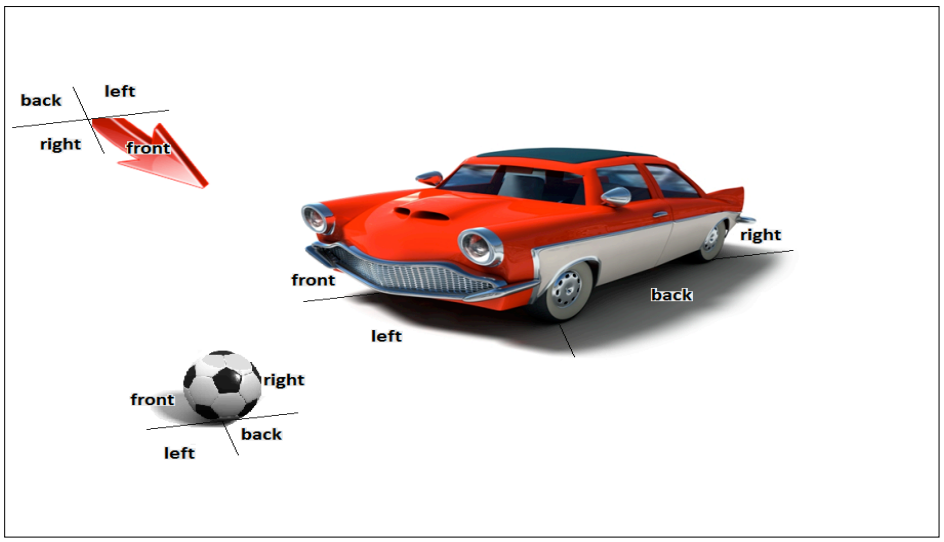
Figure 5 Relative Frame of Reference 2



According to the positions of entities in Figure 5, a speaker at the viewpoint could no longer say *the ball is in front of the car* or *the car is behind the ball*. Instead, a speaker at the viewpoint would say *the ball is behind the car* and *the car is in front of the ball*, even though neither of these objects have actually changed their location.

Levinson identifies three distinct Relative Frames of Reference seen in the world's languages—rotation, reflection, and translation. The Relative Frame of Reference with Rotation Analysis describes the case where the FRONT of the relatum is the side closest to the viewpoint, and the BACK is the side furthest from the viewpoint. Within a rotation analysis, the relatum also has a LEFT—that is, a 90-degree counter-clockwise rotation from the FRONT—and the relatum has a RIGHT—that is, a 90-degree clockwise rotation from the FRONT, as in Figure 6.

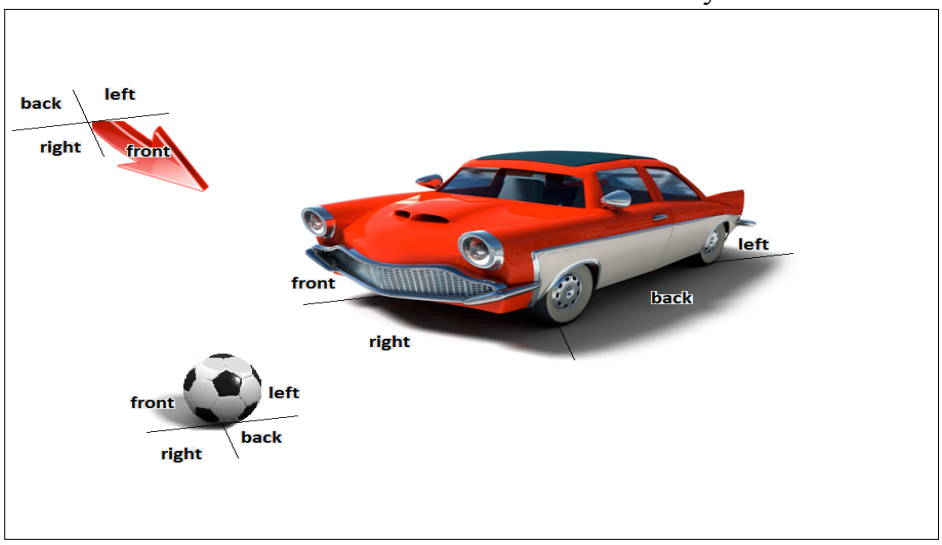
Figure 6: Relative Frame of Reference with Rotation Analysis



Locative descriptions that can be derived from the Relative Frame of Reference with Rotation Analysis seen in Figure 6 include *the ball is to the left of the car* and *the car is to the right of the ball*.

The Relative Frame of Reference with Reflection Analysis occurs when the FRONT of the relatum is the side closest to the viewpoint, and the BACK is the side furthest from the viewpoint. Within a reflection analysis, the relatum also has a RIGHT, that is, a 90-degree counter-clockwise rotation from the FRONT, and the relatum has a LEFT, that is, a 90-degree clockwise rotation from the FRONT. In other words, the RIGHT and LEFT of the relatum correspond to the RIGHT and LEFT of the viewpoint. These are depicted in Figure 7.

Figure 7: Relative Frame of Reference with Reflection Analysis

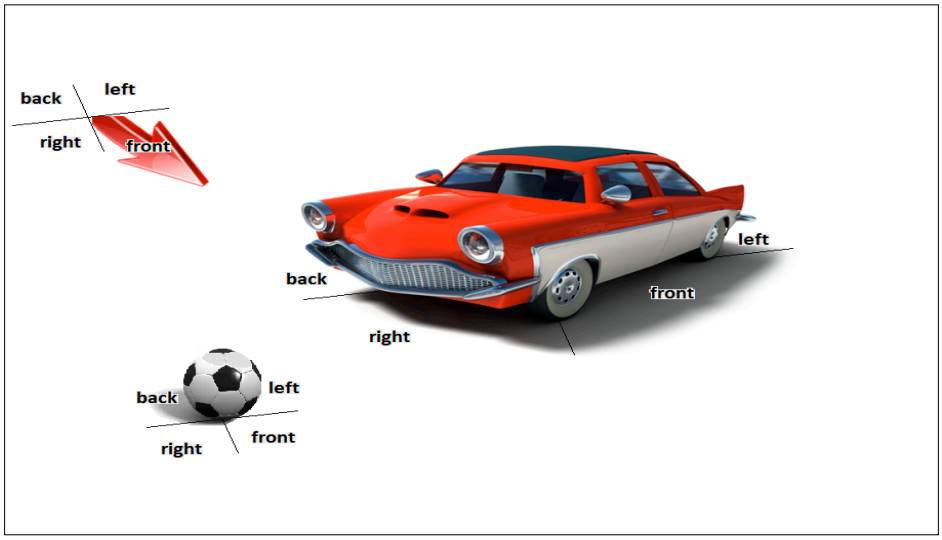


Locative descriptions that can be derived from the Relative Frame of Reference with Reflection Analysis seen in Figure 7 include *the ball is to the right of the car* and *the car is to the left of the ball.*

The Relative Frame of Reference with Translation Analysis occurs when the FRONT of the relatum is the side furthest from the viewpoint, and BACK is the side closest to the viewpoint. Within a translation analysis, the relatum also has a RIGHT (a 90-degree counter-clockwise rotation from the FRONT), and a LEFT (a 90-degree clockwise rotation from the FRONT). In other words, the RIGHT and LEFT of the relatum correspond to the RIGHT and LEFT of the viewpoint. Locative descriptions that can be derived from the Relative Frame of Reference with Translation

Analysis depicted in Figure 8 include *the ball is to the right of the car* and *the car is to the left of the ball.*

Figure 8: Relative Frame of Reference with Translation Analysis



3.4 Frames of reference in the vertical plane

Because gravity is unavoidable to speakers of the world's languages, its effects are manifest in frames of reference perhaps as much as they are in human life. Though the vertical plane can be seen to have distinct absolute, intrinsic, and relative frames of reference, these frames of reference are often aligned in the sense that a speaker would give the same description regardless of which frame of reference he or she may be using, and it is thus unclear which specific frame of reference is being used. For example, any object oriented in its canonical position—e.g., an upright bottle—will have an absolute UP/TOP due to gravity that is the same as the bottle's intrinsic UP/TOP, that is the same as the UP/TOP that would be identified by the external viewpoint of a Relative Frame of Reference. When frames of reference are thus aligned, the description *the box is on top of the bottle* could be referencing the TOP as determined by gravity, the bottle's intrinsic TOP, or the TOP of the bottle as determined by a relative viewpoint.

Despite this frequent alignment, the UP/TOP of different frames of reference can be disambiguated by orienting relatums or viewpoints in certain ways—e.g., tipping the bottle on its side.

3.5 Frames of reference across languages

Levinson has shown that spatial information is linguistically encoded in a variety of ways in the world's languages. Languages have been found to mark spatial information in the following ways: case, adpositions, relational and adverbial nominals, verbs, verbal clitics, and demonstratives. Spatial nominals, which often come from named sides or facets, seem to be the only universal pattern of linguistically coding frames of reference. These nominals also seem to be the source of spatial adpositions and cases since many languages demonstrate a diachronic grammaticalization chain where spatial nominals become adpositions, which sometimes become cases. Examples of the different ways of marking spatial information are available in Levinson (2003).

Aside from the location of spatial descriptions within a linguistic construction, there is diversity in the information distinguished by these lexemes. While some languages will use a single lexical item in all three spatial dimensions (the first, second and third dimensions illustrated as a line, a grid, and a 3D space respectively), other languages will distinguish the first dimension from a combination of the second and third dimensions, while the most marked systems will differentiate among all three dimensions. Regarding the specific frames of reference, vocabulary from a language's Intrinsic Frame of Reference is often the source of vocabulary for the language's Relative Frame of Reference.

It has been shown that there are different ways for a given language to encode coordinate systems as frames of reference. Not all languages use each frame of reference. Typologically

speaking, a given language may use only the Absolute Frame of Reference, only the Intrinsic Frame of Reference, both of these frames of reference, the Intrinsic Frame of Reference and the Relative Frame of Reference, or all three Frames of Reference. Though not every language uses every frame of reference, every language known to have been studied in regard to frames of reference and coordinate systems makes use of at least one of these three frames of reference. A language can have any combination of the frames of reference so long as they adhere to the following distributional patterns: if a language uses only one frame of reference, it will use either an Absolute or an Intrinsic Frame of Reference. Guugu Yimithirr, an indigenous language of Australia, has been shown to make exclusive use of the Absolute Frame of Reference (Levinson 2003), and only use lexical items resembling LEFT and RIGHT to name one hand from another. Mopan, a Mayan language on the other hand, has been shown to exclusively use the Intrinsic Frame of Reference (Danzinger 1996). No language has been found to use the Relative Frame of Reference exclusively, and languages will not use a Relative Frame of Reference unless they also use an Intrinsic Frame of Reference.

Levinson addresses whether or not using LEFT and RIGHT as the names of hands constitutes the Intrinsic Frame of Reference, arguing that as names of hands, LEFT and RIGHT are not angular coordinates. A significant part of Levinson's case is a cline of LEFT/RIGHT concepts as they are distributed across languages. One end of the cline is represented by languages like Guugu Yimithirr, where the only LEFT/RIGHT that exists are as distinct names of hands: all languages known have at least this distinction. The next step in the cline is LEFT/RIGHT sides of a person, followed by LEFT/RIGHT regions of a person, LEFT/RIGHT regions of an object, LEFT/RIGHT in a visual field, and finally LEFT/RIGHT bias in a word class, such as demonstratives. Languages have been shown to fall anywhere on this cline. Since an Intrinsic Frame of

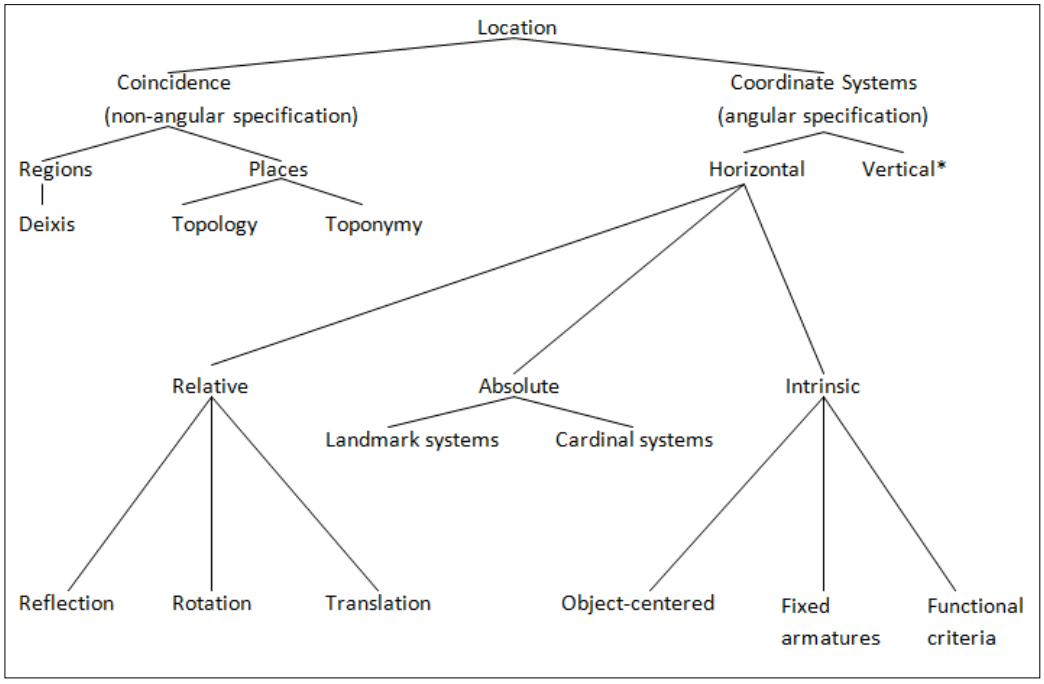
Reference is a way of distinguishing an object located in a region of space associated with a side of an entity, and because frames of reference must have a coordinate system determined by angles, LEFT/RIGHT sides of a person is the minimum LEFT/RIGHT distinction possible for an Intrinsic Frame of Reference that meets the criteria of coordinate systems. Thus, though Guugu Yimithirr has distinct names for a person's LEFT and RIGHT hands, the language does not use them as coordinates in an Intrinsic Frame of Reference.

Given the current description of coordinate systems and the ways they are manifest as frames of reference, this thesis will describe the coordinate systems in Gã, and the extent to which they manifest specific frames of reference. Such a description will allow Gã to be categorized among the world's languages according to the types of frames of reference it uses, as well as the extent to which LEFT/RIGHT are conceptualized in the language.

3.6 Summary of coordinate systems in language

Levinson categorizes coordinate systems as a semantic category under the parent category LOCATION, as depicted in the hierarchical structure in Figure 9.

Figure 9: Locative Descriptions



Coordinate systems are either horizontal or vertical. Figure 9 shows the horizontal plane broken down into three frames of reference described above: absolute, intrinsic, and relative. The asterisk next to the vertical category is to indicate that it too has the three frames of reference. An Absolute Frame of Reference can be based on either landmarks or cardinal directions. An Intrinsic Frame of Reference is based on an intrinsic system that is object centered, a fixed armature, or a set of functional criteria. A Relative Frame of Reference can be based on one of three different types of analysis: reflection, rotation, or translation. If every language's coordinate systems is based on this categorical hierarchy, as Levinson maintains, then there exist a finite number of ways coordinate systems can be manifest in the world's languages. What contributes to the uniqueness of a language's coordinate systems is the set of preferences and social registers that may or may not dictate coordinate system use. For example, Levinson (2003) discusses how experts of a given field may use a given language's coordinate systems differently than those who use coordinate systems in every day parlance. Levinson calls this type of language use "expert language". Nevertheless, it has been shown that speakers of different languages use coordinate systems in different ways, and the current study seeks to describe the ways in which speakers of Gã use coordinate systems.

4 Gã Coordinate Systems

The following account of Gã Coordinate Systems comes from the data gathered with a person who was raised in a multilingual household where Gã and English were spoken. The goals of the research were to determine the possible and preferred locative descriptions and subtypes thereof used to describe spatial relationships, with a focus on coordinate systems. The following description employs the framework of coordinate systems and other locative descriptions established in Levinson (2003).

During each elicitation, the speaker of Gã was given a variety of tasks that were designed to prompt a locative description such as *àdékà yè tɔ̀ ŋwɛ̃ĩ,* 'the box is on top of the bottle'. Examples of these tasks include a route description, picture descriptions, and descriptions of objects arranged increasingly distally from the speaker. My general findings are discussed below: The Gã speaker never used an Absolute Frame of Reference in the horizontal plane, though she did use the Absolute Frame of Reference in the vertical plane (Section 4.1). When using coordinate systems, the speaker of Gã primarily used the Intrinsic Frame of Reference and demonstrated intrinsic systems based on functional characteristics as well as a fixed armature (Section 4.2). The Gã speaker also used the Relative Frame of Reference with Rotation Analysis and the Relative Frame of Reference with Reflection Analysis in some locative descriptions (Section 4.3). The speaker of Gã used LEFT and RIGHT in various conceptual domains (Section 4.4). The Gã speaker's use of coordinate systems is summarized in 4.5. Despite using these coordinate systems to provide specific spatial descriptions of objects, the speaker of Gã overwhelmingly seemed to prefer topological descriptions over coordinate systems.

4.1 The Absolute Frame of Reference

Recall from Section 3.3.1 that the Absolute Frame of Reference provides a locative description based on a coordinate system of cardinal directions such as *north, south, east,* and *west*, in English. The Gã speaker never used any coordinates that could be said to correspond to an Absolute Frame of Reference in the horizontal plane. Several tasks were designed in an attempt to specifically elicit an Absolute Frame of Reference, but the speaker never provided such a locative description. For example, when prompted with the question *ímbè 'Mexico' eyò,* "Where is Mexico", the speaker responded with coincidence—*Mexico yè Latin America*, 'Mexico is in Latin America'—rather than with an Absolute Frame of Reference—e.g., *Mexico yè United States woi* 'Mexico is south of the United States'. After being prompted to provide translations for the English cardinal directions, the speaker admitted that she had forgotten their Gã equivalents. Eventually the Gã speaker researched the forms and volunteered *kooyi* 'north', *woi* 'south', *anai* 'west', and *boka* 'east'. Although the Absolute Frame of Reference was never used by the speaker to describe coordinates in the horizontal plane, Gã does have a set of words to describe the coordinate system of an Absolute Frame of Reference.

Regarding the Absolute Frame of Reference in the vertical plane, the speaker used the form *ŋwɛ̃ĩ̃* to describe the region of space ABOVE an object—i.e., the direction opposite the pull of gravity. For example, while pointing above herself, the speaker described the direction as *ŋwɛ̃ĩ̃*:

(1) ŋwɛ̃ĩ̃
[up, heaven][2]

[2] Translations given in brackets indicate they have been supplied by me when the speaker did not provide a translation.

Similarly, for (2), the speaker was given a set of objects to arrange according to the locative description in the Gã construction *àdékà yè tɔ̀ ŋwɛ̃̄ĩ̄* (‘The box is on top of the bottle’) and she placed the box on the opening of the upright bottle, opposite the pull of gravity.

(2) àdékà yè tɔ̀ ŋwɛ̃̄ĩ̄
box be.at bottle up/top
‘The box is on top of the bottle’

In both (1) and (2) we see the clearest examples of an absolute UP—i.e., the direction opposite the pull of gravity. However, in both of these cases, the absolute UP corresponds to an intrinsic up: the coordinate labeled UP in an Absolute Frame of Reference—i.e., the direction opposite the pull of gravity—corresponds to the coordinate labeled UP in an Intrinsic Frame of Reference—i.e., the direction projecting outward from an entity’s TOP. In (1), the speaker’s intrinsic UP is aligned with the absolute UP, and in (2), the bottle’s intrinsic UP/TOP is aligned with the absolute UP. Additionally, the description and arrangement of objects in (2) can be said to correspond to UP in a Relative Frame of Reference, where both the viewpoint relative to the bottle, and the box itself determines which coordinate is UP. These alignments are typical of the vertical plane. It is often difficult to distinguish one frame of reference from another when the absolute UP/DOWN of gravity corresponds to an object’s intrinsic UP/DOWN, and these likewise correspond to a relative UP/DOWN (Levinson 2003). Despite this alignment, (1) and (2) provide evidence of the Absolute Frame of Reference. Preventing alignment of the vertical plane can be accomplished with very specific elicitation tasks such as those discussed in 4.2.1 that tease apart the different frames of reference.

4.2 Intrinsic Frames of Reference

The Gã speaker used Intrinsic Frames of Reference to describe binary spatial relationships that were both egocentric and allocentric. In an egocentric binary spatial

relationship, the speaker used her intrinsic system to describe where another object was located. For example, the speaker was asked to describe where a purple chair was located compared to where she was. In (3), she described the location of the couch as *isɛ̀ɛ̀* 'behind me' revealing that her intrinsic back determined the coordinate used to describe the location of the purple chair.

(3) sɛ̃ĩ Ĺɛ̀ yè i-sɛ̀ɛ̀
chair purple DET be.at 1-behind
'The purple chair is behind me'

In (3), the speaker herself is the relatum whose intrinsic system provides the coordinates used to describe the location of the purple chair, which is the referent.

In an allocentric binary spatial relationship, the speaker used the coordinate system of an entity that was not herself to describe the location of the referent. When asked to describe the location of the purple chair in comparison to the investigator, in (4), the investigator is identified as the second person, and the purple chair's location is described in terms of the investigator's intrinsic system.

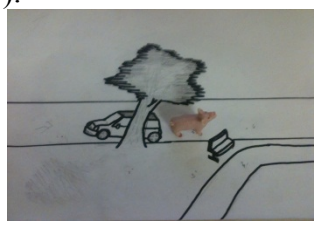
(4) sɛ̃ĩ Ĺɛ̀ yè o- nĩnè-j^{w}urɔ̃
chair purple DET be.at 2-direction-right
'It's to your right'

o-nĩnè-j^{w}urɔ̃ 'your right' is an allocentric Intrinsic Frame of Reference because it is a binary relationship between the second person and the purple chair. In (4), the second person is the relatum and the purple chair is the referent.

In addition to human entities, animate non-humans (a bear, a pig) and some inanimate entities (a car, a bottle) were all described by the speaker such that each can be said to have an intrinsic system. For different elicitation prompts, each of these entities was used, in turn, as the relatum of a binary locative description—i.e., the entity's intrinsic system determined the

coordinate that was used to describe the location of the referent—thus exemplifying an Intrinsic Frame of Reference.

Both an illustrated car and a three-dimensional figurine of a piglet were used as the relatum of an allocentric Intrinsic Frame of Reference. For (5), the speaker was asked whether 'the pig is behind the car' would describe this picture. The speaker confirmed that this description would be possible and provided the locative description in (5).



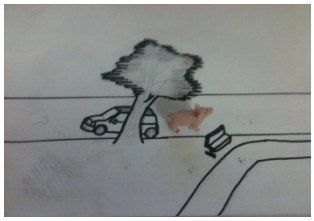
(5) kplotoo yè tsoni e- sɛ̀ɛ̀
piglet be at car 3-behind
[The pig is behind the car]

In (5), the car is the relatum whose intrinsic system provides the coordinate *sɛ̀ɛ̀* 'behind', which is used to describe the location of the referent, the pig.

The description in (5) is not making use of an Absolute Frame of Reference because there is no mention of cardinal directions. Likewise, this description is not a Relative Frame of Reference because this use of *sɛ̀ɛ̀*, 'behind', is not derived from the viewpoint of the person describing the picture. Depending on whether the speaker is using the rotation, reflection, or translation analysis, a Relative Frame of Reference would yield the coordinate *àbɛ̀kú* 'left' or *nĩnè-j^{w}urɔ̃* 'right' because the Relative Frame of Reference is dependent on the location of the viewpoint and on how the viewer's coordinates are mapped onto the relatum. Because the coordinates in (5) are not derived from the viewpoint, but rather from those of the car, (5) must be an Intrinsic Frame of Reference.

In (6), the entities are arranged in the same way as (5) but the locative descriptions in the respective examples exhibit different binary relationships. Given the picture in (6), the speaker was asked if it would make sense to describe the arrangement with "the car is behind the big". She affirmed that it would and translated the description as *tsoni yè kplotoo-e e-sɛ̀ɛ̀*.

(6) tsoni yè kplotoo-e e-sɛ̀ɛ̀
car be.at piglet-DET 3-behind
[The car is behind the pig]



In (6), the pig is the relatum whose intrinsic system provides the coordinate used to describe the location of the referent, which is the car. Again, this description could not correspond to an Absolute Frame of Reference because it makes no use of the cardinal directions, nor could this description be a Relative Frame of Reference because a Relative Frame of Reference would yield the coordinate *àbɛ̀kú* 'left' or *nĩnè-j^{w}urɔ̃* 'right'.

A figurine of a bear is seen to be the relatum of an allocentric Intrinsic Frame of Reference in both (7) and (8). In (7), a bottle is located in the region of space on the side of the bear that corresponds to the speaker's LEFT, and that would be labeled *àbɛ̀kú* 'left' in a Relative Frame of Reference with either Reflection or Translation Analysis. However, the bottle is described as being *nĩnè-j^{w}urɔ̃* 'right' of the bear, corresponding to either an Intrinsic Frame of Reference or a Relative Frame of Reference with Rotation Analysis.

(7) tɔ̀ yè bɛ nĩnè-j^{w}urɔ̃
bottle be.at bear direction-right
'the bottle is to the right of the bear'

Whether (7) is an Intrinsic or a Relative Frame of Reference depends on whether the coordinate *nĩnè-j^{w}urɔ̃* 'right' is part of the bear's intrinsic system or if it projected from the speaker's relative viewpoint. To determine which of these was the case, the pair of objects in (7) was rotated 180-degress, while the speaker maintained the same viewpoint. If the speaker maintained a Relative Frame of Reference with Rotation Analysis across these two arrangements of objects, the bottle would have been at the bear's left in the latter arrangement. However, the same

description in (7) was given for the new arrangement of objects in (8)—the bottle is still described as being on the bear's right.

(8) tɔ̀ yè bɛ nĩnè-j^{w}urɔ̃
bottle be.at bear direction-right
'the bottle is to the right of the bear'

In (8) the description *tɔ̀ yè bɛ nĩnè-j^{w}urɔ̃*, 'the bottle is to the right of the bear' could correspond to either an allocentric Intrinsic Frame of Reference or a Relative Frame of Reference with Reflection Analysis. Because the allocentric Intrinsic Frame of Reference is the only frame of reference used consistently by the speaker in these two questions, it is likely the frame of reference being used. (7) and (8) illustrate situations in which the description may be one of multiple frames of reference.

4.2.1 Intrinsic Systems

In each of the above Intrinsic Frames of Reference—the people in (3) and (4), the car in (5), the pig in (6), and the bear in (7) and (8)—the intrinsic system of each relatum can be said to be based on functional characteristics. For the people and the pig, the functional characteristics of a face and anatomical back, left side, and right side, are likely the basis of the intrinsic system of coordinates that have synonymous labels. In (5), the coordinates of the car's intrinsic system correspond to the passengers and the car's canonical path of motion giving the car an intrinsic *hĩɛ̃* 'front' and *sɛ̀ɛ̀* 'back', which again are determined by functional characteristics.

To determine how the speaker of Gã might describe an intrinsic system, the figurine of a bear was presented to the speaker and she was asked to name the bear's sides as they were pointed to, in turn. In (9), the side of the bear pointed to is described as *àbɛ̀kú* 'left'.

(9) bɛ e-àbɛ̀kú
bear 3-left
'his left hand side'

Notably, this label *àbèkú* ‘left’ would also occur in a Relative Frame of Reference with Reflection Analysis, and a Relative Frame of Reference with Translation Analysis. The fact that neither of these are the source of this label is evidenced by the description in (7) above. Unless the speaker is regularly switching between types of Relative Frame of Reference when assigning coordinate systems, she is likely using the bear’s intrinsic system based on functional characteristics to determine *àbèkú* ‘left’ and *nĩ̀nè-j^{w}urɔ̃* ‘right’ in (9) and (7) respectively. *Àbèkú* ‘left’ and *nĩ̀nè-j^{w}urɔ̃* ‘right’ correspond to the same canonical rotation used to assign a *àbèkú* ‘left’ and *nĩ̀nè-j^{w}urɔ̃* ‘right’ to a person: The *àbèkú* ‘left’ is a 90-degree counter-clockwise rotation from the front and *nĩ̀nè-j^{w}urɔ̃* ‘right’ is a 90-degree clockwise rotation from the front.

A bottle presents a case of an intrinsic system based on functional characteristics where the *àbèkú* ‘left’ and *nĩ̀nè-j^{w}urɔ̃* ‘right’ of the bottle do not correspond to the canonical rotation as seen with the bear. Instead, the sides of the bottle are labeled according to a different set of functional criteria: the bottle’s LEFT is the side that corresponds to the LEFT of a person who is facing the bottle’s FRONT. The FRONT of the bottle is determined by the side to which the bottle’s label is attached, the same side that is canonically approached by someone reaching for the bottle—e.g., the side that would be displayed on a shelf in a store.

Pointing to the functional TOP of the bottle in (10)—the opening of the bottle—the speaker described this as *ŋwɛ̃ĩ̃* ‘top’. I propose that this is a description of a the bottle’s intrinsic system even though an Absolute Frame of Reference and Relative Frame of Reference would yield the same description of this coordinate of the bottle.

(10) tɔ̀ e-ŋwɛ̃ĩ̃
bottle 3-top
‘the top of the bottle’

The fact that this is a functionally intrinsic top in (10) is confirmed in (11) when the same side of the bottle is labeled *ŋwɛ̃ĩ̃* 'top' even though the bottle has been rotated 90-degrees.

(11) tɔ̀ ŋwɛ̃ĩ̃
bottle up/above
'top of the bottle'

The description of *ŋwɛ̃ĩ̃* 'top' in (11) does not correspond to an Absolute Frame of Reference nor does it correspond to any Relative Frame of Reference. Therefore, (11) must be an intrinsic system based on functional characteristics.

The bottle's intrinsic system is further exemplified when the speaker described the *hĩɛ̃* 'front' as the side of the bottle with the label, even though this side was not facing her.

(12) tɔ̀ hĩɛ̃
bottle front
'the front side'

In (12) the side of the bottle pointed to and described as *hĩɛ̃* 'front' cannot be an Absolute Frame of Reference because a cardinal direction is not used. If the speaker had used a Relative Frame of Reference to assign a coordinate name to the side of the bottle, then *àbɛ̀kú* 'left' or *nĩ̃nɛ̀-jʷurɔ̃* 'right' would have been used in (12).

The *àbɛ̀kú* 'left' and *nĩ̃nɛ̀-jʷurɔ̃* 'right' of the bottle do not follow the same pattern of rotation used to assign the *àbɛ̀kú* 'left' and *nĩ̃nɛ̀-jʷurɔ̃* 'right' of people, bears, and pigs. Instead of the bottle's *àbɛ̀kú* 'left' being a 90-degree counter-clockwise rotation from the *hĩɛ̃* 'front', as was seen with the bear, the *àbɛ̀kú* 'left' of the bottle corresponds to the viewer's *àbɛ̀kú* 'left'. This LEFT may be considered the bottle's intrinsic LEFT if it is assigned in the same way that a desk's LEFT is assigned: the desk's intrinsic FRONT is the side at which a user sits, and the desk's intrinsic LEFT is the side to which the user's LEFT faces. When a person is facing a desk's

intrinsic front, the assignment of coordinates is identical to the way a relatum's coordinates are assigned in Relative Frame of Reference with Reflection Analysis (Levinson 2003).

For the bottle described in Gã, the intrinsic FRONT is the side with the label, and the intrinsic LEFT is the side corresponding to the LEFT of a person who is facing the bottle.

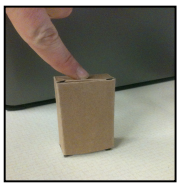
(13) tɔ̀ e-àbɛ̀kú
bottle 3-left
'the left'

This LEFT is seen to be intrinsic and not based on a fixed armature determined by Relative Frame of Reference with Reflection Analysis when the bottle is rotated 90-degrees and the bottle maintains the same intrinsic system of coordinates. In (14), the side of the bottle pointed to in (13) is now facing the speaker and it is still called *àbɛ̀kú* 'left' despite this rotation.

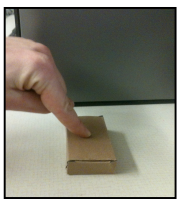
(14) tɔ̀ e-àbɛ̀kú
bottle 3-left
'the left side'

A fixed armature determined the intrinsic system of a box in (15) and (16). In both of these examples, and in accordance with a fixed armature as described by Levinson (2003), the *ŋwɛ̃ĩ̃* 'top' of the box is determined by an armature that is fixed in space. Though the box rotates between the description in (15) and that in (16), the armature stays fixed and the side of the box opposite the pull of gravity is always labeled *ŋwɛ̃ĩ̃* 'top'.

(15) àdékà ŋwɛ̃ĩ̃
box up
'top'

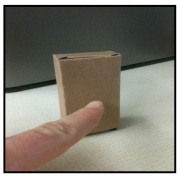


(16) àdékà ŋwɛ̃ĩ̃
box up/above
'the top of the box'



In Levinson's (2003) description of a fixed armature, each SIDE is not discriminated further as FRONT, BACK, LEFT, or RIGHT. Instead, the sides of the box in the horizontal plane are determined the way a relatum's coordinate are in a Relative Frame of Reference. In (17) and (18) the *hĩɛ̃* 'front' of the box is the side that faces the viewpoint of the speaker.

(17) àdékà e-hĩɛ̃
box 3-face/front
'the front of it'



(18) àdékà hĩɛ̃
box front
'the front of the box'

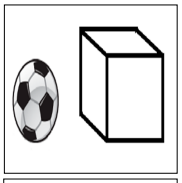
The reason that (17) and (18) do not illustrate an intrinsic system is that the FRONT labeled in (17) and (18) would rotate with the viewpoint rather than remaining fixed in space. Such a coordinate system, which is based on a viewpoint, is described as a Relative Frame of Reference (Levinson 2003).

4.3 Relative Frames of Reference

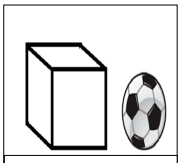
As noted above in Section 3.3.3, A Relative Frame of Reference is a ternary spatial relationship in which a viewpoint determines the coordinate system of a relatum. The relatum's given coordinate system is then used to describe the location of a referent. When the speaker used a Relative Frame of Reference she commonly used her own viewpoint, yielding egocentric Relative Frames of Reference. Of these egocentric Relative Frames of Reference, both the rotation analysis and the reflection analysis were used by the speaker. There was also one example of an allocentric Relative Frame of Reference, where an entity that was not the speaker was the viewpoint from which the relatum and referent were viewed and described.

The Relative Frame of Reference with Rotation Analysis was seen when an illustrated cube was the relatum and an illustrated ball was the referent in (19), (20), (21) and (22) below. For each of the respective examples, the Gã speaker was asked to locate the ball in comparison to the box. She saw the pictures the same way they are presented here, and provided a locative description using a coordinate system for each picture and question.

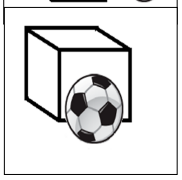
(19) e- nĩnè-j^{w}urɔ̃
3-direction-right
[Its right side]



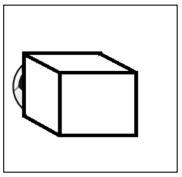
(20) e- àbɛ̀kú
3-left
[Its left]



(21) e- hĩɛ̃
3-face/front
[Its front]



(22) e- sɛ̀ɛ̀
3-behind
[Its behind]



In (19), (20), (21) and (22) the coordinates described are projected onto the box/relatum from the speaker's viewpoint. As is expected in a Relative Frame of Reference with Rotation Analysis, the *hĩɛ̃* 'front' of the relatum is the side closest to the viewpoint (21), and *sɛ̀ɛ̀* 'back' is the side furthest from the viewpoint (22). The relatum also has an *àbɛ̀kú* 'left' that is a 90-degree counter-clockwise rotation from the FRONT as in (19), and the relatum has a *nĩnè-j^{w}urɔ̃* 'right' that is a 90-degree clockwise rotation from the FRONT as in (20).

A Relative Frame of Reference with Reflection Analysis was used by the Gã speaker to describe a ternary situation in which she was the viewpoint, a box was the relatum, and a bottle

was the referent. In (23) and (24) the coordinates are projected onto the box/relatum from the speaker's viewpoint.

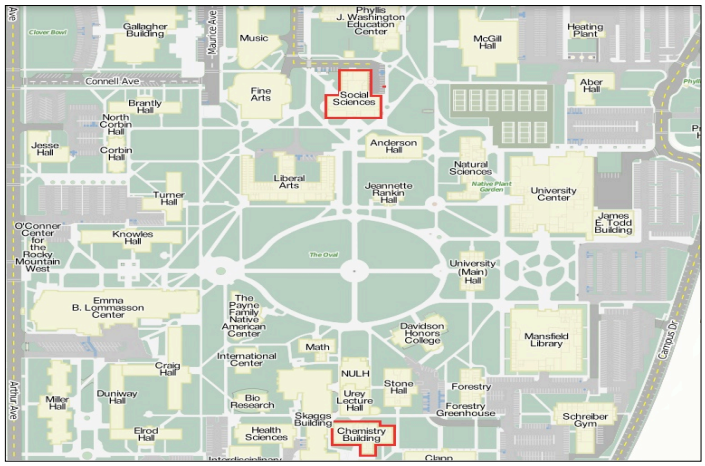
(23) tɔ̀ yè àdékà àbɛ̀kú
bottle be.at box left
'the left of the box'

(24) tɔ̀ yè àdékà sɛ̀ɛ̀
bottle be.at box behind
'the bottle is behind the box'

The coordinate descriptions elicited in (23) and (24) as a pair can only correspond to a Relative Frame of Reference with Rotation Analysis. In such a frame of reference, the *sɛ̀ɛ̀* 'back/behind' is the side of the relatum furthest from the viewpoint, and the *àbɛ̀kú* 'left' corresponds to the *àbɛ̀kú* 'left' of the speaker/viewer.

There was one example of an allocentric Relative Frame of Reference, where an entity that was not the speaker/speaker was the viewpoint from which the relatum and referent were viewed and described. For (25), the speaker was looking at a map of The University of Montana campus (Figure 10). This university campus is where the elicitations were conducted.

Figure 10: The University of Montana



When asked to describe where the Chemistry Building was located relative to the Social Sciences building (in which she was located), the speaker used the description *ovale sɛ̀ɛ̀* 'behind the oval'.

(25) kɛmɪstri tsʊ̃-e e-yè ovale sɛ̀ɛ̀
Chemistry building-DET 3-be.at Oval-DET behind
'It's behind/after the oval'

The description of the Chemistry building as being behind the Oval is only possible in the Relative Frame of Reference if the viewpoint is looking at the Oval. Since the speaker was seated in a walled room (consequently with her back to both the Chemistry building and the Oval), (25) must be an allocentric Relative Frame of Reference where the *hĩɛ̃* 'front' of the Social Sciences building is the viewpoint, the Oval is the relatum, and the Chemistry Building is the referent.

4.4 Left/right concepts in Gã

The Gã speaker used *àbɛ̀kú* 'left' and *nĩnè-j^{w}urɔ̃* 'right' in a nearly every conceptual domain described in Section 3.5. The most limited use of LEFT and RIGHT in a language is as names of hands only. When the Gã speaker was asked if there were names to distinguish one hand from the other, *àbɛ̀kú* 'left' and *nĩnè-j^{w}urɔ̃* 'right' were used as names of hands, the first of which is exemplified in (26).

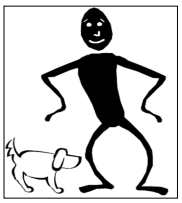
(26) àbɛ̀kú
left.hand
'my left hand'

The Gã speaker also used *àbɛ̀kú* 'left' and *nĩnè-j^{w}urɔ̃* 'right' to describe the different sides of a animate entity. In (27) the side of the bear pointed to is described as *àbɛ̀kú* 'left'.

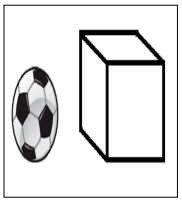
(27) bɛ e-àbɛ̀kú
bear 3-left
'his left hand side'

Àbɛ̀kú ‘left’ and *nĩnè-j^{w}urɔ̃* ‘right’ were also used by the Gã speaker to describe regions surrounding people and objects. In (28), the dog is described as being at the person’s right region, and in (29), the ball is described as being at the box’s right region.

(28) e-yè e-nĩnè-j^{w}urɔ̃
3-be.at 3-direction-right
‘It is at his right’



(29) e- nĩnè-j^{w}urɔ̃
3-direction-right
[Its right side]



The Gã speaker also used *àbɛ̀kú* ‘left’ and *nĩnè-j^{w}urɔ̃* ‘right’ in the conceptual domain of distinguishing her visual field. In (30) the illustrated person was described by the Gã speaker as pointing *nĩnè-j^{w}urɔ̃* ‘right’. Though the illustrated person is pointing to its intrinsic ‘left’, this corresponds to the viewer’s, and in this case, the Gã speaker’s, ‘right’.

(30) e-point e-nĩnè-j^{w}urɔ̃
3-point 3-direction-right
[He points his hand right]

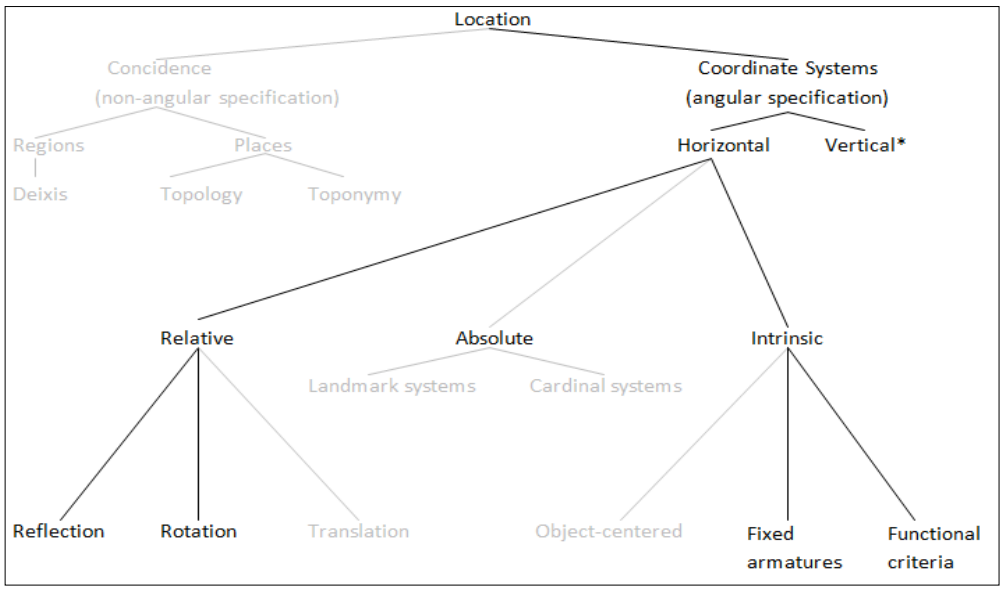
The final conceptual domain for LEFT/RIGHT is a demonstration of LEFT/RIGHT bias in some lexical category such as demonstratives. This bias was not observed in the Gã data. This description of LEFT/RIGHT conceptual domains in Gã makes it possible to classify Gã alongside other languages for their use of LEFT and RIGHT.

4.5 Summary of elicited coordinate systems

The Gã speaker’s coordinate system use included the use of multiple frames of reference and intrinsic systems. The Absolute Frame of Reference was seen in the vertical plane, though

not in the horizontal plane. Intrinsic Frames of Reference were both egocentric and allocentric with a variety of relatums. Intrinsic systems were based on functional characteristics for a variety of entities, and a fixed armature intrinsic system was also seen.

Figure 11: Coordinate systems in Gã



Relative Frames of Reference were also egocentric and allocentric, and of the egocentric Relative Frames of Reference, the rotation analysis and reflection analysis were possible. Lastly, the Gã speaker used *àbɛ̀kú* 'left' and *nĩnè-j^{w}urɔ̃* 'right' in five of six conceptual domains.

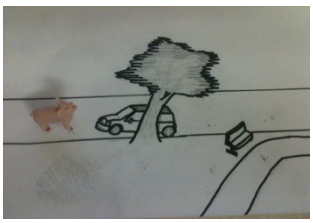
5 Analysis of Gã coordinate systems

Analyzing the corpus of Gã locative descriptions generated during the elicitation sessions reveals several patterns in this type of language use. Section 5.1 provides an analysis of the grammatical patterns that occur throughout Gã locative descriptions—mainly preferential use of the locative verb *yè* 'be at' and person-affixes on coordinate system morphology. A preference for topological locative descriptions is revealed in Section 5.2, an analysis of the Gã speaker's locative description responses to general locative questions such as 'Where is the car?' An analysis of the Gã speaker's use of frames of reference in Section 5.3 reveals a preference for the Intrinsic Frame of Reference. 5.3.1 describes how locative descriptions were categorized according to the type of frame of reference they exhibit, 5.3.2 further explains Relative Frame of Reference use by the Gã speaker, and 5.3.3 is an analysis of intrinsic systems. Section 5.4 summarizes this analysis of Gã coordinate systems.

5.1 Grammatical patterns in Gã locative descriptions

In addition to languages using different frames of reference, languages use different grammatical patterns to encode these concepts in language. Analyzing the corpus of Gã locative descriptions in terms of grammatical patterns reveals predictable sentence structure, verb use, and inflection. The majority of the speaker's locative descriptions followed the pattern *referent, locative verb, relatum, coordinate*, which could be likened to *subject, verb, object, coordinate* (SVOc). Of the 82 frame of reference descriptions that contained two entities, a referent and relatum—or a subject and object—72 used the verb *yè*, 'be at' and the aforementioned word order as in (31).

(31) kplotoo yè tsoni hĩɛ̃
piglet be at car front
'the pig is in front of the car'

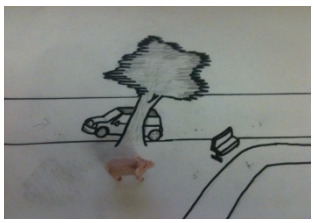


5 of the 82 descriptions were in the order *referent, locative verb, locative phrase*, *relatum,* where the locative phrase contained the intensifier *fe* and the translations given were ‘closer than’ or ‘further than’ as in (32). This word order can also be stated as *subject, verb, coordinate, object* (SVcO).

(32)

kplotoo	yè	hĩɛ̃	fe	tsoni
piglet	be.at	front	INT	car

'The pig is closer than the car'

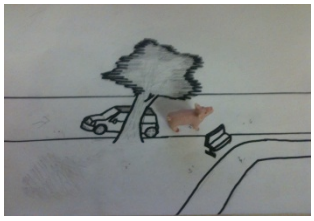


Notice that in (32), the relatum and referent are the same entities as in (31), though the pig (referent) is in a different location in each example. In (31), the car’s intrinsic system is used to provide an allocentric Intrinsic Frame of Reference. In (32), the locative description is similar to a Relative Frame of Reference with Rotation or Reflection Analysis in that the referent (the pig) is *hĩɛ̃* ‘in front’ of the relatum (the car) when it occupies the space between the viewpoint and the relatum. The intensifier *fe* seems to be cause for this word order difference from that seen in (31) and the vast majority of frame of reference descriptions. In addition to the two different word orders using the locative verb *yè* ‘be at’ seen above, the 5 remaining descriptions used a locative verb other than *yè*, ‘be at’. The other locative verbs elicited are *bɛŋke* ‘be close to’ and *ma* ‘stand’. (33) contains the same *referent, predicate, relatum* word order as (31), though it uses *bɛŋke* ‘be close’ rather than *yè* and a coordinate.

(33)

kplotoo	bɛŋke	tsoni
piglet	be.close	car

'The pig is close to the car'



An analysis of the different word orders used shows that the speaker's language use was not random: 72 uses of *yè* in SVOc order, 5 uses of *yè* in SVcO order, and 5 constructions that did not use *yè*, result in a standard deviation of 6.04. When tested for confidence using an alpha of 0.05, the p-value is 1.31, revealing the statistical significance of word order. This means that the speaker showed significant preference for the word order *referent, locative verb, relatum, coordinate*. This also means that the speaker showed a strong preference for using only one locative verb, *yè*. Though the Gã speaker used three locative verbs, the overwhelming preference for a single locative verb differs from the variety of locative verb use reported in Éwé.

Gã locative descriptions can also contain multiple verbs. Zimmerman (1858) discussed this, stating that Gã often uses a series of verbs rather than make morphological modifications to a single verb root. In (34), both *ma* 'stand' and *yè* 'be at' describe what the *tɔ̀* 'bottle' is doing, while *bɛ e-hĩ̃ɛ̃* 'in front of the bear' describes where the bottle is and where the bottle is standing.

(34) tɔ̀ ma yè bɛ e-hĩ̃ɛ̃
bottle stand be.at bear 3-front
'the bottle is standing in front of the bear'

Another feature of the grammar of Gã locative descriptions is the use of person-markers on the locative lexical item. These lexical items may be considered postpositions given their typical location at the end of a predicate phrase. Not all, but a significant number of the postpositions bear person-marking prefixes as in (35), (36), and (37). The three different constructions shown display first, second, and third person prefixes respectively.

(35) sɛ̃ĩ pepo Íɛ̀ yè i-sɛ̀ɛ̀
chair purple DET be.at 1-behind
'The purple chair is behind me'

(36) sɛ̃ĩ pepo Íɛ̀ yè o- nĩnè-j^{w}urɔ̃
chair purple DET be.at 2-direction-right
'It's to your right'

(37) sɛ̃ĩ pepo Íɛ̀ yè e- nĩnè-j^{w}urɔ̃
chair purple DET be.at 3-direction-right
'It's to her right'

In (35), the postposition *sɛ̀ɛ̀* indicating that the chair is behind the speaker takes a prefix *i-* indicating the first person, to yield the form *isɛ̀ɛ̀*. In (36), the chair is to the right of the investigator recording the elicitation, and the postposition noting this, *nĩnè-j^{w}urɔ̃*, takes a prefix, *o-,* noting that he is the frame of reference, which yields the form *onĩnè-j^{w}urɔ̃.* (37) also contains the postposition *nĩnè-j^{w}urɔ̃,* though this time with the prefix *e-*, which indicates the third person. In sum, when creating frame of reference descriptions the Gã speaker preferred SVOc word order, the locative verb *yè* 'be at', and person marking prefixes on the coordinate.

5.2 Locative description preference

The Gã speaker demonstrated a preference for locative descriptions using coincidence rather than frames of reference. This preference is revealed through an analysis of the meta-talk that occurred during the elicitation sessions, and through analysis of the Gã speaker's answers to general locative questions. General locative questions, such as 'Where is the bottle?', are those to which the speaker could have responded with any type of locative description described in Section 3.

Meta-talk provided the clearest evidence about Gã speaker preferences regarding locative descriptions. While providing a description of a route on a map, the speaker stated that speakers of Gã generally use physical locations when giving directions. This meta-talk about how speakers of Gã typically provide locative descriptions using physical locations suggests that Gã speakers prefer locative descriptions of coincidence such as (38). In (38), the speaker uses the

motion verb *shɛ* to describe the path of motion. This verb and the surrounding description make no use of angular coordinates and is thus a description of coincidence. More specifically, because the name of a location—Wilma Suites—is used in (38) this is an example of toponymy.

(38) kɛ o-shɛ wɪlma suitse
then $_2$-arrive.at Wilma suites
'Then you get to Wilma Suites'

This Gã speaker's set of directions for getting from point 'A' to point 'B' on a map were described as if the speaker were walking through town along the prescribed route. This type of description corresponds to what Tversky (1991) calls a "route description" as opposed to a "survey description" in which the speaker would describe the directions from a bird's-eye-view.

In addition to meta-talk that indicated locative descriptions are preferred, general locative questions were answered by the speaker with descriptions of coincidence. By analyzing locative descriptions in terms of the prompts that were used to elicit the descriptions, it is possible to determine the Gã speaker's contextual preferences for one type of locative description over another. There were four different types of question prompts used in this study to elicit locative descriptions: general locative questions, questions of intrinsic systems, locative questions with a relatum and referent, and route description. General locative questions such as 'Where is the bottle?' are those for which the elicited locative description could be of any type described in Chapter 3. The second type of question prompt, questions of intrinsic systems, are those in which the speaker was asked to name a plane of an object. For example, the investigator would point to a bear and would ask the speaker "How would a speaker of Gã describe this side of the bear?" The third type of question prompt, locative questions with a relatum and referent, prompted the Gã speaker to describe the location of a referent in relation to a relatum. For example, the

locative question with a relatum and referent “Where is the bottle compared to the box?” prompts the speaker to describe the location of the bottle in relation to the box. The fourth type of prompt, route description, requested that the Gã speaker describe the directions for getting from one point on a map to another. By categorizing the prompts as one of these four—general locative questions, questions of intrinsic systems, locative questions with a relatum and referent, and route description—it is possible to perform a statistical analysis that reveals how the Gã speaker preferred to respond to these certain types of prompts. These preferences could only be revealed if the elicited locative descriptions were also categorized and analyzed.

The locative descriptions elicited from these prompts were categorized as one of the three following types: “other” locative description, an intrinsic system, or a frame of reference. “Other” locative descriptions were either locative descriptions of coincidence or an ambiguous frame of reference. A locative description of coincidence could use deixis (e.g., “the bottle is there”), topology (e.g., “the bottle is by the box”), or toponymy (e.g., “the bottle is in the Social Sciences Building”) For example, in (39), the general locative question “Where is Mexico?” was answered with locative description using toponymy *Mexico yè Latin America* “Mexico is in Latin America".

(39) Mexico yè Latin America
Mexico be.at Latin America
'It’s in Latin America'

“Other” locative descriptions of an ambiguous frame of reference is one in which a locative description uses a coordinate, such as 'behind', but could not be definitively classified as belonging to a specific frame of reference. For example, in (40), the description *tɔ̀ yè àdékà sɛ̀ɛ̀* ‘the bottle is behind the box’ could be of a Relative Frame of Reference with Rotation Analysis or a Relative Frame of Reference with Reflection Analysis.

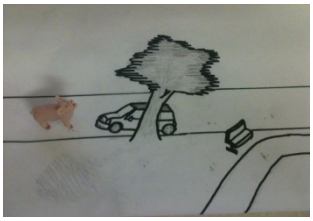
(40) tɔ̀ yè àdékà sɛ̀ɛ̀
bottle be.at bottle behind
'the bottle is behind the box'

An intrinsic system locative description is one in which the Gã speaker was naming a plane of an object rather than locating a referent. For example, in (41) the question of intrinsic system, "How would a speaker of Gã describe this part of the bear?" elicited the intrinsic system description *bear esɛ̀ɛ̀* 'the back of the bear.'

(41) bear e-sɛ̀ɛ̀
bear 3-back/behind
'the back of the bear'

A frame of reference locative description is one in which it was possible to reasonably conclude that a given locative description was a specific frame of reference. For example, in (42), the locative question with a relatum and a referent "Where is the pig compared to the car?" was answered with the description *kplotoo yè tsoni hĩ̃ɛ̃* 'the pig is in front of the car', which could only be an allocentric Intrinsic Frame of Reference.

(42) kplotoo yè tsoni hĩ̃ɛ̃
piglet be.at car front
'the pig is in front of the car'



After a series of general locative questions—e.g., "where is the car?"—about the locations of objects in a picture, it was apparent that the speaker preferred locative descriptions of coincidence—i.e., using non-angular descriptors. More specifically, the speaker used *mãsɛ̀í*

‘beside’ topologically, translating it as ‘by’, ‘next to’, and ‘near’ for locative questions that weren’t required to be as specific as possible. In the following example (43), the speaker uses *mãsɛ̀í* ‘beside’ to describe the car’s location as proximal to the tree.

(43) Prompt: Where is the car?
tsɔni e-yè tso e-mãsɛ̀í
car 3-be at tree 3-beside
'the car is beside the tree'

When specificity was required to provide an accurate description, the speaker began using coordinate systems as seen in (44). In this example she used *hĩɛ̃* ‘front’ as a way of indicating that the tree is "closer" to herself and the mountains. What is particularly interesting is the translation provided along with the description: the Gã form *hĩɛ̃* literally translates to ‘face/front’, which is a coordinate description of angular location. Despite this literal meaning, the speaker provides a translation that uses a coincidental description of non-angular location ‘closer’. It may be that the translation continues to reveal the speaker’s preference for non-angular locative descriptions of coincidence rather than coordinates; it may also show widening of the word’s meaning.

(44) tso yè hĩɛ̃ fe gɔ
tree be at front INT hill
'The tree is closer than the mountains'

Because the majority of elicitation sessions were dedicated to tasks that did not reflect everyday language use, in one of the later sessions the speaker was prompted with a set of questions designed to be “real world” general locative questions that might elicit frame of reference descriptions. For example, the speaker was asked where certain buildings were located on a college campus, where certain businesses were in a town, and where countries and oceans are located in the world. The Gã speaker was given maps for some of these tasks so she could refresh her memory if necessary. The Gã speaker could have used any frame of reference—

absolute, intrinsic, or relative—to answer these questions. The speaker primarily used general topological descriptions containing the locative verb *yè* 'be at'. For example, in (45) the Gã speaker described the location of a letter "M" on a *gɔ̃ŋ̀* 'mountain' east of town by using only using the locative verb *yè* 'be at'.

(45) em-e e-yè gɔ̃ŋ̀
M-DET 3-be.at mountain
'it's on the mountain'

These non-angular description seemed to be the speaker's preference for describing any spatial relationship. The speaker typically only gave angular descriptions if prompted for a more specific answer than a topological description.

The fact that the speaker was initially not able to use certain angular description words is further evidence that coordinate systems are not her preferred type of locative description. There were two instances in which the speaker could not recall the particular words necessary to create locative descriptions using coordinate systems. The first example was when the speaker could not recall *nĩnè-j^{w}urɔ̃*—literally 'hand right'—to describe both her right hand as well as the space to her right. After researching the form, the Gã speaker used *nĩnè-j^{w}urɔ̃* when appropriate in locative descriptions. Similarly, the fact that the speaker did not use an Absolute Frame of Reference was initially a point of curiosity until she volunteered that she did not remember the Gã equivalents of the English cardinal directions. The fact that she had forgotten these words may be due to a lack of use that is cultural or idiolectal, and at the very least, is evidence that it is not one of the Gã speaker's preferred types of locative descriptions.

To investigate overall locative description preference would require only general locative question prompts in a wide variety of settings and with a wide variety of entities. General locative questions such as "Where is the page number?" can elicit any type of locative

description. Possible locative descriptions that answer this questions include those listed below in Table 1.

Table 1: Locative descriptions and categorizations

Locative descriptions	Categorizations
"It is there"	Deixis → region → coincidence
"It is on the page"	Topology → place → coincidence
"It is in the footer"	Toponymy → place → coincidence
"It is on the bottom of the page"	Intrinsic → vertical → coordinate system
"It is on the south side of the page"	Absolute → horizontal → coordinate system

A large variety of contexts and entities are also required to attempt to elicit locative descriptions in an unbiased way. The present study attempted to provide a variety of contexts by using several different physical entities in a variety of arrangements, many different illustrated entities in a variety of arrangements, street maps, world maps, and even general questions that required speaker knowledge of locations. Similarly, the present study attempted to provide a variety of entities that may or may not influence the type of locative description given by the speaker. These entities include real and illustrated people, real and illustrated animals, and real and illustrated inanimate objects including cars, chairs, bottles, boxes, balls, and trees.

To respond to the 10 prompts that were general locative questions, the Gã speaker used a frame of reference once, topology 8 times, and toponymy once. With this distribution of types of locative descriptions, the standard deviation is 1.81. When tested for confidence, using an alpha of 0.05, the p-value is 1.12, revealing a statistically significant preference in locative description use. This means that when the Gã speaker answers a general locative question, she will almost certainly respond with a topological locative description.

5.3 Frame of reference preference

The Gã coordinate systems described in Section 4 did not occur with equal possibility when the Gã speaker was prompted to create a locative description. Locative descriptions that

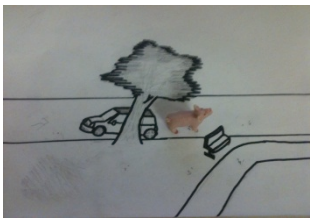
contained coordinates were categorized according to the frame of reference manifest in the description. Additionally, statistical analysis of the corpus substantiates the claim that the Gã speaker showed significant preference for the Intrinsic Frame of Reference over others. Furthermore, the Gã speaker's use of the Relative Frame of Reference varied throughout the study with consistencies only being seen in terms of discourse and type of elicitation prompt. Lastly, the intrinsic systems used by the Gã speaker in the Intrinsic Frame of Reference are also analyzed and show a relationship between intrinsic systems and animacy. As a whole, this section of this thesis attempts to address all factors that may have impacted the Gã speaker's use of frames of reference.

5.3.1 Categorizing frame of reference descriptions

The elicited locative descriptions that used a coordinate system were categorized according to the type of frame of reference it embodied—absolute, intrinsic, or relative—as established by Levinson (2003). In cases where the use of a coordinate fit more than one frame of reference, the context of the coordinate's use was considered and the locative description was categorized in one of two ways: either as a specific frame of reference but marked, or as an indeterminable frame of reference. The basis for categorizing coordinate locative descriptions as a frame of reference, a marked frame of reference, or an indeterminable frame of reference is described below.

Many locative descriptions using coordinates embodied only one type of frame of reference. For example, in (46) the description *kplotoo yè tsoni e- sɛ̀ɛ̀* 'the pig is behind the car' is an allocentric Intrinsic Frame of Reference because it does not match the coordinate description of any other frame of reference—absolute or relative.

(46) kplotoo yè tsoni e- sɛ̀ɛ̀
piglet be.at car 3-behind
[The pig is behind the car]



In (46), the car is the relatum whose intrinsic system provides the coordinate *sɛ̀ɛ̀* 'behind', which is used to describe the location of the referent, the pig.

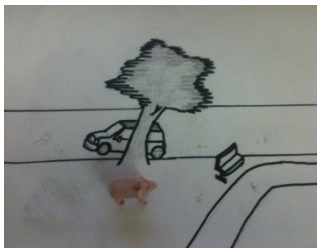
Of the locative descriptions using coordinate systems, the following frames of reference were used: egocentric Intrinsic Frame of Reference, allocentric Intrinsic Frame of Reference, Relative Frame of Reference with Rotation Analysis, or Relative Frame of Reference with Reflection Analysis. A frame of reference was considered to be used if no other frame of reference could be said to match the locative description given by the speaker. The Absolute Frame of Reference was never used, and the relative Frame of Reference with Translation Analysis was ruled out because its use was never the only possible analysis, and it was never a marked frame of reference use.

The locative descriptions using a marked frame of reference were those that fit multiple frames of reference, but had evidence supporting its categorization in one frame of reference rather than another. Evidence for marked frame of reference categorization includes meta-talk—i.e., the speaker describing her thought process—or when several consecutive frame of reference descriptions, though ambiguous, all could be said to align with either one specific frame of reference or with multiple other frames of reference.

An example of evidence for a marked frame of reference supported by meta-talk is the discussion in (47). This example gives a full transcript of the discussion of the elicitation prompt before the Gã frame of reference description was provided.

(47) Prompt: Would a speaker of Gã describe the pig as to the left of the car?
Speaker: it depends on where you are standing. If I was standing here [at the car's intrinsic front] then I would say that.

kplotoo-ɛ yè tsoni-ɛ àbɛ̀kú
piglet-DET be.at car-DET left
'The pig is to the left of the car'



The prompt in (47) "would a speaker of Gã describe it as to the left of the car?" was designed to determine whether the car could be used as the relatum of an allocentric Intrinsic Frame of Reference. The fact that the speaker stated that the speaker would have to be standing in front of the car suggests that she would have to align herself with the car in a specific way to describe this picture as *kplotoo-ɛ yè tsoni-ɛ àbɛ̀kú* 'the pig is to left of the car'. If the viewpoint of the car and pig were situated such that the speaker was standing at the car's intrinsic FRONT, then there would be alignment of the car being the relatum of an allocentric Intrinsic Frame of Reference as well as a the relatum of a Relative Frame of Reference with Rotation Analysis. The fact that the viewpoint is a concern suggests that the speaker is conceptualizing a Relative Frame of Reference. If the viewpoint was not an issue—that is, if a person were using the car's intrinsic system—then any viewpoint would allow the description in (47).

An example of a specific frame of reference being marked because of alignment of several consecutive frame of reference descriptions can be seen when considering (48) and (49). In (48), the elicited description *tɔ̀ yè àdékà àbɛ̀kú* 'the box is to the right of the bottle' could be said to correspond to a Relative Frame of Reference with either Reflection Analysis or Translation Analysis—within both of these analyses, the LEFT of the relatum corresponds to the LEFT of the viewpoint.

(48) tɔ̀ yè àdékà àbɛ̀kú
bottle be at box left
'the bottle is on the left side of the box'

Similarly, in (49) the description *tɔ̀ yè àbɛ̀kú sɛ̀ɛ̀* 'the bottle is behind the box' could be said to correspond to a Relative Frame of Reference with either Reflection Analysis or Rotation Analysis—in both of these analyses, the 'back' of the relatum is the side furthest from the viewpoint.

(49) tɔ̀ yè àdékà sɛ̀ɛ̀
bottle be at box behind
'the bottle is behind the box'

Considering (48) and (49) as a pair, the only frame of reference they have in common is the Relative Frame of Reference with Reflection Analysis. For this reason, the Relative Frame of Reference was selected as the marked frame of reference for these two elicited frame of reference descriptions. This alignment is illustrated in Table 2, in which the possible frames of reference are highlighted and those that are consistent are outlined in bold.

Table 2

		Relative Frame of Reference		
	elicitation	rotation	reflection	translation
5.15	abɛku	right	left	left
5.17	sɛɛ	back	back	front

(50) and (51), like (48) and (49), could be an Intrinsic Frame of Reference or a Relative Frame of Reference.

(50) tɔ̀ yè bɛ nĩnè-j^{w}urɔ̃
bottle be at bear direction-right
'the bottle is to the right of the bear'

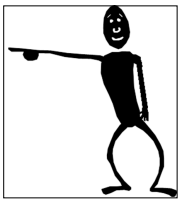
(51) tɔ̀ yè bɛ nĩnè-j^{w}urɔ̃
bottle be at bear direction-right
'the bottle is to the right of the bear'

In (50), the use of the coordinate *nĩnè-j^{w}urɔ̃* 'right' could be a use of the allocentric Intrinsic Frame of Reference or the Relative Frame of Reference with Rotation Analysis. In (51), *nĩnè-j^{w}urɔ̃* 'right' is either a second use of the allocentric Intrinsic Frame of Reference or the Relative Frame of Reference with Reflection Analysis. The reason for concluding that the Intrinsic Frame of Reference is probably being used is that it is the only frame of reference used consistently in (50) and (51). If we assume the Gã speaker is using the Relative Frame of Reference to assign coordinates in these descriptions, then we must also assume the Gã speaker would be switching between different types of analysis of the Relative Frame of Reference.

The general structure of each elicitation session also influenced the frame of reference preference of the Gã speaker, and helped to categorize marked frames of reference. After descriptions of the chair's location in (35)-(37), the remainder of Elicitation 6 consisted of the following: I would read the speaker's locative descriptions from Elicitation 2 and she would pick out the picture that corresponded to this description. Given that four weeks had passed since Elicitation 2, it is unlikely that she remembered how she described each picture. Instead, this elicitation sought to see if there was any consistency in how Frames of Reference are used in Gã.

For almost every Gã locative description in Elicitation 6, the speaker chose the exact picture corresponding to the description she had provided in Elicitation 2. The two exceptions were (52) and (53). In both of these, the speaker picked the picture that corresponded to what is either the illustrated person's Intrinsic Frame of Reference, or a Relative Frame of Reference with Rotation analysis.

(52) e-ts$\tilde{ɔ}$ɔ̃ɔ̃ e- nĩnè-j^{w}urɔ̃
3-show 3-direction-right
'He is pointing to his right'



(53) e-tsɔ̃ɔ̃ e- àbɛ̀kú
3-show 3-left
'He is pointing to his left'

In (52) the illustrated person is pointing to *e-nĩnè-j^{w}urɔ̃* 'his right' though in Elicitation 2, this picture was described as *e-tsɔɔ e-àbɛ̀kú* 'he is pointing to his left'. Likewise, for the locative description *e-tsɔ̃ɔ̃ e-àbɛ̀kú* 'he is pointing to his left' in (53), the speaker chose the image that she described as *e-point e-nĩnè-j^{w}urɔ̃* 'he is pointing to his right' in Elicitation 2.

The difference in descriptions between Elicitation 2 and Elicitation 6 shows both inconsistency and consistency. These differences show inconsistency because the same image was described one way in Elicitation 2 and another in Elicitation 6. This variation exemplifies the flexibility of frames of reference in Gã—i.e., the speaker does not always use a certain frame of reference for a certain task.

The difference between the descriptions accompanying these pictures in Elicitation 2 and Elicitation 6 shows consistency because in both elicitation sessions, the frame of reference used to describe these pictures is the same frame of reference used to describe the spatial arrangements in the immediately previous questions. In Elicitation 2, the speaker used the egocentric Intrinsic Frame of Reference to describe these pictures as well as the pictures that preceded these in the elicitation session. Likewise, in Elicitation 6, the speaker had been using allocentric Intrinsic Frames of Reference for the prompts immediately preceding (52) and (53) and she used it in (52) and (53) as well. The fact that the same frame of reference is used from one question to the next suggests the discourse of a given elicitation session may be influencing the frame of reference the Gã speaker will use when multiple frames of reference are available.

As mentioned above, the Relative Frame of Reference with Translation Analysis was never found to be probable. Some frame of reference descriptions did align with the Relative Frame of Reference with Translation Analysis such as (48) above: The description *tɔ̀ yè àdékà àbɛ̀kú* 'the box is to the right of the bottle' is such that the relatum's LEFT corresponds to the viewpoint's LEFT as is required by the translation analysis. Despite the alignment of this description and the Relative Frame of Reference with Translation Analysis, the frame of reference descriptions elicited immediately before and after descriptions such as (48) did not align with the Relative Frame of Reference with Translation Analysis. The fact that no meta-talk or alignment of multiple frame of reference descriptions indicated a probable Relative Frame of Reference with Translation Analysis is the reason this frame of reference was omitted from the statistical analysis of this study.

Instead of categorizing descriptions with multiple possible frames of reference (e.g., (48), (49), (50), and (51)) as marked frames of reference, these ambiguous descriptions could have been classified as indeterminate. However, sets of frames of reference that all aligned with the one frame of reference were interpreted as patterned frame of reference use and manifestations of the cognitive structures that underlie such use. Once each frame of reference description was categorized as a frame of reference or a marked frame of reference, it was possible to statistically analyze their use in order to support the claim that the speaker's frame of reference use showed preference and not randomness.

Simple statistical analysis of the frequency of frame of reference use reveals the Gã speaker's preferences. In the 114 elicited uses of a frame of reference, the Gã speaker used the Absolute Frame of Reference 0 times, the Intrinsic Frame of Reference 87 times and the Relative Frame of Reference 27 times. With this distribution of frame of reference types, the standard

deviation is 5.90. When tested for confidence using an alpha of 0.05, the p-value is 1.08, revealing the statistical significance of frame of reference use. This means that when the Gã speaker does use a frame of reference, she shows significant preference for the Intrinsic Frame of Reference.

Further categorizing the frames of reference used by the Gã speaker, in the same set of 114 frame of reference examples, the Gã speaker used the egocentric Intrinsic Frame of Reference 16 times, the allocentric Intrinsic Frame of Reference 71 times, the Relative Frame of Reference with Rotation Analysis 12 times, and the Relative Frame of Reference with Reflection Analysis 15 times. With this distribution of frame of reference types, the standard deviation is 5.64. When tested for confidence using an alpha of 0.05, the p-value is 0.85, revealing the statistical significance of the Gã speaker's use of frame of reference subtypes. This means that when using a frame of reference, the Gã speaker showed the strongest preference for the allocentric Intrinsic Frame of Reference. The Gã speaker likewise showed a roughly equal preference for the egocentric Intrinsic Frame of Reference, the Relative Frame of Reference with Rotation Analysis and the Relative Frame of Reference with Reflection Analysis.

5.3.2 Relative Frame of Reference use

The Gã data exhibits the use of the Relative Frame of Reference with Rotation Analysis and with Reflection Analysis. Both of these analyses describe a relative FRONT and BACK in the same way—they both describe a referent's FRONT as closest to the viewpoint—but with opposite locations of LEFT and RIGHT. Because LEFT and RIGHT usage differs between the Relative Frame of Reference with Rotation Analysis and the Relative Frame of Reference with Reflection Analysis, Gã can be said to exhibit variability in the use of LEFT and RIGHT terms in the Relative Frame of Reference. The independent shifting of LEFT and RIGHT in Gã follows the prediction of

Levinson (2003) that this type of variability is possible. Levinson's prediction is based on variability of FRONT and BACK terms when speakers of Hausa and Japanese use the Relative Frame of Reference. Both of these languages prefer to use FRONT and BACK in a translation analysis—i.e., with a relatum's BACK facing the viewpoint—though both languages also accept locative descriptions in which a relatum's FRONT is facing the viewpoint.

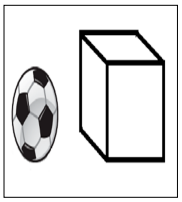
Despite the prediction for and evidence of Relative Frame of Reference variability, the variability described by Levinson (2003) is not identical to that which is seen in the Gã data. As described above, the Gã speaker used the Relative Frame of Reference with Rotation Analysis and the Relative Frame of Reference with Reflection analysis nearly an equal number of times. This distribution could be considered nearly equal use of Gã's terms for LEFT and RIGHT on either side of a relatum in a Relative Frame of Reference. This nearly equal use does not show the type of preferential use described for Hausa and Japanese by Levinson: Hausa and Japanese prefer to use FRONT and BACK as in a translation analysis, but also accept FRONT and BACK as it is used in a rotation analysis—i.e., with the front of the relatum facing the viewpoint. In other words, Gã exhibits nearly equal use of LEFT and RIGHT in reflection and rotation analyses: the reflection analysis is used 15 times and the rotation analysis is used 12 times. Gã cannot be said to generally prefer the use of LEFT and RIGHT as in one type of Relative Frame of Reference while also accepting LEFT and RIGHT as in another type of Relative Frame of Reference.

Despite lacking a general preference for the use of LEFT and RIGHT as in one type of Relative Frame of Reference, the Gã speaker exhibited preference for the Relative Frame of Reference with Rotation analysis for describing the location of objects in illustrations. At the same time, the Gã speaker preferred the Relative Frame of Reference with Reflection analysis for describing the locations of physical objects. This preference is based on the speaker's

frequency of use of the rotation analysis for illustrations and the reflection analysis for physical objects.

Recall from 4.3 that in an illustration of a box and a ball, the Gã speaker used the Relative Frame of Reference with Rotation Analysis. In (54), when prompted by the question 'where is the ball compared to the box' the speaker provided the coordinate *nĩnè-j^{w}urɔ̃* 'right'. Since the relatum's (the box's) RIGHT corresponds to the speaker's intrinsic LEFT, this is the Relative Frame of Reference with Rotation Analysis.

(54) e-nĩnè-j^{w}urɔ̃
3-direction-right
'Its right side'



On the other hand, in (55), when prompted by the question 'where is the bottle compared to the box' the speaker provided the coordinate *àbɛ̀kú* 'left'. In (55), because the relatum's (the box's) LEFT corresponds to the speaker's intrinsic LEFT, this is the Relative Frame of Reference with Reflection Analysis.

(55) tɔ̀ yè àdékà àbɛ̀kú
bottle be at box left
'the left of the box'

In the pictures accompanying both (54) and (55), the box and the bottle are in the same position relative to the respective boxes. If the Relative Frame of Reference with Rotation Analysis was used to describe both spatial arrangements, the coordinate RIGHT would have to be used to describe the referent's (the ball's or bottle's) location relative to the relatum (the box).

The illustrations in (54) and physical objects in (55) can be described as 2.5D and 3D respectively. Marr (1982) originally used 2.5D and 3D to describe two different ways that spatial arrangements can be conceptualized in his theory of vision. To Marr, 2.5D describes conceptualizations of spatial arrangements from a viewpoint, which is roughly equivalent to Levinson's Relative Frame of Reference. Marr's 3D conceptualizations of spatial arrangements are those made with respect to the parts of objects—roughly equivalent to Levinson's Intrinsic Frame of Reference. My analysis uses 2.5D to describe an illustrated or pictured spatial arrangement that the viewer looks at and cannot move around in. In my use of 2.5D, the viewpoint is fixed and the viewer can use any type of locative description. I use 3D to describe physical spatial arrangements that the viewer is a part of and can potentially move around in—i.e., physical objects situated in the same location as the speaker is 3D. Using my definitions of 2.5D and 3D, the Gã speaker used the Relative Frame of Reference with Rotation Analysis to describe the 2.5D spatial arrangement, and she used the Relative Frame of Reference with Reflection analysis to describe the 3D spatial arrangement.

The Gã speaker consistently used these different analyses of the Relative Frame of Reference to describe these different situations. Each respective analysis was first elicited in a session in which the speaker was asked to give a description for the 2.5D or 3D spatial arrangement before her. In a separate session, the speaker was given a Gã locative description and she was then asked to choose the 2.5D image to which the description corresponded. Later the speaker was given a Gã locative description and she was then asked to arrange the objects into the 3D arrangement that corresponded to the description. For both follow-up tasks in which the speaker was given a locative description and asked to provide the appropriate spatial arrangement, the speaker provided the spatial arrangements identical to those that originally

prompted the locative description—i.e., the Gã speaker repeatedly used the Relative Frame of Reference with Rotation Analysis with the 2.5D spatial arrangement, and she used the Relative Frame of Reference with Reflection analysis with the 3D spatial arrangement.

Counting the number of uses of each analysis of the Relative Frame of Reference in Gã allows the claim that the Gã speaker has a preference for using the Relative Frame of Reference with Rotation Analysis for a 2.5D spatial arrangement, and the Relative Frame of Reference with Reflection analysis for a 3D spatial arrangement. Given 43 total locative descriptions that relied on a Relative Frame of Reference, 36 followed the preference described above and 7 did not follow this preference—i.e., in 7 of the locative descriptions that relied on a Relative Frame of Reference, the speaker did not use the Relative Frame of Reference with Rotation Analysis for a 2.5D spatial arrangement, or the Relative Frame of Reference with Reflection analysis for a 3D spatial arrangement. The resulting standard deviation of this distribution is 3.13, and with an alpha of 0.05, the subsequent p-value is 0.93. These numbers confirm that the Gã speaker has preferences for use of the Relative Frame of Reference.

5.3.3 Analysis of intrinsic systems

People, animate non-human entities, and some inanimate objects were all described by the Gã speaker as having intrinsic systems. The Gã intrinsic systems described in Chapter 4 reveal that the functional properties of animate objects, especially humans are the sources of both intrinsic systems and coordinate systems in Gã. The Gã word for 'front', *hĩɛ̃*, is also the word for 'face', and the word used for the coordinate 'right', *nĩnè-j^{w}urɔ̃*, literally translates to 'hand-right'. These two names for anatomical parts of the human body have thus been extended to descriptive use of coordinates extending outward from the human body. These anatomical names—an intrinsic system based on functional characteristics—and coordinate names have also been given

to animate non-human entities like bears and pigs such that the intrinsic systems of these animals are the same as those of a person. These intrinsic systems are commonly used in Intrinsic Frames of Reference as described above in Section 3.

A bottle was also described by the Gã speaker as having an intrinsic system based on functional characteristics, which is described in Section 4. The FRONT of the bottle is the side which a person would canonically approach, and the LEFT and RIGHT of the bottle likewise correspond to these sides of a person who is approaching the bottle—i.e., the bottle's LEFT and RIGHT are opposite those of a person or animal facing the same way as the bottle. Despite the bottle being shown to have functional characteristics that determine an intrinsic system, not all locative descriptions involving the bottle were Intrinsic Frames of Reference. In (56), the speaker described the location of the box as *yè tɔ̀ sɛ̀ɛ̀* 'behind the bottle'.

(56) àdékà yè tɔ̀ sɛ̀ɛ̀
box be at bottle behind
'the box is behind the bottle'

As depicted in the picture that accompanies (56), if the bottle's Intrinsic Frame of Reference were being used, then the box would have been 'in front of the bottle' because the box is in the region of space corresponding to the functionally characteristic 'front' of the bottle. The description provided in (56) is thus a Relative Frame of Reference.

More specifically, the Relative Frame of Reference seen in (56) most likely is a reflection analysis because of the information elicited in (57). In (57) the speaker describes the location of the box as *yè tɔ̀ nĩnè-j^{w}urɔ̃* 'to the right of the bottle' even though, again, the box is in the region of space corresponding to the functionally characteristic FRONT of the bottle.

(57) àdékà yè tɔ̀ nĩnè-j^{w}urɔ̃
bottle be at bottle direction-right
'the box is to the right of the bottle'

The frame of reference descriptions that use the bottle as the relatum for describing the location of the referent, the box, illustrate the fact that, though the bottle has a functional intrinsic system, this system is not always used to create locative descriptions.

The intrinsic systems described by the Gã speaker illustrate a hierarchical relationship between animacy and coordinate systems. The functional intrinsic systems of humans are always used for coordinates when a human is the relatum of a frame of reference description. The functional intrinsic system of an animate non-human is likewise used almost every time the animate non-human is the relatum of a frame of reference. Inanimate objects like cars and bottles are sometimes used as the relatum of an Intrinsic Frame of Reference, though frames of reference using an inanimate object as relatum are typically Relative Frames of Reference.

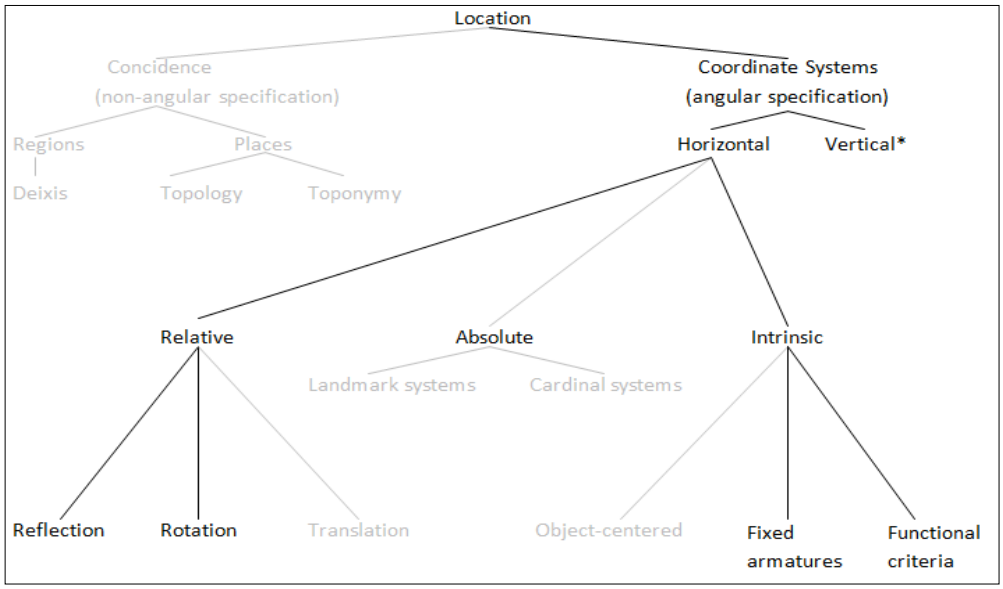
5.4 Summary

The data described in Section 4 and analyzed in Section 5 allows the following claims to be made about Gã coordinate systems: Grammatically speaking, when creating frame of reference descriptions, the Gã speaker preferred SVOc word order, the locative verb *yè* 'be at', and person marking prefixes on the coordinate. In the vertical plane, the Gã speaker used the Absolute Frame of Reference and the Intrinsic Frame of Reference. In the horizontal plane, Gã has lexical items for all three frames of reference: absolute, intrinsic, and relative. The Absolute Frame of Reference is based on a cardinal system akin to English's *north, south, east,* and *west.* The Intrinsic Frame of Reference in Gã uses intrinsic systems based primarily on functional

criteria and also fixed armatures in the case of objects like a box. Gã's Relative Frame of Reference used both Reflection and Rotation Analyses.

The horizontal frames of reference used by the Gã speaker are illustrated in Figure 11: coordinate systems in Gã. The items in gray are those either not used by the speaker for locative descriptions (as was the case with the Absolute Frame of Reference) or those that were not the primary subject of investigation for this study (as in the case of locative descriptions of coincidence).

Figure 11: coordinate systems in Gã



Giving consideration to evidence from meta-talk and general locative questions, the speaker's preference is to use locative descriptions of coincidence. When the speaker is asked to be more specific, or the context of the prompt is such that the speaker expects to be asked for an angular description, the Gã speaker will use frames of reference. The frame of reference used by the Gã speaker is also impacted by whether the relatum has an intrinsic system and whether that

relatum is animate. Statistically speaking, the allocentric Intrinsic Frame of Reference is the most commonly used frame of reference, followed by the egocentric Intrinsic Frame of Reference, then the Relative Frame of Reference with Reflection Analysis, and finally the Relative Frame of Reference with Rotation Analysis. Though Gã has lexical items to express an Absolute Frame of Reference, these were never used by the speaker in locative descriptions. All of these coordinate systems most frequently occurred in SVOc word order with the locative verb *yè* 'be at', and with person marking prefixes on the coordinate.

6 Conclusions, implications, and topics for further research

The thesis has aimed to provide a detailed description and analysis of coordinate system use in the Gã language. This work allows for several conclusions, implications, and topics for further research. Section 6.1 discusses how the fieldwork and results described herein provide the necessary details to situate Gã amongst other languages that have been categorized by frame of reference use as a language which uses Intrinsic and Relative frames of reference. Gã can also be described as a language that uses LEFT and RIGHT to describe a visual field. Section 6.2 describes how Levinson's spatial language framework is affected by the results of this study; it elucidates a clear connection between deixis and the Relative Frame of Reference. The flexibility in coordinate system use that was found in this study prompts the need for further research on locative descriptions (described in Section 6.3). Along with these conclusions, implications, and topics for further research, this thesis has shown that the Gã speaker prefers locative descriptions of coincidence over coordinate systems, but that when using coordinate systems she prefers to use the Intrinsic Frame of Reference over both the Relative and Absolute Frames of Reference.

6.1 Categorizing Gã frames of reference among other languages

Levinson (2003) describes the extent to which the different frames of reference are manifest across the world's languages with a focus on everyday parlance, by separating what he calls "expert language" from daily language. Despite the fact that some of these languages have and are capable of using other frames of reference, Levinson categorizes languages according to their most commonly used frames of reference. Levinson's table of frames of reference and the languages that use them is recreated in Table 3.

Table 3: Frame of reference distribution across languages

Intrinsic only:	Mopan (Mayan)
Absolute only:	Guugu Yimithirr (Pama Nyungan)
Intrinsic and Relative:	Dutch, Japanese
Intrinsic and Absolute:	Tzeltal (Mayan), Hai//om (Khoisan)
Intrinsic, Relative, and Absolute:	Yucatec (Mayan), Kgalagadi (Bantu)

Levinson (2003)

To this table, we can add Gã under *Intrinsic and Relative*. Even though Gã has words for cardinal directions and thus has an Absolute Frame of Reference, because the speaker never used the Absolute Frame of Reference when creating locative descriptions, it is clearly not used in her everyday parlance. The only frames of reference used by the speaker were the Intrinsic and Relative Frames of Reference, thus classifying Gã with Dutch and Japanese in terms of frame of reference use.

Another way that Levinson (2003) compares languages according to coordinate systems is the extent to which they use LEFT and RIGHT. The cline discussed in Section 3.5 is pictured below in Table 4.

Table 4: Cline of L(eft)/R(ight) concepts in languages

	L/R bias in, e.g. Demonstratives	Relative L/R in visual field	Objects with L/R regions	Persons with L/R regions	Persons with L/R sides	L/R as names of hands
Guugu Yimithirr (Australian)						+
Tzotzil (Mayan)					+	+
Longgu (Austronesian)				+	+	+
Kilivila (Austronesian)			+	+	+	+
English		+	+	+	+	+
Tamil (Dravidian)	+	+	+	+	+	+

(Levinson 2003)

From the fact that the Gã word for 'right' is *nĩnè-j^{w}urɔ̃*—literally 'hand right'—one can conclude that Gã's use of *àbɛ̀kú* 'left' and *nĩnè-j^{w}urɔ̃* 'right' began conceptually as a means of distinguishing one hand from another. Diachronically, the names for LEFT and RIGHT hands were

conceptually extended to a person's sides, a person's regions, an object's regions, and to relative space in a person's visual field. Gã can thus be said to apply LEFT and RIGHT in as many conceptual domains as English is shown to use LEFT and RIGHT in the cline above. Further research is needed to determine whether Gã exemplifies a LEFT/RIGHT bias in other grammatical categories, such as demonstratives.

6.2 Implications for Levinson's spatial language framework

Levinson (2003) can be considered a work describing the state of the field; it reviews previous frameworks of spatial language and attempts to join them into a unified whole. Despite this unification, there are parts of Levinson's framework that do not yield unequivocal accounts for some locative descriptions, suggesting that the underlying characteristics of coordinate systems and their use require further investigation. Some elicited frame of reference descriptions that were described in Chapters 4 and 5 reveal ambiguity between types of frames of reference, an ambiguity that cannot be eliminated regardless of experimental design. Additionally, Levinson's hierarchy separates deixis and coordinate systems, though in the case of the Relative Frame of Reference, I argue the locative descriptions are entirely deictic. Here I discuss the implications of the current Gã research for Levinson's spatial language framework with respect to the ambiguity between types of frames of reference (6.2.1), and the relation between the Relative Frame of Reference and deixis (6.2.2).

6.2.1 Ambiguity between types of frames of reference

Because Gã and some other languages use the same coordinate morphemes in the Intrinsic and Relative Frames of Reference, locative descriptions that use these morphemes are often ambiguous. For example, *hĩɛ̃* 'front' is used in the Gã Intrinsic Frame of Reference and the Gã Relative Frame of Reference. If a speaker of Gã said *tɔ̀ ma yè bɛ e-hĩɛ̃* 'the bottle is standing

in front of the bear', we could not be certain where the bottle was located relative to the bear without also being certain of which frame of reference the speaker was using. This ambiguity exists on two levels. First, given a locative description and an arrangement of entities in space, we sometimes cannot be certain which frame of reference is being used because multiple frames of reference are aligned. Within this sort of ambiguity, multiple frames of reference are available to account for a given locative description. This is exemplified below in (58) and (59). Second, given only a locative description, not knowing the frame of reference prevents us from predicting the arrangement of entities in space. This ambiguity arises when knowledge of a frame of reference is absent, and there is a gap in knowledge between discourse participants (discussed further in terms of 2.5D and 3D arrangements).

The locative descriptions of a spatial arrangement that fit with two different frames of reference can be described as ambiguous. The current study paired ambiguous locative descriptions in order to reasonably categorize the ambiguous locative description as one frame of reference or another. For example, in (58) the elicited description is *tɔ̀ yè àdékà àbɛ̀kú* 'the box is to the left of the bottle'.

(58) tɔ̀ yè àdékà àbɛ̀kú
bottle be at box left
'the bottle is on the left side of the box'

The description in (58) could be said to correspond to a Relative Frame of Reference with either Reflection Analysis or Translation Analysis—within both of these analyses, the LEFT of the relatum corresponds to the LEFT of the viewpoint. Because of this ambiguity, the bottle's position relative to the box was changed so that the speaker would provide another frame of reference description that might disambiguate whether (58) was the Relative Frame of Reference with

Reflection Analysis or with Translation Analysis. The description of the bottle's new position was elicited in (59) *tɔ̀ yè àbɛ̀kú sɛ̀ɛ̀* 'the bottle is behind the box', which also fits the Relative Frame of Reference with Reflection Analysis.

(59) tɔ̀ yè àdékà sɛ̀ɛ̀
bottle be at box behind
'the bottle is behind the box'

The locative description in (59) could be interpreted as a disambiguation of (58) since the only Relative Frame of Reference that fits both of these locative descriptions is the Relative Frame of Reference with Reflection Analysis. However, since (59) could also be the Relative Frame of Reference with Rotation Analysis, this locative description could also be interpreted as another ambiguous Relative Frame of Reference. This ambiguity is unavoidable because of the very structure of the Relative Frame of Reference's different analyses.

Each analysis of the Relative Frame of Reference has coordinates that align with another analysis of the Relative Frame of Reference—that is, though they can be described as distinct categories, the analyses of the Relative Frame of Reference overlap significantly. The LEFT and RIGHT of the reflection analysis and the translation analysis are always aligned because they are both determined by the side of the relatum that corresponds to the viewpoint's LEFT and RIGHT. Any locative description using the Relative Frame of Reference in which the coordinate LEFT is used such that it corresponds to the viewpoint's left will be ambiguous between a reflection analysis and a translation analysis. Consider Figure 5 and Figure 6 in Chapter 3, which depict both the reflection analysis and translation analysis; in both of these, the RIGHT and LEFT of the ball are the same sides.

In the same way that the RIGHT and LEFT of the reflection and translation analyses are always aligned, the FRONT and BACK of the reflection analysis and the rotation analysis are always aligned also. This alignment of FRONT and BACK in two analyses occurs because they are both determined by the side of the relatum that is facing the viewpoint's FRONT. Any locative description using the Relative Frame of Reference in which the coordinate FRONT is used such that it corresponds to the space between the viewpoint and relatum is ambiguous between a reflection analysis and a rotation analysis. Consider Figure 6 and Figure 5 in Chapter 3 which depict both the reflection analysis and the rotation analysis; in both of these, the FRONT and BACK of the ball are the same sides. Because of the alignment of these coordinates, it is impossible to be certain which frame of reference a speaker is using on a particular occasion.

Levinson (2003) addresses the ambiguity resulting from the alignment of these frames of reference, stating that the reflection analysis presents a complicated conceptualization[3]. He suggests two possible explanations for the reflection analysis: (i) it is an amalgam of the rotation analysis and translation analysis, or (ii) it is possibly the result of a rotation analysis in which the relatum does not actually have its own LEFT and RIGHT, rather these coordinates are actually intrinsic to the viewpoint. This ambiguity can be interpreted in a number of ways. One might see it as a failure to present a definitive classification of locative descriptions. On the other hand, one might see it as allowing flexibility that accommodates ambiguous frame of reference descriptions that are dependent on a given context. Either way, with careful and thorough experimentation, further description of Relative Frame of Reference locative descriptions could shed light on the cognitive structures behind the ambiguity in the Relative Frame of Reference.

The second type of ambiguity in coordinate systems is from simply not knowing what type of frame of reference a speaker is using in a given locative description. Because a Gã

[3] Levinson (2003), pp 86-88

speaker could create a locative description that fits either the Intrinsic or Relative Frame of Reference, it would be impossible to be confident that the spatial arrangement drawn to illustrate this description is correct. However, if we knew the frame of reference a Gã speaker intended, we could always be certain of the spatial arrangement. As seen in Section 5.3.2, the Gã speaker exhibited a preference for using the Relative Frame of Reference with Rotation Analysis for a 2.5D spatial arrangement, and the Relative Frame of Reference with Reflection analysis for a 3D spatial arrangement. Despite this preference, the speaker used both reflection and rotation analyses in both 2.5D and 3D spatial arrangements. Because both analyses were used in both contexts, it is possible that when used in discourse, these frames of reference will be ambiguous to the hearer—i.e., the hearer may have no way to determine the analysis used to describe a given spatial arrangement. Without being able either to see the spatial arrangement being described or to clarify the description with discourse, it may be impossible for a hearer to identify the type of analysis the Gã speaker is using. This ambiguity means that a person hearing the Gã spatial description would not know the referent's location relative to the relatum. The hearer would know the referent is on the LEFT/RIGHT axis, but would not be able to make a more definitive conclusion about the referent's location. Despite the ambiguity that results from the Gã Relative Frame of Reference using the same grammar and morphology as the Gã Intrinsic Frame of Reference, the Relative Frame of Reference is still necessary in certain situations.

Levinson offers three reasons for a given use of the Relative Frame of Reference. The first is that objects like rocks or plants may not have an intrinsic system that can be used for an Intrinsic Frame of Reference, and if a given language does not use an Absolute Frame of Reference, then the Relative Frame of Reference is needed. The second is that a given analysis of the Relative Frame of Reference, such as the translation analysis, will allow for logical

inferences: If A is to the left of B, and B to the left of C, then A is to the left of C (Levelt 1984). The third reason is that the Relative Frame of Reference is directly connected to the visual experience of a given viewpoint, such that if the viewpoint is known, any person could visualize a spatial arrangement that he or she has not actually witnessed based on the description in a Relative Frame of Reference. These reasons suggest why the Relative Frame of Reference is useful, and the extent to which it may or may not be manifest in language.

Levinson never states that a language will have/use only one analysis of the Relative Frame of Reference. However, if a language uses multiple analyses of the Relative Frame of Reference, the usefulness of the Relative Frame of Reference is reduced to only providing coordinates to entities without intrinsic systems. If a language uses multiple analyses of the Relative Frame of Reference, then this frame of reference is still useful for supplying coordinates to objects that do not have intrinsic systems. However, the Relative Frame of Reference only supports logical inferences if a language uses only one analysis—i.e., I can only say "if A is to the left of B, and B to the left of C, then A is to the left of C", if I am using a single analysis in the Relative Frame of Reference. If I were using, for example, the rotation analysis for A and the reflection analysis for B, then their respective 'left' and 'right' coordinates would be opposite and logical inferences would not be valid.

Furthermore, though the connection to a visual experience still exists if a language uses multiple analyses of the Relative Frame of Reference, this connection is less useful given multiple analyses of the Relative Frame of Reference. Though a person could still visualize a spatial arrangement given a description in a Relative Frame of Reference, without knowing the exact analysis used for each object, the description would be relatively unhelpful. Consider again the fact that logical inference is impossible if object A is analyzed using the Relative Frame of

Reference with Rotation Analysis, while object B is analyzed using the Relative Frame of Reference with Reflection Analysis. Unless a group of language users had established which objects are given which analysis, then the utility of these frame of reference descriptions is limited. A group of language users would need a set of criteria for knowing the type of analyses used for certain objects in order for the Relative Frame of Reference's connection to visual experience to be helpful. Without criteria for using different analyses of the Relative Frame of Reference, these coordinate descriptions are no longer helpful. Thus, it is problematic for a language to use multiple analyses of the Relative Frame of Reference. A given language may have a set of underlying criteria for interpreting coordinate system descriptions, though determining such criteria for Gã would require further research.

The fact that the Gã speaker displays a preference for using the Relative Frame of Reference with Rotation Analysis for a 2.5D spatial arrangement and the Relative Frame of Reference with Reflection analysis for a 3D spatial arrangement does not preclude ambiguity in either context—in either a 2.5D or 3D spatial arrangement, the Relative Frame of Reference could be with a rotation or a reflection analysis. Because the speaker used both the rotation analysis and reflection analysis for both 2.5D and 3D spatial arrangements, there is ambiguity in her use of the Relative Frame of Reference. As Levinson's (2003) framework stands, there is no solution for this ambiguity. The very nature of the Relative Frame of Reference and its overlapping analyses mean that it is problematic in ways such as these types of ambiguity.

Considering the examples and overlap that occur in the Relative Frame of Reference, the LEFT/RIGHT axis is the main source of these problems and ambiguity. Because the multitude of problematic ambiguities stem from the multiple ways of using the LEFT/RIGHT axis, we might call this axis unstable—i.e., there is no fixed way of using LEFT/RIGHT coordinates. This instability is

also seen in the cline of LEFT/RIGHT discussed in Section 3.5. The cline demonstrates that not all languages make use of LEFT and RIGHT to the same extent: at one end of the cline are languages that only use LEFT/RIGHT as the names of hands, while at the other end of the cline are languages that show LEFT/RIGHT bias in demonstratives. The more conceptual domains that LEFT and RIGHT are used in, the more unstable the categorical and definitive use of these terms seem to become. The instability of the LEFT/RIGHT axis in both the Relative Frame of Reference and as concepts in languages suggests that more than the linguistic properties of these words dictate their use in a language.

6.2.2 The Relative Frame of Reference and Deixis

The subjectivity of locative descriptions in the Relative Frame of Reference is what has led this type of locative description to be called deictic in previous frameworks (Levinson 2003). Despite what Levinson (2003) says early on about deixis being non-angular, he does not disagree that the Relative Frame of Reference can be deictic[4]. However, he also says the Relative Frame of Reference is not always deictic as in the case of a non-speaker occupying the space of the viewpoint as in (25), described in Chapter 4, where a building is the viewpoint of the Relative Frame of Reference rather than the viewer/speaker being the viewpoint. Though he cites sources for this requirement of deixis to be egocentric—e.g., Anderson and Keenan 1985, Fillmore 1982, Hanks 1990, Haviland 1996—egocentricity is not a necessary requirement of deixis according the notion of deixis established by Hanks (1992).

Deictic reference as discussed by Hanks (1992) is more restricted: it occurs specifically when a morpheme references an entity that is part of the context in which the morpheme itself occurs. Reference occurs when a lexical item singles out an entity in the universe. The deictic, or demonstrative, reference that Hanks discusses is not merely singling out any entity in the

[4] Levinson (2003) p 89.

universe, rather a deictic form refers to an entity in the universe that is a part of the utterance's indexical context, which includes content, speaker and hearer(s), location in time and space, etc.

Deictic forms have been identified as referential indexicals because, though they refer to a specific entity in the universe, they can only be defined by the context in which they occur. The property of being defined solely by context is known as indexicality. Indexicality in language is any linguistic phenomenon that does not reference an entity in the universe, rather the "meaning" of the phenomenon is defined by the context in which it occurs (Silverstein 1976). For example, a pragmatic feature of American English use is certain intonational cues to indicate turn-taking in discourse (Ford & Thompson 1996). These intonations do not refer to any entity in the universe, rather they refer to the idea 'it is appropriate for another person to begin speaking'. Indexicality is that which only exists in the presence of speech. For example, if a person does not speak, then he/she does not have an accent, which indexically represents that the speech patterns of people from a particular place. Reference is distinguished by the fact that what is referenced exists whether or not it is spoken about—even if I don't call a pear *a pear*, the pear still exists.

Under Hanks's (1992) definition of deictics as referential indexicals, the Relative Frame of Reference is indeed deictic. A Relative Frame of Reference singles out an entity in the universe; a coordinate such as FRONT projecting outward from a relatum. This reference is indexical because it is determined by the context in which it occurs; it is dependent on a viewpoint that is established at the time a locative description is spoken. For example, consider a ball sitting at the base of the tree and a person walking in a circle around the tree and ball. The person's location is constantly changing and so the location of the ball relative to the person's viewpoint is likewise constantly changing. The coordinate that projects from the tree and that is used to describe the ball's location is indexical because the person's location/viewpoint at

moment of speech determines the name of the coordinate. The viewpoint's location at the time of speech is the context that determines the meaning of the deictic coordinate referenced by a Relative Frame of Reference. In a certain context/location of the viewpoint, the ball is 'in front of the tree'. At another context/location of the viewpoint, the ball will be 'behind the tree'.

Consider (60) and (61). These two locative descriptions exemplify the deictic nature of the Relative Frame of Reference. In (60) the speaker is asked to imagine how a person on the opposite side of these objects would describe the position of the bear compared to the bottle. In (60) the bear is the referent, the bottle is the relatum, the viewpoint is the space on the opposite side of these objects, and the coordinate used to describe the bear's location is *àbɛ̀kú* 'left'.

(60) Prompt: How would a person sitting on the opposite side of the objects describe the location of the bear?

bɛ yè tɔ̀ àbɛ̀kú
Bear be at bottle direction-left
'the bear is to the left of the bottle'

In (61), the referent and relatum have not moved, but the speaker is asked to use her own viewpoint to create a locative description. In this context, the coordinate system used to describe the bear's location is *nĩnè-j^{w}urɔ̃* 'right'.

(61) Prompt: How would you describe the location of the bear?

bɛ yè tɔ̀ nĩnè-j^{w}urɔ̃
Bear be at bottle direction-right
'bear is to the right of the bottle'

Between (60) and (61), nothing but the context has changed. In (60) the viewpoint is on one side of the referent and relatum, in (61) the viewpoint is on the other. In order for a hearer to

understand what locations are indicated by the locative descriptions in both (60) and (61), the hearer must know the context in which the locative description is made—i.e., the hearer must know the viewpoint from which the locative description is conceptualized.

A Relative Frame of Reference is deictic because the relatum's coordinates are not fixed, rather they are determined by a context—i.e., the location of a viewpoint. The other frames of reference are not deictic because the relatum's coordinates are fixed in some way—either by an intrinsic system or by a set of cardinal directions—that allows them to be used independent of context.

6.3 Further research on locative description preferences

A good way to disambiguate preference for a certain type of locative description would be to develop a corpus of naturally spoken Gã and perform the same statistical analysis used in this study. Such a corpus would doubtlessly contain a vast body of data unrelated to locative descriptions. However, in such a corpus, the locative descriptions would not be framed by possible experimenter bias; rather they would reflect the locative questions and answers used by Gã speakers in everyday language use.

Given an appropriate variety of contexts and entities, the other requirement for attempting to elicit locative description preference for a given language would be a large assortment of speakers. Speakers of the same language may nevertheless exhibit differences in the locative descriptions they prefer, depending on individual background differences. For example, if a language has absolute, intrinsic, and relative frames of reference available, a speaker with a nautical background may prefer the absolute frame of reference if they regularly use this frame of reference for reading maps and navigating. On this level, a person's idiolect

certainly can influence preference for locative description, which Levinson (2003) described as expert language.

Additionally, a diachronic study or use of the apparent time construct (Baily et al 1991) could reveal how coordinate system use has changed over time. Given Gã's history of intense language contact, work that focuses on Gã coordinate system use diachronically might reveal change due to language contact. Studies comparing Gã to the colonial languages with which Gã came in contact—Danish, Dutch, English, and Portuguese—could provide further clues about whether Gã coordinate system use has changed because of language contact.

6.4 Summary

This thesis has sought to provide a description of coordinate system use in the Gã language. Evidence has been provided to suggest that Gã is an Intrinsic and Relative Frame of Reference language that uses LEFT and RIGHT in visual fields and four other conceptual domains. These claims can be explored in further research by expanding the number of speakers and domains of use of coordinate system elicitations. The data also highlights the need for further work on the categories of Levinson's (2003) framework of locative language, and on the perceptual and cognitive foundations of coordinate systems more generally.

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