~~De~~*sign*ing an Experience: Maps and Signs at the Archaeological Site of Troy

by

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1. Introduction

1.1 Problem Statement: Designing the Visitor Experience at Troy

Here, I discuss ways of enhancing *the visitor experience* at the archaeological site of ancient Troy near Çanakkale, Turkey, by redesigning the current maps and signage. Maps and signage are essential for visitors to understand and appreciate the cultural, historical, and natural importance of a heritage site. As discussed below, many visitors are underwhelmed by Troy. This negative visitor experience can be attributed in part to the lack of a comprehensive plan for the design of the maps and signage onsite. The purpose of this research is to improve the visitor experience, especially that of tourists, by means of redesigning the maps and signage.

To accomplish this goal, I completed a content analysis of the maps and signage found at Troy in summer 2014. To my knowledge, no comprehensive content analysis of the maps and signage at Troy had been previously conducted. However, a 2009 needs assessment study identified "poor and confusing wayfinding" and "visual clutter and chaos" as the two greatest risk factors that adversely affect the Troy visitor experience (Riorden 2009: 9-10). As a UNESCO (United Nations Education, Scientific, and Cultural Organization) World Heritage Site (UNESCO 2013), Troy should be showcased as well as preserved. Thus, any effort to improve the visitor experience at Troy is important and timely, particularly with the opening of a new museum scheduled for late 2016.

The content analysis of maps and signage at Troy was informed by scholarship in *semiotics*, broadly defined as the theory of signs (Noeth 1990). The semiotic approach is useful in understanding the denotation and connotation of maps and signage as an overarching system (MacEachren 1994) to the end of maximizing their communicative efficacy with site visitors. The content analysis also draws from practices in *environmental graphic design*, defined as the visual communication of information in a

human-constructed environment (Calori 2007) In this thesis, the term *signage* refers to the installation of signs in the environment that provide visitors with some information about the environment.

1.2 The Visitor Experience at Troy

The ancient city of Troy (also called Ilion / Wilusa) located near Çanakkale, Turkey (Figure 1.1), is one of the most famous and celebrated archaeological sites of the classical world. Troy is believed to have had a primary habitation period from about 3000 BCE to 500 CE. During its long history, Troy was at times an independent city state and was also subjugated by many empires, including those of Persia, Greece (including Alexander the Great and his successors), and Rome (Rose 2014). The legends about the destruction of the city and its aftermath are described in the *Iliad* and the *Odyssey* by Homer, the *Aeneid* by Virgil, as well as in works by many other Greco-Roman poets and historians. Because the legendary Trojan hero Aeneas, who fled the burning city, had a part in the founding of Rome, the Romans themselves would visit Troy to view their own ancient history. Thus Troy is one of the world's oldest tourist sites and has remained part of the popular imagination for over 5,000 years. The present day archaeological site is approximately 158 hectares (UNESCO 2014) and includes the remnants of the temple of Athena and a replica Trojan horse, constructed in the 1970s. Ancient Troy and its neighboring settlements constitute a region called the Troad (Rose 2014; Figure 1.2).

Figure 1.1 Troy and Famous Neighboring Sites.

Figure 1.2 The region comprising the Troad.

Today, Troy is visited annually by approximately 300,000-500,000 people (Riorden 2009). Pompeii, in comparison, has roughly 2.5 million annual visitors (Orcutt 2012). There are several known factors that influence the volume of tourism at historical sites like Troy. Most tourists decide to visit a location based on the total expense of the trip and their personal safety at the selected site (Gmelch 2004). After these considerations, tourists choose destinations based on how the places are portrayed through advertisements and other promotional materials (ibid). Tourists seek experiences that are novel or fundamentally different from their everyday lives (Graburn 26). In the case of historical destinations, tourism also serves the human desire to understand the world around us, as it existed in the past and as it exists now (Downs and Stea 4).

Urry and Larson (2011: 2) describe the *tourist gaze* as a learned way of viewing the world through "ideas, skills, desires, and expectations, framed by social class, gender, nationality, age, and education." This gaze is motivated by the quest for an "authentic" and extraordinary experience that is different from everyday life (Culler 1981: 5). Visual media that tourists consume before the trip builds an imaginary idea of what the place will be like (Urry and Larson 2011) and sets their expectations for the visit (Skinner and Theodossopoulos, 2011). As tourists leave home in search of a new experience, they then become "semioticians" of the landscape, looking for classic "signs" that "signify" the identity of the place (Urry and Larson 2011: 17, citing Culler 1981). Tourists "collect" these signs through photographs and other media as physical "markers" of place (MaCannell 2013: 122-123), and the tourist industry reproduces them for consumption through the production of trinkets and other souvenirs (Urry and Larson 2011:5). These reproductions in turn mark the "real" place as real (Culler 1981).

Many tourists report that their experience at Troy is a disappointment, with a number of factors contributing to this negative perception. First, many visit Troy after seeing Ephesus, which has rebuilt monuments, or compare the site to the better preserved Pompeii or Herculaneum. Second, Troy's complex history and the sheer size of the site result in difficult navigation and interpretation for tourists

without a guide. During its 3500 year history, Troy was destroyed due to war and earthquakes multiple times, resulting in successive layers of ruins that are difficult to read into the landscape. Third, the onsite maps and signage at Troy have been designed in an inconsistent and ad hoc manner. The tourist path is poorly marked with wayfinding signage, causing visitors to miss important structures or vistas, although signs have been placed in the shade for the convenience of tourists. Most visitors arrive by bus and are onsite for 90-120 minutes; thus the lack of efficient wayfinding and concise informational signage is particularly problematic.

Finally, the maps and signage available at Troy do not meet the standards of cartography and graphic design. The mapping and color conventions of the signs follow standards derived from maps featured in archaeologist Wilhelm Doerpfeld's 1902 book *Troy and Ilion.* These standards violate contemporary design conventions by using color hue to depict quantitative information. Additionally, the current signage at Troy was developed by archaeologists and stakeholders managing onsite research during the period of 1988 – 2012, a group without training in cartography or environmental graphic design. Due to turnover, none of these stakeholders remain involved with Troy today. Furthermore, the Turkish Ministry of Culture has constraints impacting the management of the site that produces an inverted visual hierarchy of maps and signage at Troy that emphasizes caution signs, rather than directional and informational signs explaining the history of the site. These constraints require the posting of warning signs which forbid smoking (smoking is rarely restricted in Turkey but fire is a hazard facing the site), avoiding weed control chemicals that can damage the site, and avoiding injury and liability.

1.3 Thesis Organization

The thesis continues with four additional chapters. In the second chapter, I review literature on semiotics, explaining the dyadic and triadic models of the sign. I introduce the semiotic triangle, which comprises the referent, sign vehicle, and interpretant, and 'spin' the semiotic triangle to demonstrate

how each axis of the semiotic triangle mediates the other two axes. I conclude the chapter by summarizing additional considerations drawn from environmental graphic design about the signage material, the surrounding environment, and additional wayfinding embellishments.

In the third chapter, I detail the content analysis applied in this study, beginning with an overview of the quantitative content analysis method. I then describe my procedure for capturing the maps and signage at Troy, providing a basic description of the resulting corpus of artifacts for analysis. I conclude the third chapter with an overview of the coding scheme—which was derived from the literature review—applied to analyze and interpret the corpus of maps and signage. The chapter concludes with an explanation of the coding scheme and the analysis.

The fourth chapter discusses the results of the quantitative content analysis organized around the spinning of the semiotic triangle: referent-as-mediator, interpretant-as-mediator, and sign-vehicle-as-mediator, as well as considerations from environmental graphic design. Missed opportunities are identified, and key recommendations are provided to improve the visitor's experience at Troy.

The fifth chapter summarizes the research completed, provides design imperatives to improve the signage at Troy, and discusses the limitations and future directions of this research.

2. Literature Review

In the following, I draw on scholarship from semiotics and environmental graphic design to review the multiple dimensions of designing effective maps and signage. Section 2.1 discusses semiotics, explaining the dyadic and triadic models of the sign. Sections 2.2 – 2.4 discuss the semiotic triangle and ways to 'spin' the triangle to allow one axis to mediate the others. Because signs operate in the environment, Section 2.5 integrates material and environmental considerations from the discipline of environmental graphic design.

2.1 An Introduction to Semiotics

As introduced in the previous chapter, semiotics is the study of signs and sign systems. Concepts from semiotics have been applied in dozens of fields, from anthropology and religious studies to mathematics and zoology (Noeth 1990), and have a strong tradition in visual design fields such as cartography and information visualization (Bertin 1967; MacEachren 1995). The roots of semiotics lie in the philosophy of the classical world in which the Roman *nobilitas* (ruling class) was well-schooled. Although the classical philosophers did not identify semiotics as a distinct line of inquiry, the study of signs was part of the study of semantics, which in turn arose from broad inquiries into "logic, rhetoric, poetics and hermeneutics" (Noeth 1990:14). The Epicurean philosophers held a *dyadic* model of signs that differs from the modern conception of a dyadic system. To them, a sign consisted of two components: the *signified* (the message conveyed or impression given) and a real world object or phenomenon addressed by the sign (Noeth 1990: 16). In contrast, the Stoic philosophers held a triadic model of signs. Its three components were (i) the signified, (ii) the real world object (as with the dyadic model), and (iii) the *signifier* (or vehicle for communicating the sign) (Noeth 1990:15-16). The different models reflected a different view regarding the perception of reality and foreshadowed the split between the modern day dyadic / triadic models.

Like ancient semiotics, modern semiotics is influenced by two dominant models of the sign: one dyadic (developed by Ferdinand Saussure between 1907 and 1911) and the other triadic (proposed by Charles Sanders Peirce; 1867) (Noeth 1990; Hoopes 1991). However, the modern definition of the dyadic system differs from the ancient system. Saussure's *dyadic* model originated in linguistics and consisted of the signified and signifier, but unlike the Epicurean system, did *not* include the real world object. Using the Saussurian dyadic model, a map mark "H" consists of the representation—the letter "H" on the map—and the message, which could be "Hospital" on some maps, or "Helicopter" on others. This example indicates the importance of carefully considering real world context in the design of maps and signage.

Peirce's *triadic* model instead originated in philosophy and was likely informed by his studies in many sciences (Peirce was a polymath). His model of the sign includes the *interpretant* (the meaning of the sign or signified as defined above) and the *sign vehicle* (the signifier as defined above) (The terminology was updated by Morris 1938). Pierce added the *referent,* or real-world object or phenomenon, included by both the Epicurians and Stoics (Noeth 1990; Table 2.1). The same "H" map mark, using the triadic model, consists (i) representation—the letter "H" on the map, (ii) the message, "Hospital" or "Helicopter", and (iii) the real life object to which the sign refers—the hospital or helicopter pad.

System	Sign-Vehicle	Referent	Interpretant
Stoic	'material object'	'external object'	'incorporeal'
Epicurean	'words and objects'	'sense impression or feeling'	*None*
Sassurean	'sound-image' (signifier)	*None*	'concept' (signified)
Peircean	"perceptible object"	"existing thing"	"meaning of a sign"

Table 2.1 Comparison of Sign Systems. Content from Handbook of Semiotics (1990).

The advantage of the triadic model over the dyadic model is that the former allows for additional consideration of the real world phenomena. For reasons discussed previously, the real life

ruins of an archaeological site like Troy are difficult for visitors to comprehend. The relations among the referent, interpretant, and sign vehicle may reveal ways in which the visitor's interpretation of the archaeological site can be improved.

Ogden and Richards (1923) visualized Peirce's triadic model in a triangle to put the emphasis on the interpretant's mediation of the sign vehicle and referent (Figure 2.1), but each axis of the semiotic triangle can mediate "between what is seen and what is known" (MacEachren 1994: 221). Thus "spinning" this semiotic triangle provides different ways of looking at the interplay among the referent, interpretant, and sign vehicle, resulting in three different dimensions for assessing the maps and signage at Troy.

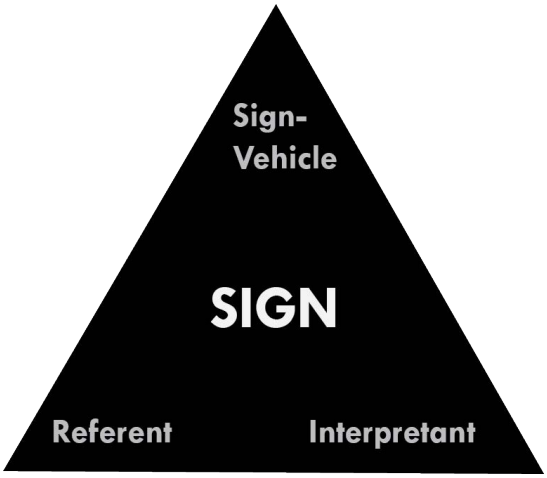

Figure 2.1 Ogden-Richards Triangle.

A *referent-as-mediator* approach acknowledges that there are many kinds of representations possible for a given real world object and that congruence should be maintained between characteristics in ultimate design and the referent the sign describes. The second axis of the triangle, the *intepretant-as-mediator* approach, acknowledges that a sign serves as shared knowledge between the designer and the visitor. Sign classification systems, such as the Robinson taxonomy, as well as the continuum of iconic / abstract, fall within this approach.

The last axis of the triangle describes the *sign-vehicle-as-mediator* approach and acknowledges the sign vehicle as the connection between the real life object and its meaning. Using each axis as

mediator allows for a multifaceted analysis of how signs generate meaning using different visual variables.

In the next sections, I 'spin' the Ogden-Richards triangle to provide a cartographic framework for semiotic analysis of the current visual representation of the archaeological site of ancient Troy. Given that the signs are in the environment, I also review the environmental graphic design body of knowledge that focuses on practical aspects of designing maps and signage for wayfinding.

2.2 Referent-as-Mediator

The referent-as-mediator perspective places the emphasis on the real-world objects that inform the design of maps and signage. The design is clearest when it congruently aligns with the object or idea being communicated. Here, I focus on two aspects of the design process that impact how the referent is treated in the design of maps and signage: the type of information about the referent and the embedded knowledge about the referent. Embedded knowledge differs from the information content in that embedded knowledge is expert knowledge that enhances the interpretation of the sign and surrounding environment as opposed to a classification of information type.

2.2.1 Information Content

First, maps and signage vary in the type of information they convey to visitors (Peuquet 1994). In this study, I focus on three types of information commonly found on maps and signage: attribute information, geographic information, and historical information. *Attribute information* provides description information about the quality or character of a phenomenon, such as a statistic about a population. *Geographic information* provides details about space and places within space, such as the absolute location of Troy in Turkey and relative location of points of interest within Troy. Maps and signage are useful because they integrate geographic and attribute information into a single visual (Bolstad 2012). Finally, archaeological sites are unique in their emphasis of temporal, or *historical* information, which puts events and artifacts in historical context. Maps and signage may communicate

all of these types of information, with these three kinds of information forming the basis of the visitor's understanding of the place and thus the richness of the user experience.

2.2.2 Embedded Knowledge

Second, the knowledge embedded within a representation impacts what and how the visitor learns from the maps or signage. The field of spatial cognition identifies three types of knowledge that can be layered into the map or signage through annotation and accenting that draw the visitor's attention. *Declarative* knowledge organizes information about "objects [and] places together with meanings and significances" in long-term memory (Golledge and Stimson 1987: 94). *Procedural* knowledge organizes information about how to complete a task or move from place to place. *Configural* knowledge organizes information about the spatial arrangements of objects. In addition to being encoded directly in a map, configural knowledge can also be derived from existing declarative and procedural knowledge (Golledge et al 1992). Although declarative and procedural knowledge are helpful for wayfinding, configural knowledge is needed to develop a comprehensive understanding of the "shape, pattern, distribution and association" of phenomenon in the landscape (Golledge 1992: 212).

2.3 Interpretant-as-Mediator

The interpretant-as-mediator perspective focuses on the ambiguity in the way that a sign shares information between the designer and the visitor. For the design of maps and signage, this spinning of the semiotic triangle examines the way that the sign's communication varies in its iconicity or its place in existing symbol taxonomies, such as the Robinson taxonomy or a widely recognized sign library in mapping and signage such as AIGA/DOT or ISO 7001.

2.3.1 Iconicity

A highly symbolic sign has a high degree of abstractness. An abstract sign resembles a generalized shape more than a detailed image. In contrast, a highly figurative sign has a high degree of iconicity, and

resembles an image more than a graphic. Most signs fall on a continuum somewhere between symbolic and figurative, or abstract and iconic (Ganter and MacEachren 1990).

The iconicity of a sign can be characterized using the Robinson (1995) taxonomy, which classifies symbols as pictorial, geometric, and associative. *Pictorial symbols* have sign vehicles that closely resemble their referents (metonymy) and thus are the most iconic. In contrast, *geometric symbols* are abstract and have sign vehicles that bear no resemblance to their referents. The classic example is a star to represent a capital city: the star bears no similarity with a capital, but because it is so commonly used in this context, it is well understood (Robinson et al 1984). Finally, *associative symbols* fall somewhat in between a pictorial and geometric symbol and have sign vehicles that resemble concepts that are culturally associated with their referents but not the referents themselves. Associative symbols typically are more iconic than abstract and can be equally as iconic as pictorial symbols. The Robison taxonomy does not account for signs that were a step towards realism beyond pictorial representations. This new category, defined as image / realism, describes the use of realistic illustrations.

2.3.2 Sign Libraries

Many commonly encountered symbols in maps and signage are part of sign libraries. Two of the most common sign libraries used on cultural heritage sites are the AIGA /DOT symbol library and the ISO 7001 (International Standards Organization) symbol library (Figure 2.2). The AIGA / DOT library of 50 symbols was developed by the American Institute for Graphic Arts (AIGA) in collaboration with the US Department of Transportation (DOT) for the purpose of showing travelers information (AIGA 2016). The ISO 7001 library of 137 symbols was developed by the International Organization for Standardization (ISO) for the purpose of public information (ISO 2016). Because these symbols are so widely used, they have a greater potential to be recognized by the visitors and thus limit confusion while promoting learning and wayfinding.

Figure 2.2 Comparison of AIGA (left) and ISO 7001 (right) symbol sets.

2.4 Sign-Vehicle-as-Mediator

The sign-vehicle-as-mediator perspective examines the ways in which sign vehicles activate different levels of meaning about the referent and interpretant (MacEachren 1994). This perspective addresses the ways in which maps and signage communicate meaning using the *visual variables* or the fundamental dimensions of a graphic sign vehicle that can be varied to communicate information visually. This section also considers how the design of typography also serves to evoke meaning about the referent and interpretant.

2.4.1 Symbolization

Visual variables differ in their effectiveness for depicting information based on the level of measurement of collected data (Figure 2.3). Traditionally, one of four levels of measurement is used for collecting data about a phenomenon or process: nominal, ordinal, interval, and ratio. *Nominal* data identifies categorical differences only. In contrast, *ordinal* data identifies categories that are ranked in an order but without numerical magnitudes between ranked categories. Finally, both the *interval* and *ratio* level of measurement collect numerical data, but zero is arbitrary for interval data, such as degrees Celsius, while zero is meaningful for ratio data, such as degrees kelvin. In the following discussion, representations of interval and ratio data are described as depicting *quantitative* differences, while nominal data are described as depicting *qualitative* differences. Other scales of measurement have been proposed, such as cyclical (Slocum 2009).

Knowing the scale of measurement is important for understanding the utility of each visual variable in the design of maps and signage. For instance, the perception of color is based on three visual variables that can be modified separately to communicated information: *color hue* (the dominant

wavelength of color), *color value* (the intensity of the color, or lightness or darkness of the color), and *color saturation* (the brilliance or spectral signature of the color; Figure 2.3). The visual variable color hue is particularly useful for depicting qualitative differences, while value and saturation are better reserved for depicting ordinal differences (Bertin 1967, MacEachren 1994). The perception of color leads to recommendations for color schemes in maps and signage. A *spectral* or *qualitative scheme* using separate hues is most effective at displaying nominal data, while *sequential scheme* in which a single hue or a pair of two hues progressive darken in value works best for ordinal or numerical data. *Diverging schemes* show deviation from a critical central value, such as an average (Figure 2.3, Brewer 1994).

Beyond color hue, the visual variable *shape* (the form or figure of a sign), *orientation* (the rotation of a sign), and *texture* (the fineness or coarseness of a stroke or fill pattern) also are recommended for representing nominal data as they convey qualitative differences well but marginally show quantitative differences. Orientation is especially useful when conveying wayfinding information, as the orientation of arrows indicate a change in direction.

Additional visual variables recommended for depicting ordinal data beyond color value and saturation include *transparency* (the perceived opacity of a symbol) and *size* (the amount of space occupied by the symbol). Size is considered the strongest visual variable for depicting interval and ratio data, as it is effective for showing quantitative differences but ineffective in showing qualitative differences. However, color value also is used conventionally to represent classed quantitative information in cartography (e.g., color shading in choropleth maps), despite its being better purposed for ordinal rather than numerical data.

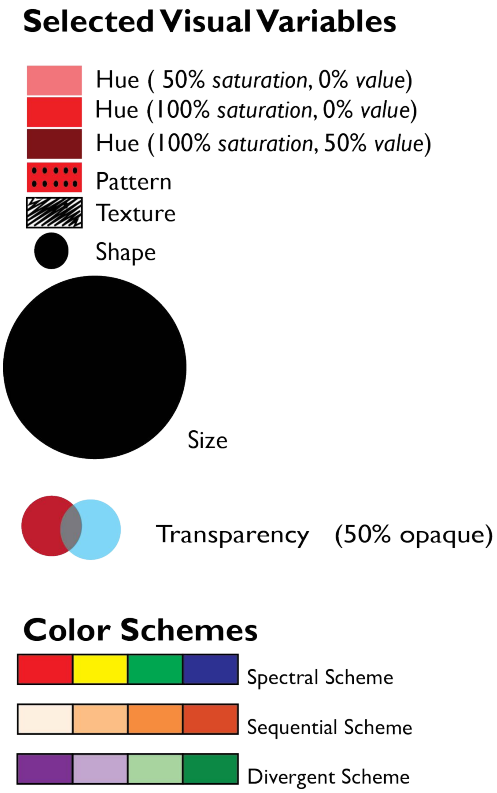

Figure 2.3 Selected visual variables and color schemes for depicting information on maps.

2.4.2 Typography

The design of text also can be varied by a designer to encode meaning. The term *typography* refers to the process of creating and setting type on a page (Slocum 2009) and more broadly to the art of visual forms given to human language (Bringhust 2005:11). Type can vary by class, by case, and by style.

The different *classes* of type, such as roman, blackletter, and modernist, arise from the nibs and pen strokes used to form the letters and were usually unique to the historical period in which the typeface was devised. Roman and italic typefaces are called *humanist* because these typefaces originated during the 1500s and reflect the work of a right-handed scribe (Bringhust 2005). These *humanist* typefaces feature *serifs* or small strokes at the beginning or end of a segment of a letter (Bringhust 2005). Modernist typefaces are commonly *sans-serif* (without serifs). In cartography, it is conventional to use serif typefaces to label natural features and sans-serif typefaces to label cultural features as the presence or absence of serifs mimics the smooth or abrupt geography of the physical and human worlds, respectively (Imhof 1977)

Type also is available in different *cases* (Figure 2.4). The first moveable type originated in China, and thus did not include different cases for each character (Lupton 2010). In Europe, the first moveable type included capitalized characters only, but today's *normal orthography* includes upper and lowercase characters. A third case is *small caps* in which the letters are all capitals, but the first capital letter is larger than subsequent capital letters. Well-designed small caps are not miniaturized versions of the typeface, but a unique type case in their own right (Bringhust 2005). It is a convention in cartography to use all caps for basemap material and normal orthography for important place names because blocky, all caps type is more difficult to read, causing it to recede into the background (Slocum et al. 2009).

Lastly, within a font family, typefaces differ by *style* (Figure 2.4). Most, but not all, *roman* typefaces are paired with a complementary *italic* typeface. Although the italic typeface of a given font may be considered a different style of that same font, the italic is not just a slanted version of a roman typeface. Instead, the italic is a style in which the serifs represent continuous strokes, similar to the cursive forms (Lupton 2010). Bold versions of typefaces increase the type's *weight* or the width of the stroke (Coles 2012). In cartography, bold is used to indicate an important feature (i.e., an ordinal difference), while italics is used to indicate a special feature (i.e., a nominal difference).

Roman Class, Normal Orthography
Roman Class, Bold Weight, Normal Orthography
ROMAN CLASS, ALL CAPITALS
Roman Class, Small Capitals
Italic Style ('False' Sloped Capitals)
Italic Style (True Capitals)
BLACKLETTER CLASS
Modernist Class (sans-serif)

Figure 2.4 Type class, case, and style.

2.5 Material Environmental and Wayfinding Embellishments

The final section of Chapter 2 captures additional insights from environmental graphic design. Discussion is organized according to aspects of signage related to the materials and environment and additional considerations from wayfinding theory.

2.5.1 Material Environment

In environmental graphic design, signs in the environment are frequently classified by function e.g., road warning signs (Smitshuijizen 2007). However, sign designers (e.g., Mollerup 2013, Smitshuijizen 2007, Katz 2012, Gibson 2009, etc.) generally list six overarching sign classifications: (i) identification, (ii) directional, (iii) informational, (iv) regulation, (v) ad-hoc, and (vi) indirect (Table 1). Identification signs are of particular importance to Troy because the features of the site are not easy to identify (e.g., compare the library of Celsus at Ephesus to the Sanctuary at Troy; Figure 2.5). Signage needs to communicate that the vistas "are indeed extraordinary, even though it does not seem to be so" (Urrey and Larson 2011: 16).

Figure 2.5 The library of Celsus at Ephesus (left) and the Sanctuary at Troy (right). The image on the left is much easier to identify. Images taken from the creative commons.

Sign Type & Sample Sign	Function
Identification 	*Identifies* or names a given location. The shape of an object or the architecture of a building can also serve as a sign, e.g., the distinctive design of a cathedral needs no sign announcing that it is a church. The giant horse serves as an identification sign because it is so closely linked with Troy.
Directional 	Explains the *direction* to a location.
Informational 	Provides *information* about a location.
Regulation 	Warns the traveler about the *regulations* of a given place.
Ad-Hoc	A handwritten sign placed in the absence of a 'formal' sign; a hallmark of an insufficient sign system. No ad-hoc signs were found at Troy.
Indirect / Environmental 	Not a formal sign, but a form of sensory information that provides information: e.g., the sound of a ringing bell indicating the location of a carillon; the smell of baking pastries guiding an individual to a patisserie; a camera indicating *you are being watched.* The dumpsters are the first site of Troy along the path to the site, signaling that Troy is dirty or unkempt.

Table 2.1 Sign Types. This table identifies signage type according to classification in environmental graphic design, and explains the function of each signage type.

The variance in a sign's shape can reflect the function that the sign serves. There are common patterns in sign shapes, primarily derived from road signage. Circular signs typically provide instruction

or regulation; rectangular signs, including square signs, identify or provide directions; triangular or diamond-shaped signs serve warning (AASHTO; E.U. Inland Transport Committee). Following these patterns imbues signs with an extra layer of meaning and facilitates comprehension.

Signs and maps installed outdoors are subject to environmental conditions. While this study cannot consider all aspects of a sign's installation, such as the sign's angle or height from the ground, other environmental factors such as a sign's finish and contrast with the environment can be included in the semiotic analysis of the site. Lighting can drastically change the legibility of a sign, and the effect of lighting is mediated by the finish used on the sign. Designers must consider whether the sign should use a glossy surface that will reflect direct sunlight or a semi-matte / matte surface which reflects little light (Calori 2007; Mollerup 2013).Furthermore, a sign may be well-designed, but its placement in the environment can decrease its effectiveness. While recording the exact positions of installed signs at Troy is beyond the scope of this thesis, it is possible to note the sign's contrast with the environment, its occlusion by other objects, and whether the sign causes visual pollution. *Highly contrasting signs* stand out as an object of notice in the environment, while *lower contrast signs* are more difficult for wayfinders to spot (Mollerup 2013). *Occluded signs* are those which are either partially or totally blocked by something else in the environment such as foliage. Other signs, particularly commercial signs, can cause *visual pollution,* which distracts from the visitors' sense of place (Portella 2014).

Signs can visually pollute if they operate outside of the sign hierarchy (Portella 2014). Like the visual hierarchy in a map—which makes the most important information the most prominent in the map design—the sign hierarchy necessitates that the most important signs be the easiest to discern in the environment (Mollerup 2013). Signs that violate this rule cause confusion.

2.5.2 Wayfinding Embellishments

Visual wayfinding embellishments affect the success of the sign system. As introduced above, wayfinding is supported by inclusion of declarative, procedural, and especially configural knowledge.

Environmental graphic designers have identified several considerations for improving maps and signage for navigation: following naming conventions, changing the map orientation, and improving wayfinding symbolization (Mollerup 2013).

Following naming conventions reduces the cognitive load of the map or sign system on the wayfinder. Place names should include procedural directions (Mollerup 2013), and names should be the same between maps and signs because synonyms for place names (e.g., "Main Street" versus "Downtown") can cause confusion (Arthur and Passini 1992; Smitshuijzen 2007; Calori 2007; Mollerup 2013). Abbreviated place names can be easier for visitors—especially if using an abbreviation will help avoid a hyphenation—but should not come at the cost of not using descriptive place names (Mollerup 2013).

Designers should consider the direction that the visitor is facing when making a map for installation in the environment instead of relying on the traditional "north-up" alignment of paper maps. A "heads up" display, orienting the map in the direction that the visitor is facing, does not require mental rotation to understand the environment (Katz 2012). Occasionally a designer may choose to distort distance or geography in the interests of simplicity, such as in a schematic map of a subway.

On map installations, the *You-Are-Here* mark should be used with an arrow indicating the direction that the person is facing rather than a dot that does not inform the visitor of his or her orientation (Katz 2012). Other navigational information should be released as needed. The entirety of the sign system should follow common patterns to speed up visitors' processing of information.

3. Methods

In this chapter, I describe the method used for gathering and analyzing the maps and signage at Troy. I first introduce the quantitative content analysis method used to analyze Troy maps and signage. I then describe the procedure followed to collect and exclude artifacts from Troy. I conclude the chapter with a description of the coding scheme and the analysis process.

3.1 Content Analysis

As summarized in Chapter 1, my overarching research goal is to identify ways of enhancing the visitor experience at Troy. To this end, I conducted a content analysis of the maps and signage found at Troy in accordance with the principles of semiotics and environmental graphic design in order to assess their effectiveness. A *content analysis* is a method of systematically evaluating a corpus of secondary sources in order to reveal key themes and anomalies in the materials (Suchan and Brewer 2000). I followed the tenets of *quantitative content analysis* (QCA) to apply a set of codes to the collected artifacts. QCA describes the process of generating quantitative information from a sample by counting and comparing different qualities of the objects studied (Muehlenhaus 2011). Variations of QCA have been used in cartography to study journalistic cartography (Monmonier 1989), persuasive maps (Muehlenhaus 2011), web mapping technologies (Roth et al. 2014), among others. In the following sections, I describe the content analysis conducted for the maps and signage at Troy.

3.2 Materials and Procedure

I visited Turkey in the summer of 2014 and was able to access the Troy site for two and a half days. The archaeological research team guided me through all portions of the site open to visitors and assisted me in filming the tourist path in its entirety. I photographed all maps and signage I found along the path and other areas accessible to tourists using a Sony high definition video recorder with photo capability and a digital camera as a backup. I used a Garmin gtrex GPS unit to note the positional information of each

sign. Finally, I collected all promotional material and purchased copies of all English and German books containing maps and signage for sale at the Troy visitor center.

In total, I collected geocoded images of 108 signs from the Troy site, with 22 of the signs containing some form of map (Figure 3.1). I also collected 12 books and 4 stand-alone paper maps from the visitor center. The maps were drawn from the following books, with each book having one or more maps: *Turkey, Gate to the Orient* (2010; 2 maps), *Turkey, a Complete Guide* (2014; 1 map), *Troy, a Revised Edition* (2014; 7 maps), *Troia/Wilusa Guidebook* (2013; 25 maps), *Troy Brochure* (no date; 3 maps), *Troy-Assos-Pergamum* (2013; 1 map), *Pergamum and Troy* (2013; 3 maps). I restricted the number of maps included in the content analysis based on inclusionary and exclusionary factors described below. Filtering the corpus resulted in a total 152 artifacts for the content analysis. Of those, 86 were signage without maps, 22 were signage with maps, 42 were maps in books, and 2 were paper maps.

Signs without maps	86
Signs with maps	22
Maps in books	42
Paper maps	2
Total	*152*

Table 3.1 The corpus of artifacts. The table shows the four different kinds of artifacts included in the corpus.

Inclusionary Factors: I included only the first entry for any redundancies in the sample, removing signage when photographed a second time and maps when appearing in a book additional times. Signage and maps were included only in a single language because those translated into multiple languages were in effect duplicates. If an unusual lighting condition was captured by the camera, the sign was coded as it should have appeared based on assessment of the tourist path recording. If a photograph in print media was used in a "map-like" way, such as a photograph with labels or overlaid linework, the photograph was counted as a map.

Exclusionary factors: Photographs were excluded from the study if the image was too blurry or the angle was oblique. Photographs of signage outside the boundaries of the site were excluded as were

duplicate photos of the same signage. Photographs of ephemeral signage, such as a stanchion without a fixed position, were excluded. Books without maps of Troy, maps unavailable for purchase onsite at Troy, and paper maps that did not depict Troy were also excluded from the study.

3.3 Coding Scheme and Analysis

I developed 60 unique codes to apply to the collected corpus of artifacts, with each code capturing a specific design theme introduced in Chapter 2 (Appendix A). The codes were grouped according to the spinning of the Odgens-Richard Triangle, resulting in broader referent-as-mediator, interpretant-as-mediator, and sign-vehicle-as-mediator categories. Recommendations from environmental graphic design were included in a fourth category. The coding scheme enabled me to analyze how the maps and signage function across broad semiotic categories and by individual semiotic codes.

The content analysis was performed using Microsoft Excel, with each artifact given a row and each code a column (Figure 3.1 provides an example). Each artifact was coded in a binary scheme: the object either exhibited or did not exhibit a given code. Most codes constituting a single category were not mutually exclusive: for example, an object could be coded as containing both attribute and historical / historical information. Appendix B displays the overall frequency and extensiveness of each code across the corpus of artifacts. In Chapter 4, I present the results and discuss the impact of these semiotic design patterns on the visitor experience using specific examples from the content analysis.

	A	B	C	D	E
1	ID	Media Type	Sign Type (if sign)	HueQual	HueQuant
2	1	sign	Information		
3	2	sign	Information		
4	3	sign	Information	1	
5	4	sign	Information	1	1
6	5	sign	Information		
7	6	sign	Information		
8	7	sign	Information	1	

Figure 3.1 Content analysis coding in Excel.

4. Improving the "Tourist Gaze": Results

I applied a total of 1828 codes across the 152 sampled artifacts, a rate of 12.0 codes per artifact (Appendix B). Across the content analysis, 1378 codes were applied to signs (75.4%) and 450 codes were applied to materials from the visitor center (24.6%). This code distribution roughly matched the artifact distribution: 108 signs represented 71% of the sample, and 44 materials from the visitor center represented the remaining 29%. Sign vehicle-as-mediator was the most applied code category (630 codes; 425 typography), followed by referent-as-mediator (444 codes), material environment (391 codes), and interpretant-as-mediator (283 codes). The sign vehicle-as-mediator's dominance was expected given that this category contained typography. The majority of collected materials contained some kind of text and generally multiple kinds of text.

In the following subsections, I spin the semiotic triangle to analyze and interpret the corpus of artifacts, summarizing patterns and anomalies in the code themes for the referent-as-mediator (Section 4.1), interpretant-as-mediator (Section 4.2), sign-vehicle-as-mediator (Section 4.3), and material environment (Section 4.4) perspectives respectively. Throughout, the discussion highlights opportunities for improving the maps and signage at Troy.

4.1 Referent-as-Mediator

The referent-as-mediator-approach suggests that congruence should be maintained between the characteristics of the real-world (i.e., the referent) and the ultimate design of the maps and signage. Two categories of codes were included to capture variation in the referent-as-mediator: the information content and the embedded knowledge. Overall, there was more discussion regarding information content (256; 56.1% artifacts) than embedded knowledge (188; 41.2%).

4.1.1 Information Content

Following Peuquet (1994), maps and signage were coded across three components of the information content: geographic information, attribute information, and historical information. Of the 152 artifacts, 105 contained geographic information (IC3; 69.0%), 90 contained attribute information (IC1; 59.2%), and 61 contained historical information (IC2; 40.1%).

Geographic information (IC3) was the most common type of information present in the sample. All of the visitor center maps (100%) contained geographic information (i.e., none were solely diagrammatic, in that all representations depicted a spatial aspect of the Troy site). However, only 28 of 108 onsite signs (25.9%) included geographic information in the form of maps, which was a missed opportunity to highlight and identify geographic features in the landscape that warranted visitor attention. Geographic information was found on many directional signs in the form of spatial navigation procedures indicating the direction to a particular layer of the site, but such directional signage was text-based and included no map visuals. Therefore, an opportunity was missed to pair identification and directional signs with maps (Figure 4.1) and thus to provide both procedural and configural knowledge within a single sign (see discussion below).

Figure 4.1 A directional sign at Troy indicating the way to archaeological layers IX, VIII, and VIIb that could be improved with the inclusion of a map depicting the relation of the archaeological layers to the surrounding environment.

Attribute information (IC1) was skewed heavily towards signage: 79 signs (73.1%) and 11 visitor center materials (25.0%) contained attribute information. Similarly, historical information (IC2)

appeared in 50 signs (46.2%) and 11 visitor center materials (25.0%). Thus the general strategy at Troy was to rely on attribute and, to a lesser extent, on historical information in the onsite signage, limiting geographic information to publications in the visitor center or to text on identification signs. This strategy carries multiple disadvantages: Troy visitors might never be aware that these materials are available in the visitor center, many of these materials have an additional cost, and visitors who do purchase the materials are likely to do so upon leaving the site, limiting their experience while onsite. Thus a broad recommendation for improving the Troy experience is to integrate geographic information throughout the onsite signage at Troy, unlocking the geographic insights available only through the visitor center.

The relative lack of historical information across maps and signage was particularly problematic for Troy as a cultural heritage site, given the importance to the visitor experience of explaining Troy's history. While geographic information is important for identification, directional, and informational signs (as discussed above), historical information—and the integration of geographic and historical information—is fundamental to the success of informational signs. Although some informational signs contained historical information, a number did not (4/28; 14.3%). For instance, the sign "Flora and Fauna of Troy" (Figure 4.2) included pictures of plants and animals at Troy but did not describe the historical context and significance of these animals, leaving visitors to speculate as to whether these plants and animals were found in the ancient Troad as well as in the modern day. Because Troy is a historic site, the dominance of attribute information over historical information in onsite signage should be reconsidered, with historic information prioritized and attribute information used to enrich the historical description.

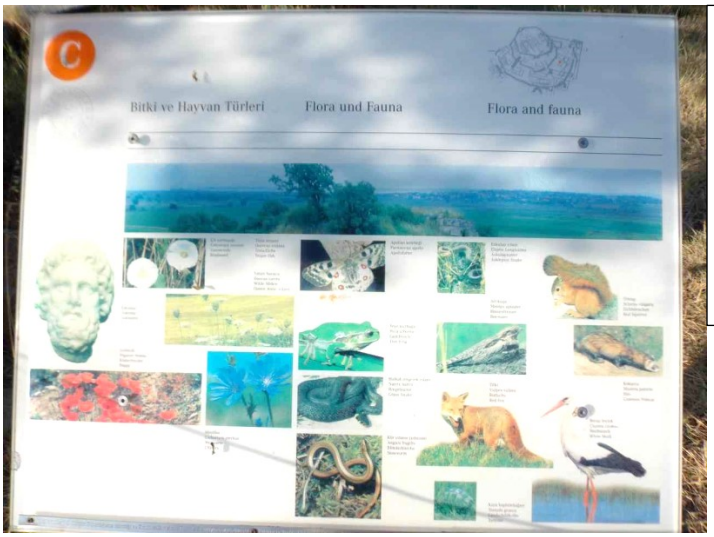

Figure 4.2 Flora and Fauna of Troy. The small text describes the name of each species in Turkish, German, and English. A description of the historical importance of these species and photographs of the species found at Troy (rather than generic photographs) would improve this sign.

4.1.2 Embedded Knowledge

Following Golledge and Stimson (1987), artifacts were coded by the interpretive knowledge they embedded within the map or sign. Of the 152 artifacts, 76 included declarative knowledge (K1: 50.0%), 66 included configural knowledge (K3: 43.4%), and 46 included procedural knowledge (K2: 30.3%).

Declarative knowledge (K1) was the most common form of knowledge found in the corpus. Although the majority of signs (69/108; 63.9%) included declarative knowledge (K1), only 7 visitor center materials (15.9%) contained declarative knowledge. The declarative knowledge in the maps and signage primarily served to name points of interest on identification signs and did not provide meaningful cultural or physical descriptions of these places (Figure 4.3). While such identification is essential for confidently locating features at Troy—and thus getting a full sense of the complexity of the Troy site—further effort is needed to add interpretative declarative knowledge to enrich the visitor experience. As stated above, identification signs containing declarative names did not include additional geographic information (and associated procedural and configural knowledge) to assist with navigating between places.

Figure 4.3 An identification sign showing the location of layer III provides no declarative knowledge about layer III such as the name of the feature the visitor is looking at.

Configural knowledge (K3) was the second most common type of knowledge at Troy and is important for helping visitors understand the spatial relationships of features in the landscape. While all (100%) visitor center maps contained configural knowledge, little of the rich configural knowledge included in these materials was redundantly embedded in onsite signage, thereby limiting their value in providing configural knowledge to visitors while they actually experienced the Troy environment.

Although few signs embedded configural knowledge (22/108; 20.4%), most informational signs (22/28; 78.6%) contained configural knowledge in the form of small inset maps with the layer(s) of interest colored on a gray basemap (Figure 4.4). However, this configural information was difficult to relate to the immediate environment because of the high degree of abstraction or generalization in the inset map. Visitors would find it difficult to relate their current location to the highlighted position in the inset map and thereby build configural knowledge about points of interest and pathways at Troy. Additionally, these inset maps did not rotate to reflect the direction that the visitor faces when reading the sign, or include a You-Are-Here symbol (Figure 4.4). Thus semiotic theory would indicate that the current map and signage strategy was ineffective in helping visitors build configural knowledge about Troy, a problem that restricts onsite wayfinding and results in a negative visitor experience.

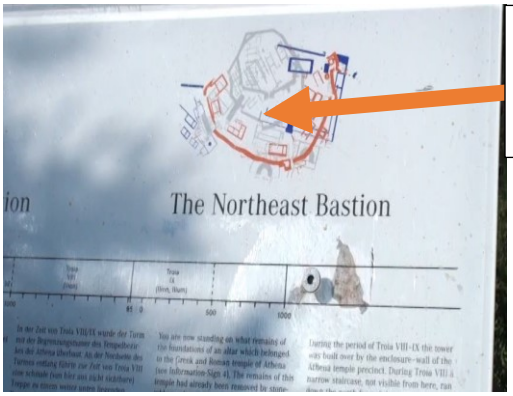

Figure 4.4 An example of configural information present on informational signs. The map, intended to function as a locator map, does not include a You-Are-Here symbol or match the perspective the visitor faces.

Finally, procedural instruction (K2) was found in 40 of 108 of the onsite signage (37.0%) and 6 of 44 visitor center materials (13.6%). However, all directional signs (39/39; 100%) contained procedural knowledge in the form of navigational instructions to a point of interest such as a given layer of the archaeological site or the location of the bathrooms. Unfortunately, the directional signs that did embed procedure knowledge did so in a way that was likely confusing to general visitors by using the letter and roman numeral labels assigned to the site by archaeologists for research purposes (e.g., VIIb; Figure 4.1). Better care should be taken to design the maps and signage in the visitor's "language", using clear phrasing and labels that can be interpreted and followed by a typical visitor.

Although frequently used on directional signs, procedural knowledge was underutilized on informational signs. When listing specific points of interest, the informational signs could have advised visitors where to find other related features in Troy. This was a missed opportunity to enrich "what with where." Furthermore, the procedural knowledge that was embedded in informational signs often failed cartographically. Figure 4.5 shows a flow map displaying the order of the informational signs at Troy, and Figure 4.6 shows an informational sign with orange circles using numbers and mixed case letters representing the order of information signs along the tourist path. Because of the mixed case system (1a follows A, C follows 3, etc.), navigating each sequence was difficult, and visitors might be led to believe they had made a wayfinding error when in fact they were on the correct path, an issue likely exacerbated by the short amount of time onsite when traveling by bus. A comprehensive redesign of the

procedural wayfinding strategy is needed to clearly mark recommend tourist routes, including a clearer demarcation of different routes in a logical and informative order using color coding.

Figure 4.5 Flow map showing the order of informational signs at Troy. The numbers attempt to provide procedural information; however, this information does not follow a logical linear sequence. In a walk through the Troy loop from the visitor's center, a visitor would experience the following sequence of procedural directions on informational signs: A, B, 1a, 1b, 2, 1b, 3, C, 3, 4, 5a, 5b, 5, 6, 7, D, 8, 9, 10, 10a, 10B, 11, 12. (reproduced from *Troia/ Wilusa Guidebook* 2013: no page number).

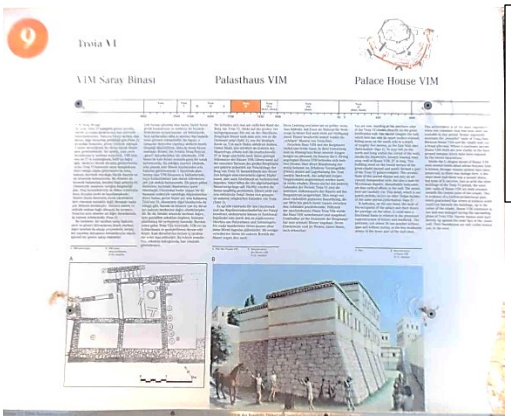

Figure 4.6 Procedural information on an informational sign (orange circle in upper left hand corner) found on the tourist route. Because the numbers are not in sequence, the procedural information on this sign is difficult for visitors to comprehend.

4.2 Interpretant-as-mediator

The interpretant-as-mediator approach describes the way that a sign serves as a shared understanding between the designer and the visitor. The interpretant-as-mediator approach includes codes for the iconicity of the sign and the presence / absence of common symbol libraries. Overall, signs exhibited more aspects of iconicity (160 codes total, 26.3% of sample, on average) than symbols from prominent sign libraries (only 15 codes, 13.8% of signs). This distribution reflects an underutilization of sign libraries across the signage and visitor center materials at Troy.

4.2.1 Iconicity

Artifacts at Troy were coded for iconicity following a modified Robinson (1984) taxonomy: associative / iconic (I1: 15, 9.9%), pictorial / iconic (I2:19, 12.5%), geometric / abstract (I3:97, 63.8%), and image / realism (I4:29, 19.1%) for a total of 160 applied codes across these four design strategies.

Geometric / abstract—coded in 60 / 108 signs (55.6%) and 37 / 44 visitor center materials (84.1%)—was the most common symbol solution at Troy. Geometric / abstract designs can be useful as conventional symbols well known to the audience. However, geometric / abstract symbols require prior knowledge on the part of the visitor in order to be understood and run the risk of failing to immediately communicate complex meaning. For instance, Figure 4.6 shows an abstract representation of the layers of the archaeological site (see the left hand arrow), but without a background in archaeology a visitor will not be able to understand how the shapes correspond with the features at Troy. Reliance on

geometric / abstract map symbols and signage is particularly problematic at Troy because the landscape provides few salient landmarks that work without the presence of a sign—either abstract (e.g., a wall) or iconic (e.g., the Trojan horse)—to help the visitor connect maps and signage to the surrounding environment.

Image / realism was the second most common iconicity strategy at Troy: 21 signs (19.4%) and 8 visitor center materials (18.2%) utilized this approach. Realism was presented in the form of artistic interpretations of the city during different time periods (Figure 4.6). Because Troy is a ruin, the "true to ancient life" visual interpretations of ancient Troy are difficult to read into the modern environment (Figure 4.7). From a semiotic standpoint, abstraction and realism are antipodes on a continuum of iconicity. It was therefore interesting to find that designers primarily chose either realistic or extremely abstract representations and that they gave little consideration of solutions in between. Additionally, this pair of iconicity solutions was commonly mixed within a single sign, resulting in an internal incoherence of aesthetics (Figure 4.7).

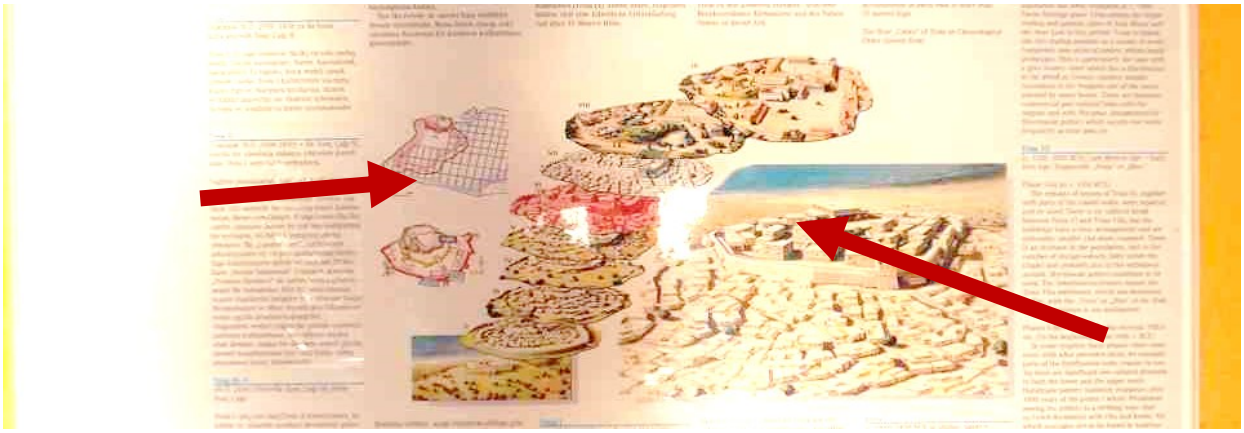

Figure 4.7 Extremes of abstraction (arrow on left) and realism (arrow on right) found on an informational sign at Troy. The abstract designs are difficult for a visitor to understand without a background in archaeology, especially given the lack of a legend. The realistic designs are so detailed that visitors may be overwhelmed by excess detail and lose connection between the map and the environment. The mismatched representation would be improved with well-designed maps and consistency in iconicity.

Figure 4.8 Sign with realistic map (left image, bottom left), abstracted map (left image, upper right) and vista (right image). It is difficult to relate the map to the environment because of the lack of salient landmarks.

Pictorial / iconic solutions were found in only 15 signs (13.9%) and 4 visitor center materials (9.1%). The least common representation strategy was associative / iconic: only 10 signs (10.8%) and 5 visitor center materials (11.4%) had associative / iconic symbols. More maps and signage using pictorial or associative representations would be beneficial because they present information in a more readily understood format, although at the drawback of potentially relying on culturally-specific meanings (Figure 4.9). Research is needed to develop a set of pictorial and associative symbols for maps and signage that would work unambiguously for all the diverse visitors to Troy.

Figure 4.9 Iconic No Smoking sign communicates message quickly and does not overwhelm the visitor with excess detail or a block of text.

Notably, 29 artifacts could not be coded for iconicity: 12 signs were all text, 16 signs were indirect and did not use text or pictures, and 1 map from the visitor center contained no point symbols. The all-text signs were prohibition signs or identification signs (Figure 4.10). As signs are only available in

Turkish, German, and English at Troy, including additional visual content would help the signs communicate with visitors who are unable to read these languages. Furthermore, the visual content would be more broadly recognized if drawn from established sign libraries, as discussed in the next section.

Figure 4.10 A prohibition sign which could be improved with the use of symbols (left), such as a modified AIGA symbol for no entry (right).

4.2.2 Sign Library

The artifacts were coded by their use of standard symbol sets available from the AIGA/DOT (American Institute of Graphic Arts; SL1) and ISO 7001 (International Standards Organization; SL2). These symbols were designed to be broadly comprehensible across cultures. A standard symbol was defined as a symbol with no alteration in shape; a change in color was an acceptable variation. Although visitor center materials contained symbols, they did not contain any symbols from symbol libraries; thus the subsequent discussion is specific to the onsite signage found at Troy.

Of the 108 signs, 15 (14.1%) had standard symbols for Parking, Bathroom, and No Smoking (4.6% ISO, 9.5% AIGA). Symbols from sign libraries were present on regulation and directional signs only: 62.5% of regulation signs had a symbol from a symbol set (all AIGA) but only 12.8% of directional signs had symbols from a standard library (5.1% AIGA, 7.7% ISO). However, the remaining regulation and directional signs included text only and did not use standard library symbols or custom symbols. Thus when symbols were included on regulation and directional signs, they drew from standard libraries. Other signs, such as informational signs, did include symbols but did not draw from standard symbol

libraries. Therefore, an opportunity was missed to leverage the ISO and AIGA symbol libraries more consistently to homogenize the visitor experience at Troy.

Moreover, the signs that included symbols from standard libraries drew only several symbols from these libraries. The only ISO symbol used was the associative male / female silhouette representing a bathroom (Figure 4.11). Similarly, the only AIGA symbols used were the pictorial cigarette with a circle and bar (Figure 4.12) and the associative P for parking (Figure 4.13). While these symbols were effective because they are so well-known, the use of so few standard symbols led to a reliance on text across the Troy signage and inclusion of custom abstract or realistic symbols when text was supplemented with visuals.

The symbolization onsite at Troy would be improved by the wider use of standard symbols (as opposed to text-only signs) especially when placed on an installation of a map of the site. In addition, small modifications of the base ISO/AIGA symbols could more effectively build a sense of place that reflects Troy's identity: for example, the male / female bathroom symbols could be slightly modified so that the male is wearing an ancient warrior's armor and helmet and the female a tunica.

Figure 4.11 Associative ISO symbol "bathroom" (PI PF 003) and example sign at Troy.

Figure 4.12 Pictorial AIGA symbol "no smoking" and example sign at Troy.

Figure 4.13 Associative AIGA symbol "parking" and example sign at Troy.

4.3 Sign-vehicle-as-mediator

The sign vehicle-as-mediator approach focuses on the map or sign as the connection between the real life object and its meaning. Two categories of codes were included to capture variation in the sign-vehicle-as-mediator: symbolization and typography. Overall, there was more discussion regarding typography (425, on average 31.3% of artifacts) than symbolization (205, on average 11.2%).

4.3.1 Symbolization

The coding for symbolization used a subset of commonly manipulated visual variables in cartography: color hue, color value, texture, size, and orientation. Although these visual variables and others were applied in a number of ways across the corpus as design embellishments, a visual variable code only was applied to an artifact if used intentionally to encode information (i.e., if the visual variable carried semiotic weight). Symbolization was either qualitative, depicting nominal information, or quantitative, depicting numerical information. Of the 152 artifacts, 65 used color hue quantitatively (H1; 42.8%)—a clear artifact of the Doerpfeld text—while 13 used color hue qualitatively (H2; 8.2%); 7 used color value

quantitatively (V1; 4.2%), 7 used color value qualitatively (V2; 4.2%); 23 used texture quantitatively (T1; 15.1%) while 4 used texture qualitatively (T2; 2.6%); 15 used shape quantitatively (S1; 9.9%) while 6 used shape qualitatively (S2; 3.9%); 0 used size quantitatively (SZ1; 0.0%) while 9 used size qualitatively (SZ2; 5.9%); and 16 used orientation quantitatively (O1; 10.5%) while 40 used orientation qualitatively (O2; 26.3%). Overall, the majority of visual variables carrying semiotic weight were used qualitatively, and many applications violated recommendations from semiotics (Figure 4.14).

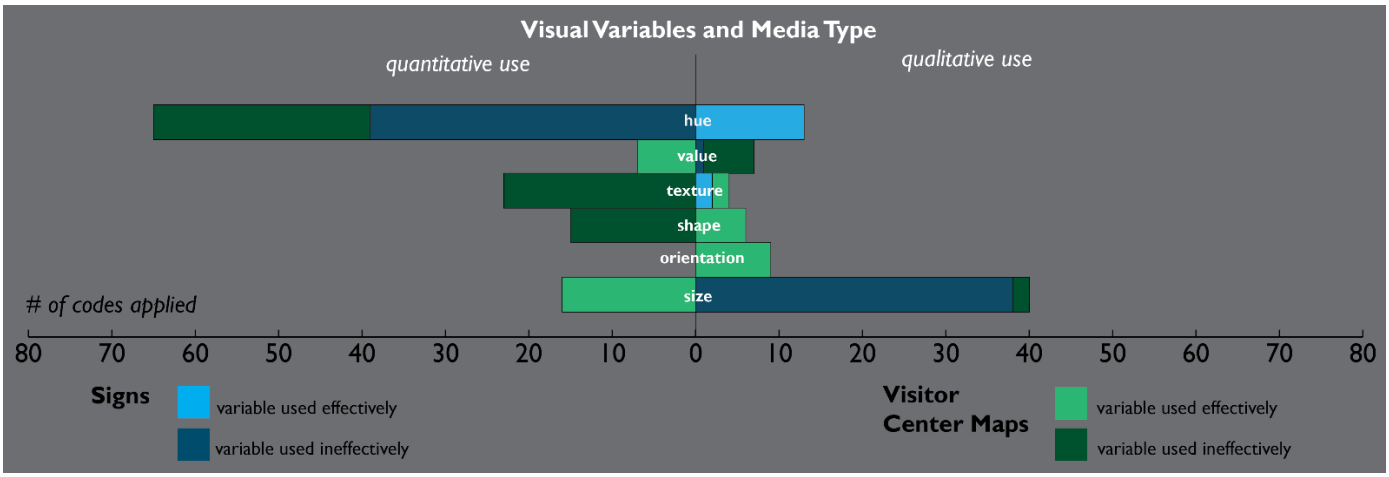

Figure 4.14 Visual Variables and Media Type.

Starting with quantitative applications of the visual variables, color hue was the most frequently used visual variable to represent quantitative differences, despite recommendations from semiotics to reserve color hue for depicting qualitative differences. On maps and signage, color hue primarily was used to show a temporal difference between the historical layers at Troy or to highlight positions on a numerical timeline (Figure 4.15). Hue's quantitative use on signage followed the 1902 Troy color conventions established by Doerpfeld (1902) and signaled an opportunity to rebrand the signage based on contemporary conventions with the opening of a new museum. However, because color hue only is recommended for qualitative information, the symbolization of historical information would be strengthened if the spectral color scheme relying solely on color hue was replaced with a sequential scheme modifying color value in addition to color hue (Figure 4.16).

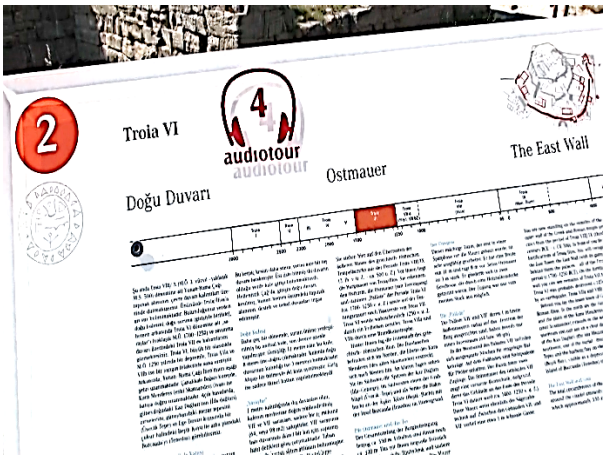

Figure 4.15 Quantitative use of visual variable: hue (timeline). The timeline could have been improved with the use of a sequential or a diverging color scheme, which modifies color value across one or several color hues.

Fig. 105 Phase-plan of the structures outside the citadel to the west (Troia V-X).

Figure 4.16 Quantitative use of visual variable: hue (map). The map could have been improved with the use of a sequential or a diverging scheme. Color steps with multiple colors (indicated by black arrows overlaid on the image) cause confusion. (reproduced from *Troia / Wilusa Guidebook* 2013: pg. 107)

In contrast, color value was correctly applied in a subset of visitor center maps (7/44; 15.9%) to depict quantitative differences between historical layers of Troy. Although color value was used

appropriately given recommendations from semiotics, the grayscale color ramp applied in these materials was not perceptually-scaled, resulting in a sequence of gray shades that do not have equal perceptual gaps (Figure 4.17). The lack of perceptual scaling impeded quantitative reading of the map symbols using color value, impairing the effectiveness of the otherwise appropriate sequential scheme used for quantitative differences.

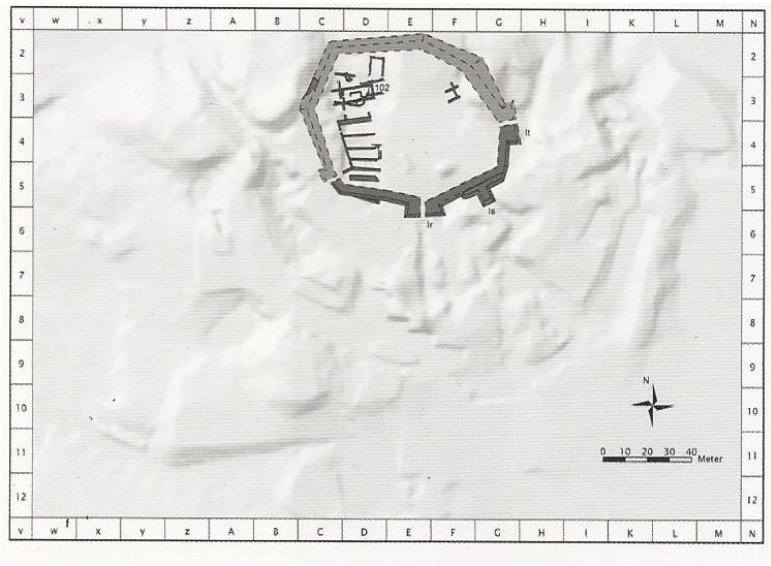

Figure 4.17 Visitor center map using value to show differences in time. The lack of perceptual scaling on this map makes it very difficult to identify the darkest color, which is the most important feature on the map. (reproduced from *Troia/Wilusa Guidebook* 2013: pg. 47)

Despite the use of color value on some maps, the visitor center materials more frequently (23/44; 52.3%) used the visual variable texture to show quantitative differences between the layers of Troy, a visual variable typically best suited for indicating qualitative differences between phenomena. In one instance, texture and color hue—a pair of visual variables recommended for qualitative differences—were used to represent historical information redundantly (Figure 4.18). Here, texture could have been replaced by a perceptually-scaled sequential scheme varying color value. In one example, the density of texture was increased to mimic a sequentially read texture ramp in a hand-drawn sketch (Figure 4.19). This strategy was a viable use of texture for quantitative data, particularly for graphics using only one color ink such as hand-drawn sketches.

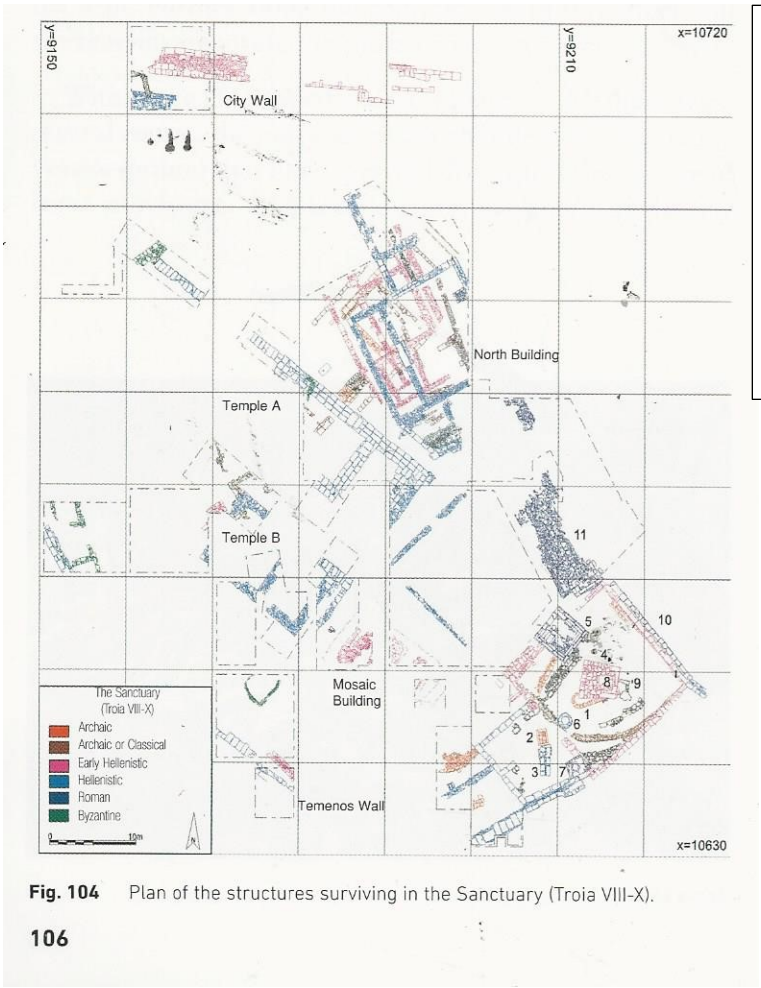

Fig. 104 Plan of the structures surviving in the Sanctuary (Troia VIII-X).

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*Figure 4.18 Visitor center map redundantly using the visual variables of texture and color hue to show a quantitative difference (historical); neither visual variable strongly encodes ordinal or numerical information. The redundant use of texture to show quantitative difference also adds visual complexity, causing illegibility and poor reproducibility in the image. (*reproduced from *Troia / Wilusa Guidebook,* 2013 pg. 106*)*

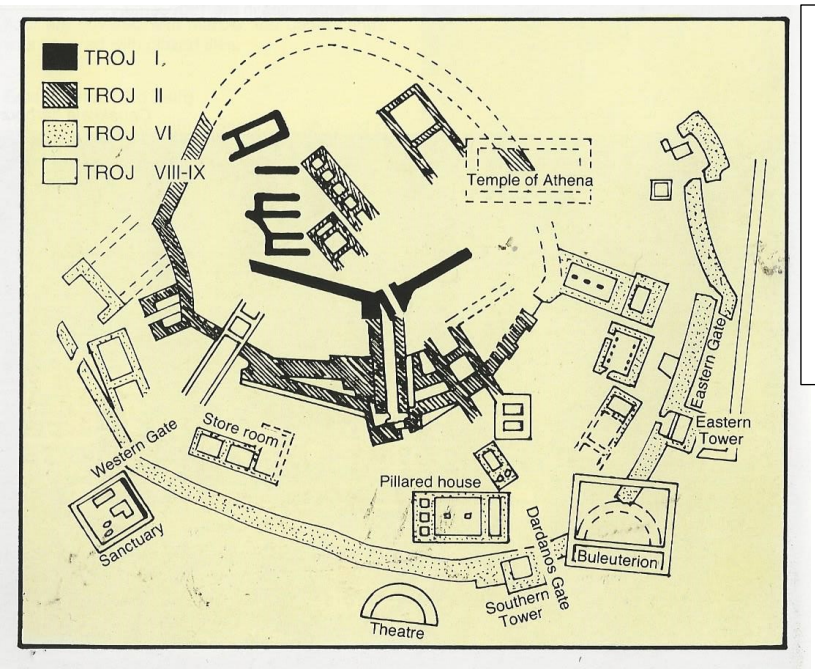

Figure 4.19 Visitor center map using the visual variable of texture to successfully show quantitative difference (historical). Here, the relative densities of the texture are modified to encode historical information, an effective solution when using only one color ink in a hand-drawn sketch. (reproduced from *Turkey: Guide to the Orient.* 2010: pg. 42)

Orientation was commonly used quantitatively in visitor center maps to show the different historical layers of Troy on cross-section maps (16/44; 36.3%). While orientation typically is reserved for qualitative data in statistical mapping, the quantitative use of orientation to depict angular directions was successful in support wayfinding. Except for one cross section map (1/108; 0.9%, Figure 4.21), orientation was not used quantitatively on signage to show the vertical positions of historical strata. This was a missed opportunity because the display of subterranean strata throughout Troy using orientation would better connect Troy's layered history to the current landscape, enabling the visitor to get a deeper understanding of the unseen.

Figure 4.20 An informational sign showing the strata throughout Troy. Cross-section maps would have been useful in other locations throughout the archaeological site to help the visitor understand the complicated strata.

Shape was not used to show quantitative difference on signage but was used in a subset of visitor center materials (15/44; 34.1%) as a geometric symbol to differentiate between time periods (Figure 4.22). The use of a sequential color scheme modifying color value to depict historical information would have been a better alternative than the use of shape.

No artifacts at Troy used the visual variable size to communicate quantitative differences—the strongest visual variable for depicting numerical information. The absence of size as a visual variable reflects a focus on reference mapping rather than thematic mapping to support the user experience at

Troy, presenting an opportunity to add statistical archaeological information to the maps and signage in addition to the map-based wayfinding information.

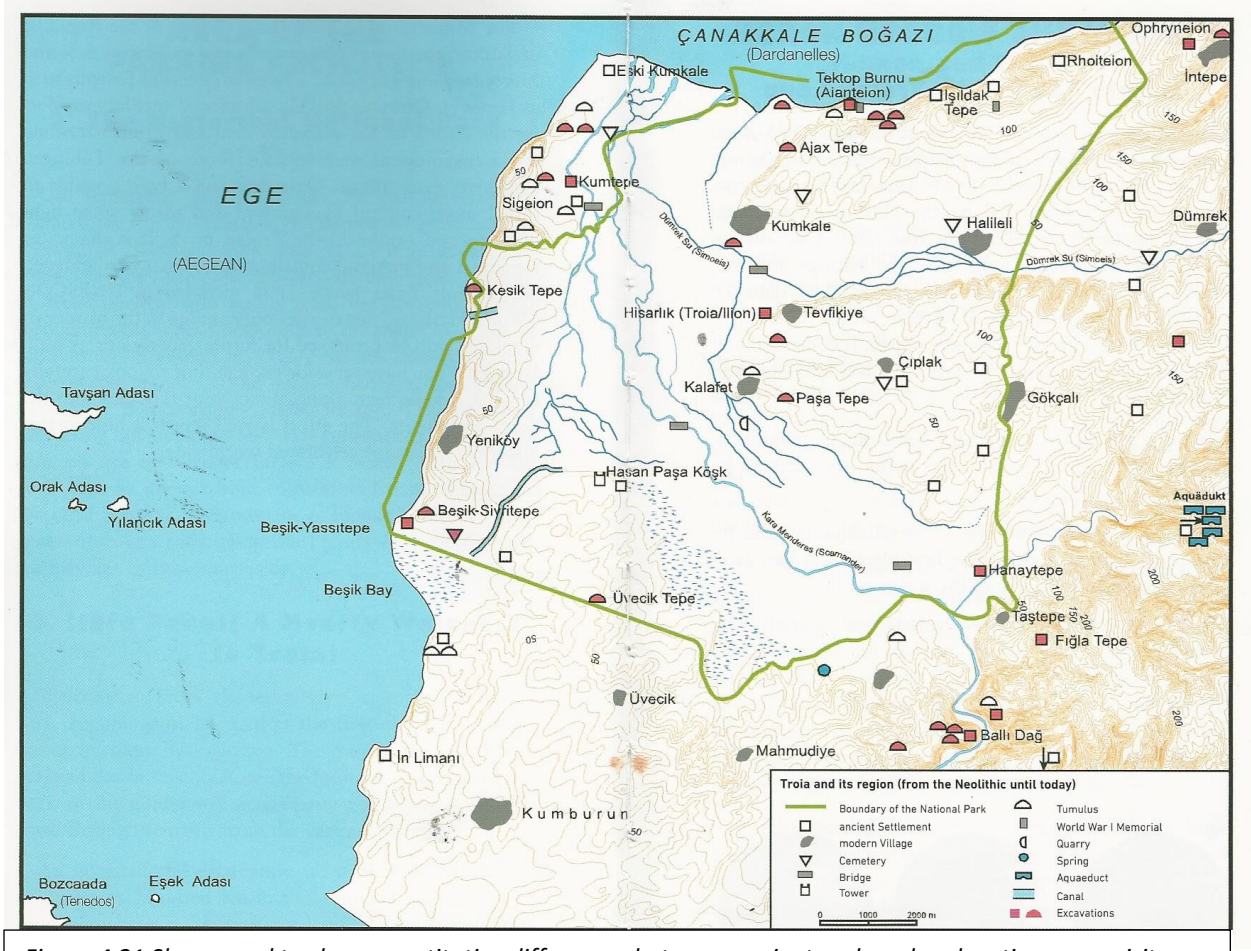

Figure 4.21 Shape used to show quantitative differences between ancient and modern locations on a visitor center map. (reproduced from *Troia / Wilusa Guidebook* 2013: pg. 36-37.)

In contrast to quantitative representations, all six of the coded visual variables were used qualitatively in the corpus of artifacts. Color hue was used to highlight a features of interest on maps and signage or to indicate categorical differences in Troy features. Despite this proper use of color hue, which follows semiotics, there was a missed opportunity to use color hue consistently on identification signs. Using a consistent, qualitative color scheme across maps and signage would promote their learnability and generally improve wayfinding (Figure 4.22). Also, several low-contrast hue choices

impacted the legibility of these signs, indicating that value variation within a color hue or outer framing may be needed to account for variable environmental conditions (Figure 4.22, two leftmost images).

Figure 4.22 Various styles of identification signs at Troy. The inconsistant choice of color hue requires visitors to read these signs in order to know their function from the qualitative use of color hue alone.

Although used infrequently (4; 2.6%, Figure 4.23), the visual variable texture was employed to depict qualitative differences in the land cover across Troy or the architectural materials of ruins within Troy. Such an application of texture for qualitative realism was highly effective, and could be promoted on additional maps and signage throughout Troy.

Figure 4.23 The visual variable of texture depicting differences in land cover. (reproduced from *Troy Brochure*, 2014.)

While uncommon in the visitor center materials (2/44; 4.5%), the qualitative use of orientation was found in all onsite directional signs (39/39; 100%). Here, a triangular symbol found on either side of a signpost pointed out the direction to the indicated phenomenon. This highly successful qualitative use

of orientation could also be applied in identification and informational signs to indicate the direction a visitor should look when arriving at a point of interest. However, this orientation cue in some onsite signage contained no meaning, causing confusion (Figure 4.24). These signs should be removed from the site.

Figure 4.24 Signage using the visual variable of orientation without any semiotic meaning caused confusion at Troy.

The qualitative use of shape—a strong visual variable for depicting categorical data— was underutilized at Troy, appearing only in visitor center materials (6/44; 13.6%). Shape was primarily used to depict the distributions of different kinds of objects throughout the Troad (Figure 4.25). However, shape could have been used to indicate features of interest on a map of the archaeological site or to coordinate points of interest across maps and signage. For example, the shapes of the signs themselves could have provided information about the contents of the sign, enabling the visitor to distinguish between an informational sign and a regulatory sign. Because the majority of the signage at Troy was rectangular-shaped (59; 54.6%), signage shapes did not carry semiotic meaning (as discussed below).

Some visitor center materials (9; 20.5%) used the visual variable size to show qualitative differences between symbols. However, the use of size implies a quantitative difference and is misleading when applied for qualitative differences. Using color or shape to show qualitative differences would be a better design solution.

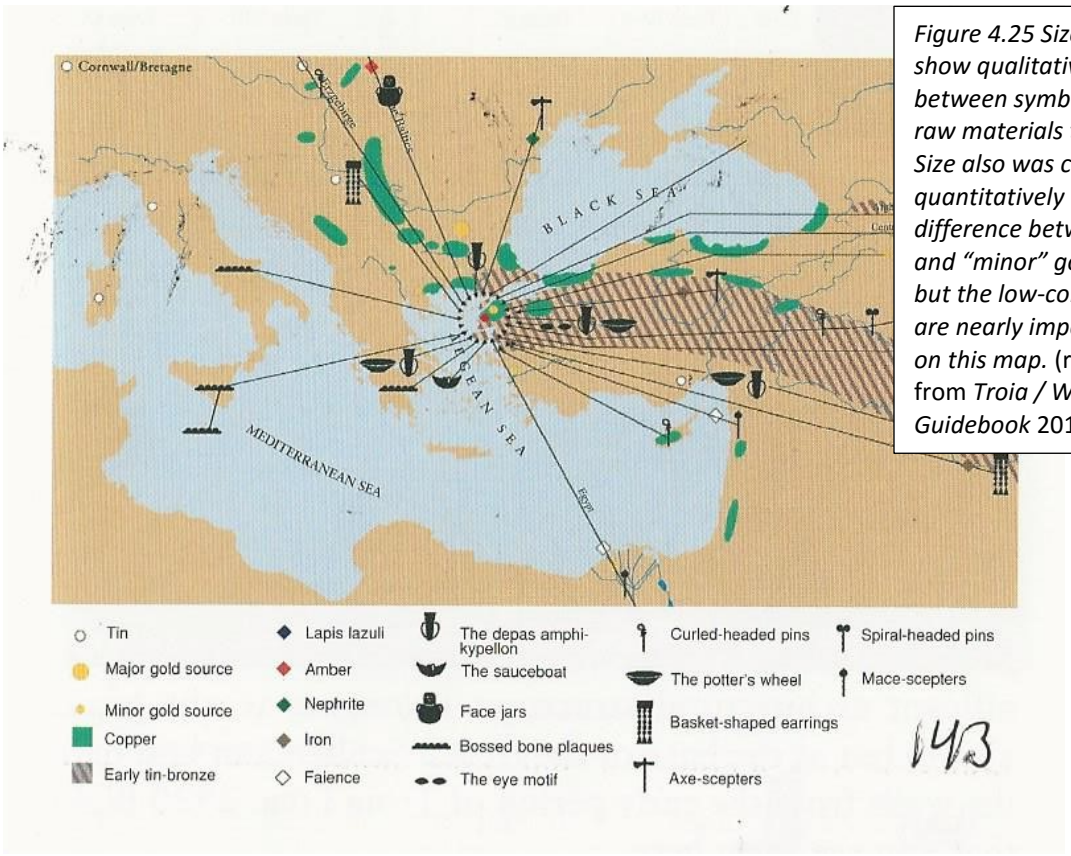

Figure 4.25 Size used to show qualitative difference between symbols (compare raw materials to products). Size also was correctly used quantitatively to show the difference between "major" and "minor" gold sources, but the low-contrast colors are nearly impossible to spot on this map. (reproduced from *Troia / Wilusa Guidebook* 2013: pg. 95)

4.3.2 Typography

The typography category included codes for type class, case, and style. Across the 152 artifacts, there were 55 instances of a serif typeface (TF1; 36.2%) and 74 instances of a sans-serif typeface (TF2; 48.7%). Type case utilized normal orthography (TC1) 54.6% of the time (83/152), all-caps (TC2) 36.2% of the time (55/152), and did not utilize small caps (TC3; 0.0%). The majority of artifacts displayed roman type style (TS1; 121/152, 79.6%) and less commonly featured bold (TS2; 33/152, 21.7%) or italic (TS3; 4/152, 2.6%). While all materials from the visitor center contained type, 16 onsite signs (14.8%) did not contain text because they functioned as indirect (Figure 4.26).

Figure 4.26 Surveillance placed in a prominent location: an indirect sign indicating the visitor is being watched. No text is needed to explain the function of this sign.

Nearly half (47/108, 43.5%) of onsite signs featured a serif typeface. However, the serif typeface chosen was not consistent across signage, although better consistency existed within a specific type of sign. Using a consistent serif typeface across all types of onsite signs would have improved Troy branding and satisfaction in the visitor experience. Serif typefaces were uncommon within visitor center materials (8/44; 18.2%). For both maps and signage, the use of a serif typeface to label natural phenomena would increase congruency between reference and sign-vehicle, a cartographic convention used in map labeling.

In contrast, the relative use of sans-serif typefaces was inverted between onsite signage and visitor center materials: 40 visitor center maps (90.9%) used a sans-serif typeface but only 34 onsite signs (31.5%) did so. Given a similar discrepancy between attribute / historical information on signs versus geographic information on visitor center maps, the general strategy was to pair serif typefaces with attribute and historical information in onsite signage and sans-serif typefaces with geographic information in the visitor center materials. Like serif typefaces, the sans-serif typefaces used for onsite signage was not consistent across Troy. Additionally, many sans-serif typefaces found in signage were

possibly (Figure 4.27) or definitely (Figure 4.28) hand-made, giving the signage a slapdash, unprofessional appearance.

Figure 4.27 Regulation sign with sans-serif typeface, possibly handmade.

Figure 4.28 Directional sign with obviously handmade sans-serif.

Regarding orthography, 44 signs (40.7%) and 39 visitor center maps (88.6%) included normal orthography. The use of all caps was found in 36 signs (33.3%) and 19 visitor center materials (43.2%). All caps (TC2) connotes authority and caution and thus was a particularly effective choice for regulation signs (Figure 4.29). Notably, many maps in the visitor center materials used all caps throughout and thereby failed to establish a visual hierarchy by following the cartographic convention of reserving all caps for labeling basemap / background features (Figure 4.30). No maps or signs used small capital letters (TC3), a stylistic choice that would have evoked a historical aesthetic these maps of ancient Troy.

Figure 4.29 All caps used effectively on a regulation sign.

Figure 4.30 All caps used as a stylistic choice, rather than to establish a visual hierarchy. Across the visitor center materials, an opportunity was lost to follow cartographic conventions in type case and type style to establish a visual hierarchy. (reproduced from *Troy: A Revised Edition.* 2014: pg. 61.)

Roman text (TS1) was the overwhelming choice for maps and signage at Troy: 79/108 signs (73.1%) and 42/44 of visitor center materials (95.5%) included the roman text style. However, roman text was sparsely paired with bold (TS2) or italics: 24 signs (22.2%) and 9 visitor center maps (20.5%) included bold, while 0 signs (0%) and 4 visitor center maps (9.1%) included italics. The complementary use of bold and italics with the roman text can emphasize important or special details in signs and

encode additional nominal and ordinal information in maps (Figure 4.30), thereby improving their effectiveness.

4.4 Material Environment and Wayfinding Embellishments

The final category of codes on the material environment captures best practices from environmental graphic design regarding the physical shapes of signage, the size and sign hierarchy, and additional wayfinding embellishments. These codes were applied to signage only. Overall, the best practices from environmental graphic design were not followed at Troy, limiting the following discussion.

4.4.1 Material Environment

Nearly half of the 108 signs were semi-matte (P3; 50/108, 46.3%), followed by matte (P2; 19/108, 17.6%) and glossy (P1; 23/108, 21.3%). Matte and semi-matte signs did not present legibility problems at Troy, but glossy signage was difficult to read in conditions of bright light and dark shadow (Figure 4.31). The use of matte or semi-matte signs rather than glossy signs would prevent reflectance and shadow issues.

Figure 4.31 Lighting conditions impede the legibility of glossy signage due to reflections caused by bright sunlight (left) and shadows (middle). Compare with the matte signage in bright sunlight (right).

4.4.2 Physical Shape of Signage

The majority of signs at Troy were rectangular in shaped (PS2; 59/108, 54.6%). Only one regulation sign was circular (PS1; 1/108, 0.9%), conforming to ISO sign shape standards. Although 10/108 signs were triangular (PS3; 9.3%), this triangular shape was not used to carry the conventional semiotic meaning of caution or warning. Some signage combined a rectangular sign with a single triangular edge (PS4; 22/108, 20.4%). These signs functioned well when providing general directions to a destination such as a parking lot or a bathroom (Figure 4.32), but were ineffective when indicating a layer of the complex archaeological site, given the ambiguity in relating the direction to a subterranean feature in the landscape without additional interpretive cues (Figure 4.33). Pairing these directional signs with maps that illustrate stratigraphy would help solve this problem. Solutions stated previously, such as adding a You-Are-Here symbol and rotating north to the visitor's current perspective, would further tie these ambiguously shaped directional symbols into the overall map and signage strategy at Troy.

Figure 4.32 "Triangular & Rectangular" directional sign attempting to indicate the direction to a specific layer of the archaeological site.

Figure 4.33 Ambiguous directional sign attempts to communicate the location of Troy I. Where in the environment is Troy I? An opportunity was missed to pair directional signs with maps that explain what the visitor should recognize in the environment.

4.4.3 Size and Sign Hierarchy

The majority of signs at Troy were prominent and consistent with the sign hierarchy (SH1; 74/108, 68.5%). However, four very large No Smoking signs were prominent and inconsistent with the visual hierarchy (SH2), thereby causing distraction (Figure 4.34). As previously discussed, the information communicated by the No Smoking signs is important because smoking poses a fire risk to the site and smoking prohibitions are uncommon in Turkey. But visitors to Troy need to gain more from their experience than the knowledge that smoking is prohibited. Raising the prominence of other information in the sign hierarchy may help solve this problem.

Similarly, 10 signs were recessive and inconsistent with the sign hierarchy (SH4; 9.2%). They were placed in shaded locations used as waypoints during the hot Troy summers and were difficult to see from the trail. Some of these recessive signs were identification signs (Figure 4.35) that could cause visitors to become frustrated when they could not confirm that an important vista or point of interest was reached. Of more concern, visitors failing to see recessive regulation signs could enter a dangerous area off the tourist path, leading to injury or damage to the site (Figure 4.36).

Figure 4.34 Prominent No Smoking sign is inconsistent with the sign hierarchy.

Figure 4.35 Recessive identification sign, inconsistent with the visual hierarchy. This sign is not readable without a zoom lens.

Figure 4.36 Recessive regulation sign, inconsistent with the visual hierarchy. This sign advises that the tourist path ends, but a visitor must walk up to the sign to learn this information.

Other signage at Troy was ineffective due to material damage (D1; 15/108, 13.9%) (Figure 4.37). Elements in the environment such as excessive foliage occluded 11 signs (OD1; 10.1%) impairing the visitor experience of place and contributing to a potentially unsafe situation (Figure 4.38). The occluded signs demonstrate the importance of maintaining the Troy site in a manner that preserves the signage hierarchy. Also, signage should not be placed in areas where it cannot be regularly maintained, even though the positions are visually salient.

Figure 4.37 Damaged signs are difficult to read and hurt the visitor's experience of Troy.

Figure 4.38 Occluded sign.

4.4.4 Wayfinding Embellishments

The signage at Troy could have been greatly improved with the inclusion of wayfinding embellishments from the best practices of environmental graphic design. Although many signs (23/108; 21.3%) used a consistent system of names, only one such sign included procedural directions (left, right, ahead) to the named feature (Figure 4.39). The failure to include procedural directions and distance estimates in identification and directional signs was a missed opportunity to orient the Troy visitor.

While the signs themselves frequently used common patterns such as color coding for each layer at Troy (65/108; 60.9%), the patterns could have been improved by the better use of the visual variables as described in Section 4.3. The signage could have made use of the heads-up display, thereby orienting the visitors as to what was actually in front of them, but no signs made use of this feature (Figure 4.39). Likewise, none of the maps and signage included a You-Are-Here symbol, which could

have improved wayfinding, especially if that You-Are-Here symbol was an arrow. By making better use of wayfinding embellishments, the signs at Troy could have better serve the needs of visitors.

Figure 4.39 The East Wall of Troy. The signage contains directions in the place name. However, the sign could have been improved if the maps and images used a heads-up display, matching the direction that the visitor is facing.

5. Conclusions: *Designing* an Experience

In this chapter, I conclude with a summary and discussion of the work completed, focusing on recommendations for improving Troy's experience design. In the first section, I restate the work completed to improve the visitor experience at Troy and summarize key findings from my quantitative content analysis of the maps and signage at Troy. In the second section, I provide a set of imperatives for the redesign of maps and signage at Troy, synthesized from the results of the content analysis. In the third section, I discuss the limitations of the work completed for Troy and extension to other locations. I discuss future directions for research in the fourth and final section.

5.1 Summary of Work Completed

The purpose of the research reported here was to enhance the visitor experience at ancient Troy. Being a stratigraphically complicated archaeological site with few standing structural ruins, Troy currently requires substantial interpretation, such as a professional tour guide or a well-functioning sign system, for a visitor person to understand the site. Unfortunately, Troy suffers from "poor and confusing wayfinding" and "visual clutter and chaos" due to incomplete and poorly-designed maps and signage onsite (Riorden 2009: 9-10). To understand how the maps and signage fail to communicate with visitors, I undertook the following two tasks: First, I completed a review of the relevant literature in semiotics and environmental graphic design to understand how maps and signage communicate meaning to the viewer and to identify best practices in signage design. Second, I generated a set of codes informed by this review and organized by the spinning of the semiotic triangle or the three ways that a sign can be understood to create meaning: the referent-as-mediator, the interpretant-as-mediator, and the sign vehicle-as-mediator. I also included an additional set of codes for environmental and wayfinding analysis. These codes acted as the lens through which I assessed the maps and signage at Troy.

Using these codes, I then completed a quantitative content analysis of the maps and signage onsite at Troy and the materials available at the visitor's center to understand where and how the maps and signage strategy failed to support a positive visitor experience. From the content analysis, I identified missed design opportunities and ways that the wayfinding could be improved. This work serves as a foundation for the semiotic redesign of maps and signage at Troy. Imperatives for the redesign of signage are summarized in section 5.2.

5.2 Imperatives for Design

In the following, I provide a set of recommendations for signage at Troy resulting from the content analysis. Recommendations are organized according to the larger themes in semiotics and environmental graphic design reviewed above. The recommendations address specific deficiencies in the Troy visitor experience due to the design of maps and signage.

5.2.1 Referent-as-Mediator

Information content imperatives:

- Include geographic information in signage to highlight and identify salient landscape features.
- Make geographic information available throughout the site, not just at the visitor's center.
- Put more historical information on signs.

The content analysis revealed that geographic and historic information was underutilized as a way to identify and interpret points of interest at Troy. Furthermore, most geographic information was available only at the visitor's center. These deficiencies likely left the Troy visitor to wonder: "What are the important features of the environment?" and "What is the historical significance of these features?" To create a designed experience at Troy, geographic and historic information needs to be available throughout the site.

Embedded knowledge imperatives:

- Include maps on identification signs and directional signs.

- Use declarative knowledge to identify and interpret features.
- Make configural information on maps relatable to the configuration of the environment.
- Rotate inset maps to reflect the direction that the visitor is facing when reading the sign.
- Include a You-Are-Here symbol on maps.
- Deliver procedural information in an understandable format.

The content analysis revealed an overarching difficulty in relating maps and signage to the contemporary locations in the landscape as well as a dearth of declarative, configural, and procedural knowledge across onsite maps and signage. Direction and identification signs should be paired with maps so that the visitor knows where to turn when wayfinding or where to look when arriving at a point of interest. Declarative knowledge should be used to identify important vistas and explain their features. Highly abstract inset maps showing the different layers of Troy were difficult for visitors to transpose onto the environment and should be redesigned as cross-section maps (see 5.2.3 sign vehicle-as-mediator) or eliminated. Finally, procedural information should be homogenized into a consistent strategy. For example, the mixed case system of numbers and letters was confusing and could lead visitors to believe that they had made a wayfinding error even though they were actually on the correct path.

5.2.2 Interpretant-as-Mediator

Iconicity imperatives:

- Use geometric / abstract & “true to ancient life” image / realism representations with landmarks so that visitors can “read” them into the modern environment.
- Add more pictorial or associative representations to maps and signage.

Representation at Troy relied on either extreme abstraction or extreme realism, antipodes on the continuum of iconicity. Both strategies fell victim to a common problem: they were hard to read into the environment. Geometric / abstract symbols failed to communicate complex information to visitors, especially in the Troy landscape of few salient landmarks. Likewise, “true to ancient life” image / realism representations of historical landscapes were difficult to relate to the present day Troy landscape, which consists mainly of piles of ruins and few standing structures. The use of these approaches also ignored

other effective display choices such as pictorial or associative representations that can present information in a more readily understood format.

When it is not possible to use pictorial or associative representations, designers should include recognizable landmarks in the design so that the visitor looking at either a geometric / abstract or image/realism representation will readily know where in the environment to look. Another option for image/realism representations is transposing a geometric outline of the subject ruin over a depiction of the present day vista, so that the viewer can appreciate how the modern day landscape compares with the site's appearance in ancient days.

Sign Library imperatives:

- Use standard symbols from widely recognized symbol libraries such as AIGA / ISO.
- Alter standard symbols to connect to the theme of place.
- Use standard symbols to reduce the amount of text on signs.
- Use standard symbols to communicate with visitors who cannot read Turkish, German, or English.

The content analysis revealed that the few symbols drawn from sign libraries were very effective at Troy. Standard symbols reduce the amount of text on signs and thus facilitate communicate with visitors who cannot read Turkish, German, or English. Some symbols from sign libraries can undergo small alterations to connect them with the theme of Troy such as dressing the "male" bathroom symbol as an ancient warrior.

5.2.3 Sign-vehicle-as-mediator

Visual variable imperatives:

- Reserve color hue, texture, and shape for qualitative differences.
- Keep color hue consistent across the sign system.
- Use perceptual scaling for color value.
- Reserve size for quantitative differences
- Utilize orientation to show the strata onsite at Troy.
- Rely on orientation to indicate the direction a viewer should look when arriving at a point of interest.

Broadly speaking, the greatest opportunity for improving the use of visual variables at Troy is to follow the semiotic conventions for depicting quantitative versus qualitative differences. Pairing visual variables with level of measurement will enable faster and more effective communication with visitors. Hue, texture, and shape should be reserved to show qualitative differences, and size should be reserved to show quantitative differences. Color value and orientation were generally used correctly, but their application could be tweaked for better effectiveness. Color value, when employed in representations, should use perceptual scaling so that the difference between the color steps can be easily seen. Using the visual variable of orientation to show the different strata at Troy can help a visitor "see the unseen," by showing them where to look when they arrive at a point of interest.

Typography imperatives:

- Use typefaces consistently across signs.
- Use a serif typeface to label natural phenomena.
- Do not use handmade typefaces.
- Follow cartographic conventions regarding orthography.
- Use bold and italic to complement the roman lettering.

Overall, the content analysis revealed that typefaces were not used consistently across signs and did not follow conventions of cartography. Lack of consistency was the biggest problem with the sign system, and if improved, will promote branding and recognition of each sign type. The use of bold and italic to complement roman lettering would allow designers to emphasize important or special details in signs and encode additional nominal and ordinal information in maps. Serif typeface should be used to label natural phenomena to increase congruency between referent and sign vehicle. Handmade typefaces are difficult to reproduce consistently and give the archaeological site a haphazard and unprofessional appearance, especially when almost all of the other signs do not use handmade typefaces.

5.2.4 Material Environment and Wayfinding Embellishments

Material environment imperatives:

- Change glossy signs to a matte or semi matte finish.

- Conform signage to ISO sign shape standards.
- Pair directional signs with maps that illustrate stratigraphy.
- Ensure signage is consistent with the sign hierarchy so that unimportant signs do not cause distraction.
- Make sure important signs, such as identification signs, are large enough for visitors to read at a reasonable distance when they arrive at a vista or point of interest.
- Repair or remove damaged signs.
- Ensure that signs are visible because occluded signs impair the experience of place.

Overall, the legibility of maps and signage should be improved to promote a visual hierarchy onsite and to ensure that visitors will be able to access the content on the signs. Glossy signs at Troy were hard to read due to reflectance issues and should be replaced with matte or semi-matte signs. Many signs did not follow ISO sign shape standards and thus missed an opportunity to communicate instructions by the shape of the sign alone.

Ensuring that signs follow the sign hierarchy promotes a better experience of place at Troy. Recessive regulation signs and occluded signs degrade the visitor's experience of place and may cause unsafe conditions because visitors who miss the signs might injure themselves or cause damage to the site. These signs must be raised in prominence in the sign hierarchy. Damaged signs gave an unkempt appearance and should be repaired or removed. Signs should not be placed in hard-to-access areas where they cannot be easily maintained.

Wayfinding embellishment imperatives:

- Include consistent systems of names.
- Use procedural directions in place names to orient the visitor.
- Use a heads-up display to orient visitors as to what is in front of them.
- Make the You-Are-Here symbol an arrow so that visitors can identify on the map the direction they are facing.

Using consistent names promotes the learnability of the sign system and including procedural directions in place names helps orient the visitor. Maps at Troy did not utilize the heads-up display, which rotates to the direction that the viewer is facing to help orientation. The use of the heads-up display will help visitors understand the vistas they are looking at and assist with navigation. No signs at Troy used the

You-Are-Here symbol, but when that symbol is used, it should be in the shape of an arrow so that visitors understand the direction they are facing.

5.3 Limitations

In the following, I discuss limitations of the study. First, artifacts were collected in the summer of 2014. Since then, the maps and signage may have changed at the site. Thus any revisions to maps and signage at Troy based on the above recommendations need to account for changes made during the past two years. Further, a new museum is being built at Troy which is likely to increase the maps and signage available at Troy. The museum opening is an excellent opportunity to rethink the maps and signage across Troy, linking visuals inside the museum to those onsite.

There were several aspects of the visitor experience at Troy that I did not capture due to the limited time I had at Troy. Dimensions that I would have liked to capture included the audio guides on the visitor experience, dimensions of the maps and signage, and landmarks or vistas that were off the tourist path or otherwise not identified with a sign. Regarding the latter, I am unable to identify locations at Troy where additional maps and signage are needed—an important consideration for wayfinding and visitor experience—as the study scope approached the content of existing signs only. Furthermore, several codes in the content analysis were difficult to apply consistently due to lighting conditions in the photographs.

This study focuses on the ways information was displayed to visitors at Troy but does not focus on the historical content itself such as the choice of the specific information appearing on a given sign. Conducting an interview study to understand the needs of stakeholders such as locals, visitors, and researchers would expose aspects of the historical content missing in the maps and signage as well as capture broader opinions, values, and reactions to Troy maps and signage overall. However, the collection of primary information from these stakeholders was out of the project scope due to the limited time onsite.

Lastly, the study did not consider the phenomena of *visual pollution* or the presence of signs that detract from a sense of place (Portella 2014). Troy contained examples of visual pollution, such as mobile advertisement signs, but ultimately this factor was left out of the analysis because the degree to which a sign "pollutes" is subjective and difficult to measure.

5.4 Future Directions

This study explored the ways that signage at Troy could be improved using the principles of semiotics and best practices of environmental graphic design. There are several future directions for this research.

First, the study is situated within the overlap of cartography and environmental graphic design. The fields of environmental graphic design and cartography overlap in many ways, and a further exploration of the similarities between the fields would benefit both. Cartography and environmental graphic design can share their respective insights into the design process, the consistency of representations, and the structure of the visual hierarchy. The sharing of insights between these fields will result in better maps produced by environmental graphic designers, and cartographers will have a better awareness of the environment in which the maps are used.

Second, a redesign of Troy's signage and symbols could be tested through an evaluation that is visitor driven. Through a survey or interview study, the perspectives of visitors, locals, and researchers could be obtained through target profiles to understand what each group would like shown on the sign system. Sample designs could be generated from their feedback, informed by the design imperatives set forth in this study. Of particular interest is finding pictorial and associative symbols for maps and signage that work unambiguously across the diverse set of visitors to Troy. The resulting sample designs then could be tested as to how well they communicate with these visitors.

Lastly, the study can be expanded through a multi-site comparison. The end goal would be a semiotic / EGD checksheet for maps and signage at cultural sites to ensure that the environment is communicating effectively with the visitor. Complementing the multi-site comparison, extending the

study to the effects of digital tools, such as audio tours, interactive displays in the museum, and augmented reality via mobile devices will enrich knowledge about designing an experience.

Ensuring that Troy has a functional sign system will attract more visitors, which will increase its public visibility and funding (hopefully), thereby furthering its preservation. In this study, I have derived design imperatives from semiotics and environmental graphic design to help designers transform this legendary World Heritage Site from a *signed* experience into a *designed* experience. Future designers could use these opportunities for improvement so that Troy may inspire visitors for generations to come.

Appendix

Appendix A Codes used in the sample.

Media Type	Definition	Source
Map in Book	A map embedded in a book or a paper map.	
Sign	A sign in the environment. May contain an embedded map.	
Referent-as-Mediator		
Information Content	*Applies to all artifacts.*	
IC1. Attribute (historical)	Artifact contains historical information.	
IC2. Attribute (other)	Artifact contains non-historical information.	
IC3. Geographic	Artifact contains geographic, non-attribute information.	
Knowledge or Instruction Provided	*Applies to all artifacts.*	
K1. Declarative	Knowledge about objects, attributes and places.	Gollege and Stimson 1987
K2. Procedural	Knowledge about how to complete a task.	Gollege and Stimson 1987
K3. Configural	Knowledge about spatial relations between objects.	Gollege and Stimson 1987
Interpretant-as-Mediator		
Iconicity (Modified Robinson Taxonomy)	*Applies to all artifacts containing images.*	MacEachren 1994
I1. Associative / Iconic	Artifact relates to referent via association.	
I2. Pictorial / Iconic	Artifact physically resembles referent.	
I3. Geometric / abstract	Artifact's relation is arbitrary or conventional.	
I4. Image / Realism	Artifact's relation is highly realistic.	
Part of a Symbol Library	*Applies to signs only.*	
SL1. ISO	Part of ISO library of symbols.	ISO 2015
SL2. AIGA	Part of AIGA library of symbols.	AIGA 2015
SL3. No	Not part of a known symbol library.	
Sign Type	*Applies to signs only.*	Berger, Smithshuijizen, Calori, Mollerup etc
ST1. Informational	Artifact provides information about a place.	
ST2. Identification	Artifact identifies a place, location or object.	
ST3. Directional	Artifact indicates the direction to an object or location.	
ST4. Regulatory	Artifact regulates or prohibits behavior in a space.	
ST5. Ad-Hoc	Handmade sign used when a sign system fails; or graffiti.	
ST6. Indirect	A sign that is not a formal sign but provides information about the environment.	
Sign-vehicle-as-mediator		
Color Hue	*Applies to all artifacts.*	Bertin 1967, MacEachren 1994
H1. Hue Quantitative	Hue use shows a quantitative difference.	
H2. Hue Qualitative	Hue use shows a qualitative difference.	
Color Value	*Applies to all artifacts.*	Bertin 1967, MacEachren 1994
V1. Value Quantitative	Value variable use shows a quantitative difference.	
V2. Value Qualitative	Value variable use shows a qualitative difference.	
Texture	*Applies to all artifacts.*	Bertin 1967, MacEachren 1994
T1. Texture Quantitative	Texture variable use shows a quantitative difference.	
T2. Texture Qualitative	Texture variable use shows a qualitative difference.	
Shape	*Applies to all artifacts.*	Bertin 1967, MacEachren 1994
S1. Shape Quantitative	Shape variable use shows a quantitative difference.	
S2. Shape Qualitative	Shape variable use shows a qualitative difference.	
Size	*Applies to all artifacts.*	Bertin 1967, MacEachren 1994
SZ1. Size Quantitative	Size variable use shows a quantitative difference.	
SZ2. Size Qualitative	Size variable use shows a qualitative difference.	
Orientation	*Applies to all artifacts.*	Bertin 1967, MacEachren 1994
O1. Orientation Quantitative	Orientation variable use shows a quantitative difference.	
O2. Orientation Qualitative	Orientation variable use shows a qualitative difference.	
Typeface	*Applies to all artifacts.*	
TF1. Serif used	Artifact uses a serif typeface.	
TF2. Sans-serif used	Artifact uses a sans-serif typeface.	
Type Case	*Applies to all artifacts.*	

TC1. Normal orthography	Artifact uses normal orthography.	
TC2. All Caps	Artifact uses all caps.	
TC3. Small caps	Artifact uses small caps.	
Type Style	*Applies to all artifacts.*	
TS1. Roman	Artifact uses roman style.	
TS2. Bold	Artifact uses bold style.	
TS3. Italic	Artifact uses italic style.	
Material Environment		
Physical Properties of Sign	*Applies to signs only.*	Calori, Mollerup
P1. Matte	Sign does not reflect light.	
P2. Gloss	Highly reflective sign.	
P3. Semi-Matte	Sign reflects light but is not highly reflective.	
Physical Shape	*Applies to signs only.*	Calori, Mollerup, Berger, etc
PS1. Circular	Artifact (sign) is circular – shaped.	
PS2. Rectangular	Artifact (sign) is rectangular – shaped.	
PS3. Triangular	Artifact (sign) is triangular – shaped.	
PS4. Triangular and Rectangular	Artifact (sign) is a combination of triangular and rectangular – shaped	
PS5. Other	Artifact (sign) is neither circular, rectangular or triangular	
Size & Sign Hierarchy	*Applies to signs only.*	
SH1. Prominent and Consistent with Sign Hierarchy	Artifact (sign) is in a prominent location appropriate to the sign hierarchy.	
SH2. Prominent and Inconsistent with Sign Hierarchy	Artifact (sign) is in a prominent location not appropriate to the sign hierarchy.	
SH3. Recessive and Consistent with Sign Hierarchy	Artifact (sign) recedes appropriately in the sign hierarchy.	
SH4. Recessive and Inconsistent with Sign Hierarchy	Artifact (sign) recedes inappropriately in the sign hierarchy.	
Damaged or Heavily Worn	*Applies to signs only.*	
D1. Yes	Artifact (sign) is damaged.	
D2. No	Artifact (sign) is not damaged.	
Occluded or Poor Visibility	*Applies to signs only.*	
OD1. Yes	Artifact (sign) is blocked or partially blocked from the visitor's sight.	
OD2. No	Artifact (sign) is not blocked from the visitor's sight.	
Procedural Directions included in Place Names	*Applies to signs only.*	Mollerup
CD1. Yes	Procedural directions are included in place names.	
CD2. No	Procedural directions are not included in place names.	
Coordinated Names	*Applies to signs only.*	Mollerup
CN1. Yes	Artifact (sign) uses coordinated names.	
CN2. No	Artifact (sign) does not use coordinated names.	
Common Patterns Used	*Applies to signs only.*	Mollerup
CP1. Yes	Artifact (sign) uses common patterns.	
CP2. No	Artifact (sign) does not use common patterns.	
Heads-Up Display	*Applies to signs only.*	Mollerup
HU1. Yes	Artifact (sign) uses a heads-up display.	
HU2. No	Artifact (sign) does not use a heads-up display.	
You-Are-Here Symbol Present	*Applies to signs only.*	Katz
Y1. Yes	Artifact (sign) uses a You-Are-Here symbol.	
Y2. No	Artifact (sign) does not use a You-Are-Here symbol.	
If Present, Symbol is Arrow	*Applies to signs only.*	Katz
YP1. Yes	Artifact (sign) uses an arrow-shaped You-Are-Here symbol.	
YP2. No	Artifact (sign) does not use an arrow-shaped You-Are-Here symbol.	
Distance / Geography Distorted	*Applies to signs only.*	Katz
GD1. Yes	Artifact (sign) distorts distance or geography.	
GD2. No	Artifact (sign) does not distort distance or geography.	

Appendix B Analysis Results.

Media Type	Installed Signs		Visitor center Maps		All Artifacts	
	Total	% (of 108)	Total	(% of 44)	Total	% (of 152)
Referent-as-Mediator						
Information Content		*45.6%*		*50.0%*		*56.1%*
IC1. Attribute (historical)	50	46.2%	11	25.0%	61	40.1%
IC2. Attribute (other)	79	73.1%	11	25.0%	90	59.2%
IC3. Geographic	61	20.4%	44	100%	105	69.0%
Knowledge Provided		*40.4%*		*43.3%*		*41.2%*
K1. Declarative	69	63.9%	7	15.9%	76	50.0%
K2. Procedural	40	37.0%	6	13.6%	46	30.3%
K3. Configural	22	20.4%	44	100%	66	43.4%
Interpretant-as-Mediator						
Iconicity (Modified Robinson Taxonomy)		*24.9%*		*30.7%*		*26.3%*
I1. Associative / Iconic	10	10.8%	5	11.4%	15	9.9%
I2. Pictorial / Iconic	15	13.9%	4	9.1%	19	12.5%
I3. Geometric / abstract	60	55.6%	37	84.1%	97	63.8%
I4. Image / Realism	21	19.4%	8	18.2%	29	19.1%
Part of a Symbol Library (signs only)						
SL1. ISO	3	2.8%	N/A	N/A	N/A	N/A
SL2. AIGA	12	11.1%	N/A	N/A	N/A	N/A
Sign Type (signs only)						
ST1. Informational	28	25.9%	N/A	N/A	N/A	N/A
ST2. Identification	9	8.3%	N/A	N/A	N/A	N/A
ST3. Directional	39	36.1%	N/A	N/A	N/A	N/A
ST4. Regulatory	16	14.8%	N/A	N/A	N/A	N/A
ST5. Ad-Hoc	0	0.0%	N/A	N/A	N/A	N/A
ST6. Indirect	16	14.8%	N/A	N/A	N/A	N/A
Sign-vehicle-as-mediator						
Color Hue		*24.0%*		*29.5%*		*25.7%*
H1. Hue Quantitative	39	36.1%	26	59.1%	65	42.8%
H2. Hue Qualitative	13	12.0%	0	0.0%	13	8.6%
Color Value		*0.45%*		*14.7%*		*4.6%*
V1. Value Quantitative	0	0.0%	7	15.9%	7	4.6%

V2. Value Qualitative	1	0.9%	6	13.6%	7	4.6%
Texture		*0.9%*		*28.4%*		*8.8%*
T1. Texture Quantitative	0	0.0%	23	52.35	23	15.1%
T2. Texture Qualitative	2	1.9%	2	4.5%	4	2.6%
Shape		*0.0%*		*23.8%*		*6.9%*
S1. Shape Quantitative	0	0.0%	15	34.1%	15	9.9%
S2. Shape Qualitative	0	0.0%	6	13.6%	6	3.9%
Size		*0.0%*		*10.2%*		*2.9%*
SZ1. Size Quantitative	0	0.0%	0	0.0%	0	0.0%
SZ2. Size Qualitative	0	0.0%	9	20.5%	9	5.9%
Orientation		*17.6%*		*20.4%*		*18.4%*
O1. Orientation Quantitative	0	0.0%	16	36.4%	16	10.5%
O2. Orientation Qualitative	38	35.2%	2	4.5%	40	26.3%
Typeface		*37.5%*		*54.5%*		*42.4%*
T1. Serif used	47	43.5%	8	18.2%	55	36.2%
T2. Sans-serif used	34	31.5%	40	90.9%	74	48.7%
Type Case		*24.7%*		*43.9%*		*30.3%*
TC1. Normal orthography	44	40.7%	39	88.6%	83	54.6%
TC2. All Caps	36	33.3%	19	43.2%	55	36.2%
TC3. Small caps	0	0.0%	0	0.0%	0	0.0%
Type Style		*31.7%*		*41.7%*		*34.6%*
TS1. Roman	79	73.1%	42	95.5%	121	79.6%
TS2. Bold	24	22.2%	9	20.5%	33	21.7%
TS3. Italic	0	0.0%	4	9.1%	4	2.6%
Material Environment (signs only)						
Physical Properties of Sign						
P1. Matte	19	17.6%	N/A	N/A	N/A	N/A
P2. Gloss	23	21.3%	N/A	N/A	N/A	N/A
P3. Semi-Matte	50	46.3%	N/A	N/A	N/A	N/A
P4. Halation present	0	0.0%	N/A	N/A	N/A	N/A
Physical Shape						
PS1. Circular	1	0.9%	N/A	N/A	N/A	N/A
PS2. Rectangular	59	54.6%	N/A	N/A	N/A	N/A
PS3. Triangular	10	9.3%	N/A	N/A	N/A	N/A
PS4. Triangular and Rectangular	22	20.4%	N/A	N/A	N/A	N/A
PS5. Other	0	0.0%	N/A	N/A	N/A	N/A
Size & Sign Hierarchy						

SH1. Prominent and Consistent with Sign Hierarchy	74	68.5%	N/A	N/A	N/A	N/A
SH2. Prominent and Inconsistent with Sign Hierarchy	4	3.7%	N/A	N/A	N/A	N/A
SH3. Recessive and Consistent with Sign Hierarchy	4	3.7%	N/A	N/A	N/A	N/A
SH4. Recessive and Inconsistent with Sign Hierarchy	10	9.3%	N/A	N/A	N/A	N/A
Damaged or Heavily Worn						
D1. Yes	15	13.9%	N/A	N/A	N/A	N/A
Occluded or Poor Visibility						
OD1. Yes	11	10.2%	N/A	N/A	N/A	N/A
Procedural Directions included in Place Names						
CD1. Yes	1	0.9%	N/A	N/A	N/A	N/A
Coordinated Names						
CN1. Yes	23	21.3%	N/A	N/A	N/A	N/A
Common Patterns Used						
CP1. Yes	65	60.2%	N/A	N/A	N/A	N/A
Heads-Up Display						
HU1. Yes	0	0.0%	N/A	N/A	N/A	N/A
You-Are-Here Symbol Present						
Y1. Yes	0	0.0%	N/A	N/A	N/A	N/A
If Present, You-Are-Here Symbol is Arrow						
YP1. Yes	0	0.0%	N/A	N/A	N/A	N/A
Distance / Geography Distorted						
GD1. Yes	0	0.0%	N/A	N/A	N/A	N/A

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