

THE DEVELOPMENT OF AN ACADEMICALLY-BASED ENTERTAINMENT-  
EDUCATION (ABEE) MODEL: CO-OPTING BEHAVIORAL CHANGE EFFICACY  
OF ENTERTAINMENT-EDUCATION FOR ACADEMIC LEARNING TARGETING  
THE SOCIETAL LANDSCAPE OF U.S. GEOGRAPHIC ILLITERACY

A Dissertation

by

MICHELLE LOUISE SIMMS

Submitted to the Office of Graduate Studies of  
Texas A&M University  
in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

May 2011

Major Subject: Curriculum and Instruction

The Development of an Academically-based Entertainment-Education (ABEE) Model:

Co-opting Behavioral Change Efficacy of Entertainment-Education for Academic

Learning Targeting the Societal Landscape of U.S. Geographic Illiteracy

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## ABSTRACT

The Development of an Academically-Based Entertainment-Education (ABEE) Model:  
Co-opting Behavioral Change Efficacy of Entertainment-Education for Academic  
Learning Targeting the Societal Landscape of U.S. Geographic Illiteracy.

(May 2011)

Michelle Louise Simms, B.S.; M.Ag.; M.S.,

Texas A&M University

Chair of Advisory Committee: Dr. B. Stephen Carpenter, II

Educators and scholars continue to lament United States citizens' geographic illiteracy and are calling on Congress to address the crisis. However, despite recent public attention, a lack of national commitment to teaching geography in all public school grade levels persists. Therefore, non-formal educational avenues need to be pursued to address this crisis. One such avenue may be Entertainment-Education (E-E). E-E interventions have been used outside of the U.S. to impact social problems and detrimental behaviors by presenting positive role models in entertainment products designed to stimulate changes in viewers' behavior. For example, soap operas promote condoms use as a HIV prevention strategy (Tanzania), model culturally-sensitive actions to stop domestic violence (South Africa), and promote infant oral-rehydration therapy (Egypt).

This study posits academic learning can be facilitated in a similar fashion as behavior change through an E-E methodology. Beginning with an examination of the E-E field by indexing E-E literature found in scholarly publication databases, this study demonstrates the 30-year health message focus of the field and presents a catalogue of E-E interventions cross-referenced by name and target country. The combination of these two products illuminates how U.S. audiences and non-behaviorally based outcomes have not been targeted, leaving academic subject learning as an area into which E-E can expand.

The expansion of E-E methodology into geography education (or any other subject) requires understanding of how academic concepts interact with the structure of fictional narratives. Using a grounded theory approach, this study analyzes the U.S. television series *NUMB3RS*, which uses math to drive the story (as opposed to simply serving as context), to develop an Academically-Based Entertainment-Education (ABEE) model. ABEE is then applied to Google Earth, exploring how to leverage non-linear and visually dependent narratives as well as develop user-driven learning experiences.

The implications of research presented here and through future refinement of the ABEE model may potentially (1) develop educative entertainment products supporting formal education and (2) bring geographic knowledge into the realm of popular culture through mass media, thereby impacting geographic literacy at a societal level in the U.S.

The electronic version of this dissertation is accessible from <http://hdl.handle.net/1969.1/ETD-TAMU-2011-05-9128>.

## DEDICATION

I heard “no” but kept going,

Revelations 3:7

Until “no” became my fuel.

James 1: 2-4

Those who told me “yes” ignited the fuel,

Proverbs 17:17; 27:9

Revealing the plan of the One who plants

dreams and makes them come true.

Philippians 1:21

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For their efforts in helping me navigate the personnel and legal aspects of securing publication permission for excerpts from television show scripts, a special thank you goes to Cheryl Heuton, Nicolas Falacci, Robert Port, Michael Cano, Adam Huss (Writers Guild of America Foundation), Laurie Espinosa (WGA legal department), Karen Howard (CBS legal department), and Alan Hergott (Bloom Hergott Diemer Rosenthal LaViolette Feldman Schenkman & Goodman, LLP). I am also so grateful to the show's writers who generously gave me their time to discuss my research. In compliance with my IRB protocol approved by the Office of Research Compliance, I cannot name them specifically but please know how much I appreciate your time and interest in my research!

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## NOMENCLATURE

ABEE	Academically-based Entertainment-Education
GE	Google Earth
E-E	Entertainment-Education
MDPP	Math-Driven Plot Point
PBS	Public Broadcasting System
PP	Plot Point

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## CHAPTER I

### INTRODUCTION

If casual proclamations such as “I am terrible with directions” or “I don’t remember anything I learned about geography when I was in school” are any indication, geographic illiteracy in the United States does not appear to be considered a liability. Take for example popular talk show host Kelly Ripa’s self-deprecating story told to her *Live with Regis and Kelly* television audience about not being able to assist her children with accurate placement of cities on a world map in their home (Dodai, 2009). Evidence of a national crisis is suggested by a recent study reported by National Geographic Society which found “young adults in the United States fail to understand the world and their place in it” (Roach, 2006). This crisis was recognized by the U.S. Congress through inclusion of the discipline in the No Child Left Behind Act (107th Congress, 2002), however, geography was the only core subject not funded by the legislation. Yet, even if geography was taught as an independent subject in all grades of U.S. classroom, more educational effort and support may be needed to arrest or reverse the growth rate of geographic illiteracy.

With the high rate of entertainment media consumption by Americans, popular culture may be a candidate for delivering educational content as a form of non-formal education, that is to say through learning experiences situated outside of the classroom (M. K. Smith, 2001). For example, a strategy for using popular television programs to

communicate health messages has been used by researchers and organizations such as the Hollywood, Health & Society at the University of Southern California (Glik, et al., 1998; A. Singhal, M. Cody, E. Rogers, & M. Sabido, 2004a; The Norman Lear Center, 2010). On a broader scale, this strategy has been used more extensively in developing countries through soap operas and radio dramas specifically designed to teach viewers how to mitigate pressing social issues. This strategy of embedding educational content into entertainment is called “Entertainment-Education” (Singhal, Cody, et al., 2004a) and has proven to be an effective tool in changing social behaviors in cultures around the world. Entertainment-Education (E-E) differs from traditional educational programming found in the U.S. such as what one finds on Public Broadcasting System (PBS) television network which features programs that are primarily instructional, biographical/documentary, or some variation thereof. For example, the long-running series *New Yankee Workshop* featured host Norm Abrams building a carpentry project step-by-step. In another archetypal example, filmmaker Ken Burns follows the historical path of the U.S. Civil War, the technological and historical context of the building of New York’s iconic Brooklyn Bridge, or the legacy of American architect Frank Lloyd Wright. Generally, these types of programs are facilitated by an on-camera instructor or unseen narrator and use television as the delivery vehicle. Instruction is the context for the shows. While Ken Burns’ films provide significant production value, I would argue that classroom lectures or museum exhibits could deliver experiences similar to this genre’s programs, albeit with lower production values. As opposed to direct instruction or following a historical path, E-E teaches using the language of the medium most



commonly expressed through the fictional narratives of dramas or soap operas. Said another way, it is entertainment that educates (Singhal & Brown, 1995; Singhal, Cody, et al., 2004a; Singhal & Obregon, 1999; Singhal & Rogers, 1989) because instruction is embedded in a situation. For example, in a radio soap opera broadcast in South Africa, *Soul City* follows the lives of characters as they deal “with a range of health and development issues with the aim to empower audiences to make healthy choices” (The Communication Initiative, 2001). This is accomplished, for example, through the narrative of the protagonist learning what behaviors put him at risk of HIV infection and how to protect himself. Through the implementation of E-E interventions around the world, social problems such as HIV prevention and women’s reproductive health have been positively impacted. However, what has not been evaluated to date is the delivery of academic concepts found in the classroom instead of behavioral/health messages.

Therefore, considering the success of E-E to positively impact social behaviors, my research goal for this dissertation is to expand the behaviorally-based outcome focus of E-E methodology (i.e. changing attitudes, beliefs, or behaviors) into the realm of academic learning, specifically geographic education. This dissertation seeks to address the following overarching questions:

1. If dramas can be used to induce behavioral changes in viewers, could they also be used to induce academic learning as well?
2. If so, how could an E-E strategy be developed to teach geography or other academic subjects?

## **Problem Statement**

If the Vice President for Education at National Geographic Society is correct when he states “it's no secret that Americans know next to nothing about geography” (Edelson, 2009), then the problem of geographic illiteracy in the United States is at a crisis point. One approach to mediating this problem may reside in the adaption of the Entertainment-Education (E-E) methodology, which has been used successfully around the world to impact a variety of social problems and detrimental behaviors (Singhal, Cody, et al., 2004a). However, current learning theories have not addressed learning via fictional narratives in terms of how academic concepts can or should be woven into the fabric of fictional narratives in order to drive the story. Therefore the problem of understanding how academic concepts interact with the narrative structure of fictional narratives is vital to developing what I am calling Academically-Based Entertainment-Education (ABEE). ABEE becomes the basis for developing E-E interventions that promote positive *academic* outcomes in its consumers, with an emphasis on learning geography.

## **Purpose of This Study**

The overarching purpose of this multiple-article dissertation is to develop a model for academically-based Entertainment-Education (ABEE) interventions for use in traditional and new media targeting geography education. The main research question guiding this dissertation is the following: How might ABEE interventions based on fictional narratives be developed to teach academic concepts in geography? This

question can be broken down into three elemental questions, which become the central questions addressed in the articles of this dissertation:

1. How might Entertainment-Education be used to teach academic subjects?
2. How have scientific academic concepts been used to drive fictional narratives made for television?
3. How can the academically-based Entertainment-Education (ABEE) model be used in the non-linear environment found in new media?

### ***Form and content of the dissertation***

This dissertation reports on the development of an E-E strategy for teaching geography. First, I present an index of literature from the field of E-E as well as a catalog of E-E intervention titles cross-referenced to their target country audience. Although historically E-E has focused on health education, due to the interdisciplinary nature of the E-E field there is not a single disciplinary home in which it resides. In addition, there is not currently a way to locate E-E interventions by name or by country. I present these works to not only establish the historical context for E-E research but to also satisfy a critical need of providing a cross-referenced record of interventions from around the world. Second, I present the results of a qualitative case study using grounded theory to develop an Academically-based Entertainment-Education (ABEE) model for teaching through the language of traditional media. This research creates the bridge over which E-E can be transitioned from behaviorally-based into academic learning. Third, I theorize how my ABEE model can be adapted and applied to the non-linear and visual environment of Google Earth, which on the surface might appear to be devoid of the

narrative mechanics found in traditional media. In so doing, I translate the narrative mechanism for use in a more visually-dependent environment as well as one that is more explicitly a geography education environment. Lastly, I will discuss implications of my research for not only geography education, but for the elevation of non-formal education as an important component in life-long learning for all citizens of the United States, young and old alike. To begin, we need to understand the nature of the crisis of geographic illiteracy in the United States.

### **Cultural Acceptance of Geographic Illiteracy?**

In an unintentional way, a 2009 AT&T cell phone commercial ("ShareATT", 2009) uses geographic illiteracy as the context through which the brand features the strength of its services. Extolling the convenience and assistance of simultaneously talking and surfing the web, spokesman Luke Wilson assists a friend who calls him as a "phone a friend" while a contestant on a game show. He needs to know the capital of Peru. When Wilson uses his phone to search the Internet for the answer, the commercial inadvertently provides two incidences of geographic illiteracy for the proverbial price of one. This, and the Kelly Ripa anecdotal evidence of geographic illiteracy in the United States, are quantitatively supported by a 2006 study commissioned by the National Geographic Society (NGS) (National Geographic-Roper Public Affairs, 2006; National Geographic Society, 2009a, 2009b). The NGS study, which utilized a representative sample of 510 young people aged 18-24 from the contiguous United States, reported that "the average respondent answered 54 percent of the questions correctly" (Roach, 2006). What makes these findings even more disconcerting is the fact that the survey did not

focus on obscure locations or *Jeopardy*-type questions requiring a high level of proficiency in the discipline of geography to answer. Instead, respondents were asked questions about places that were in the news on a regular basis, such as Iraq and Sudan rather than Paraguay or Madagascar. Even if a lack of world geography knowledge could be excused as unnecessary, consider that half of those surveyed were unsuccessful in finding New York state on a map, a third could not locate Louisiana and fewer than fifty percent could locate Mississippi on a map (and this after the one-two punch of Hurricanes Katrina and Rita). In light of these results, the inability of 18 year-old Miss Teen USA beauty pageant contestant Caitlin Upton ("IRamzyl", 2007) to explain her thoughts when asked why she thought a recent poll had found a fifth of all Americans could not find the U.S. on a world map seems predictable.

These scenarios suggest two possible points: (1) U.S. students are not being taught geography (or they are not being taught geography in an effective way), and (2) students are not connecting concepts from the classroom (formal education) with the world around them. To the first point, "geo-literacy is not a priority in today's schools, leaving teachers and schools without the resources to teach important content like cultural, political, and economic geography, earth science, environmental science, ecology, and geographic information systems (GIS)" (National Geographic Education Foundation, 2009). In a national survey (National Geographic-Roper Public Affairs, 2006), 49% of participants (age 18-24 years) reported having never taken a course devoted to geography during grades six to twelve of formal schooling (p. 17). Consider for example Texas elementary and middle school students experience geography only as

a subset of Social Studies (Texas Education Agency, 2010). In high school, course offerings may not exceed one semester of either World Geography or Advanced Placement (AP) World Geography and the optional AP Human Geography (Texas Education Agency, 2010).

The national survey may also suggest evidence that students are not being taught geography in an effective way. While 34% of those having taken a geography course felt they were “more likely to say they know ‘more’ about geography than the average person” (National Geographic-Roper Public Affairs, 2006, p. 17), the report concluded that taking a geography class had only a marginal impact on geographic knowledge since “overall they perform the same on this survey as those who did not have a specific geography course” (p. 17).

Offering only one semester of geography (two for highly motivated students wanting to test out of a college course, for example in Texas) for high school students and even less exposure to geography in the lower grades, provides little time to explore the full spectrum of the discipline rooted in the relationships not only between humans and the environment but the relationships between patterns and processes (e.g. Geography Education Standards Project, 1994; Gersmehl, 2008). Without these connections, I believe students are left with an impression of geography as nothing more than disconnected facts about where “things” are located.

Why does this matter? Geography as a discipline equips citizens with the cognitive tools needed to make decisions in this new era of globalization and global crises where what happens here affects “over there” and vice versa (e.g. Associated

Press, 2006; R. S. Bednarz & Bednarz, 2008; S. W. Bednarz & Bednarz, 1998; Fien, Cox, & Fossey, 1989; Gersmehl, 2008). The geographic illiteracy crisis revealed by the National Geographic survey might be addressed by the pending legislation *Teaching Geography Is Fundamental* (Cochran, Dodd, Van Hollen, & Wicker, 2007) currently in Congress (S.1376 and H.R.1240). However, even if geography enters the curriculum of formal educational in the United States, school geography may not be sufficient for developing a geographically literate society. As Coffield (2000) states,

If all learning were to be represented by an iceberg, then the section above the surface of the water would be sufficient to cover formal learning, but the submerged two thirds of the structure would be needed to convey the much greater importance of informal learning. (p. 1)

What resides below the water's surface may indeed hold the key for promoting the development of a geographically literate society in the United States and speaks to the second point I made previously regarding the need for students to make connections between the classroom and the greater world. To facilitate this connectivity, educators must find opportunities suited for learning that take place outside of formal education (La Belle, 1982). It is within this context that I frame my dissertation through the exploration of opportunities facilitated by non-formal and informal education (Bandura, 1986; Scibner & Cole, 1973; M. Smith, 2005). As a site for non-formal education (i.e. structured learning experiences outside of the formal classroom setting), E-E offers an interesting environment that may be well-suited for geography education, particularly through the medium of television.

CHAPTER II  
MANUSCRIPT #1:  
LITERATURE INDEX

**Overview**

Embarking on an Entertainment-Education (E-E) literature review revealed the body of literature in this field to be (a) relatively small, and (b) difficult to find. Keyword searches in traditional scholarly publication databases returned relatively few citations compared to the newer resource of Google Scholar, which provided significantly more publication records. During this search, the lack of a catalog of E-E interventions by title, country, and type was also discovered. In a field focused on developing and implementing interventions, the lack of an inventory of entertainment products that have been produced and are available for analysis presents a significant gap in the body of literature. Therefore, it was determined that an index of E-E literature published to date may be of more value than synthesis of E-E literature similar to the literature reviews provided in the 45 dissertations found in scholarly database searches.

I present here a categorized index of E-E literature. In addition, during review of each publication, I extracted the names of each E-E intervention to create a catalog cross-referenced by target audience, country, and media type. Furthermore, I present a brief discussion on the negative space revealed by this index. With the dominant focus of E-E on behavioral changes, there is an absence in the E-E literature of interventions



seeking to teach academic concepts. Lastly, suggestions for measures needed to improve access to E-E literature are presented.

### **Introduction**

Embarking on a literature review for research conducted in the relatively young field of Entertainment-Education (E-E) presented several challenges. This article seeks to elucidate those challenges and report how they were met to produce a new product, a literature index, which subsequently emerged as a significant need for the E-E field.

Several complicating factors impacting the production of a comprehensive E-E literature review were revealed during a preliminary search of literature-indexing databases. First, a keyword search using the field's moniker "Entertainment-Education" or the unhyphenated "entertainment education" resulted in a significant number of citations dealing with either entertainment or education, but not relevant to the specific discipline of E-E. Second, despite E-E's interdisciplinary nature, one has to have prior knowledge of E-E's *de facto* home in the subfield of health education and health communication in order to locate the bulk of E-E literature. Such singularity of application runs counterintuitive to an interdisciplinary field. Third, even though E-E possesses the word "education" in its name and purpose, it is poorly represented in education journals. As a result, the traditional databases which index educational publications, such as ProQuest or EBSCO, provide relatively few relevant "hits" when searched using "Entertainment-Education" keyword. Furthermore, none of the literature found in these databases reported research connected to the shows fitting my

academically-based Entertainment-Education (ABEE), indicating a lack of cross-pollination between the disciplines.

Complicating matters further, there is not at the present an index of E-E interventions. One has to scour individual articles in order to glean the titles of media projects. Whereas Internet databases of almost every film or television series ever produced currently exist, such as The Internet Movie Database (IMDb.com, 2009) or The Paley Center for Media Collection database (2009), E-E film and television interventions are generally not included, at least not tagged as E-E products. A final complication involves the differences in the way E-E interventions are developed for audiences in the United States versus other audiences. Outside of the U.S., E-E interventions are predominately designed as independent television or radio series. However within the United States, E-E interventions are limited to single episodes in existing television series or short-run story arcs spanning several episodes. Again, there is not a catalog of these interventions currently available in publication or online. Therefore, since these complicating factors could contribute to researchers missing significant literature in the field needed to inform future research, this article seeks to fill this need by using a systematic approach to assemble an index of research published to date in the field of E-E. With the assemblage of this body of work, it is then possible to also compose an index of E-E film and television interventions by reviewing the literature populating the index.

## Methodology

In a preliminary search of databases, key word searches for “edutainment” and “infotainment” returned publications generally focused on instructional technology applications (such as the use of multimedia or computer-based educational games) as opposed to narrative-based entertainment designed to teach which is associated with the term “Entertainment-Education.” Therefore, I selected the keyword “Entertainment-Education” for this review. Using a systematic literature review approach (Evans & Benefield, 2001; Fink, 2010), I performed a keyword search of scholarly literature databases (Table 2-1). The search was conducted during a two week period beginning June 12, 2010. Each database was searched using the keyword “Entertainment-Education,” seeking to find discipline-specific literature as opposed to literature containing either the use of entertainment (in its broadest sense) in education or vice versa.

Table 2-1  
*Scholarly Databases Searched.* Key word “Entertainment-Education” was used.

Date searched	Database name	Citations returned
6/12/2010	ProQuest	95
6/13/2010	Google Scholar	5856
6/21/2010	InformaWorld	1148
6/22/2010	Scopus	138
6/23/2010	EBSCOhost	467
6/26/2010	ERIC (CSA)	34
6/26/2010	Global Health (Ovid)	20
6/26/2010	EPSCO/Medline	48
6/26/2010	PsychInfo	126
6/27/2010	PubMed	49
6/27/2010	ProQuest Social Science Journals	15

Based on the excessive amount of return “hits” on the keyword, two databases were further filtered to hone the search (see Table 2-2 for filtering parameters). While all of the databases returned citations that had “entertainment” or “education” in the title or abstract but were not applicable to the field of Entertainment-Education, Google Scholar (Google, 2010) produced the most citations for this investigation. In all of the database results, it was necessary to review each citation to determine applicability to the discipline of E-E (criteria discussed below). For example, Google Scholar returned 5590 “hits” on the keyword search, however the rate of finding a relevant or non-duplicated citation declined significantly the deeper into the first 1000 citations I went. From citation #878 to #1000, no relevant citations were found. Therefore, it is more likely that all relevant E-E citations were represented in the first approximate 900 returns in Google Scholar. Since the interface does not provide access beyond 1000 records, further verification was not possible.

To determine relevance of citations for this study, the following criteria was used: If the literature had an aspect of Entertainment-Education as its central focus (e.g. reporting and/or describing a narrative-based an E-E intervention; evolution of the E-E field; discussing theoretically bases of E-E, etc.) defined as an intentional educational message embedded in a narrative as opposed to teaching using television (such as distance education), it was downloaded to the bibliography management software EndNote (*EndNote*, 2010). Each piece of literature was reviewed and coded based on content, theme, and intervention targets (audience type, country, message, etc). Names of media interventions (film, radio, television, etc.) mentioned in each publication were

compiled into a separate catalogue (Table 2-4A) recording E-E message (e.g. HIV/AIDS education, domestic violence prevention, oral rehydration therapy promotion, etc.), media type (film, television, radio, etc.), and target country. The emergent categories thus produce key words used to develop the Index.

Table 2-2  
*Filters Used for ProQuest and Google Scholar Databases.*

ProQuest restricted to:	Google Scholar restricted to:
Arts & Humanities Full Text (ID 26643)	English only
Dissertations & Theses: Full Text (ID 15119)	Articles only (no patents)
Education Periodicals (ID 2146)	
Nursing & Allied Health Source (no ID)	
ProQuest Nursing & Allied Health Source (ID 5441)	
ProQuest Central (ID 25443)	
ProQuest Education Journals (ID 7262)	
ProQuest Family Health (ID 18044)	
ProQuest Health and Medical Complete (ID 4795)	
ProQuest Health Management (ID 15439)	
ProQuest Medical Library (ID 2390)	
ProQuest Psychology Journals (ID 5440)	

Table 2-2 (continued)

ProQuest restricted to:
ProQuest Science Journals (ID 9063)
ProQuest SciTech Journals (39047)
ProQuest Social Science Journals (ID 9065)
ProQuest Sociology (ID 27645)
Research Library (ID 4138)

### **Results and Discussion**

From a combined total of just over 1,000 citations returned from 11 databases, 291 citations were found to be directly related to the field of E-E. It appears the use of the hyphenated “Entertainment-Education” and its abbreviation “E-E” have become the standard within the field. It should be noted that literature using older terminology may have been missed in this review. Terms such as “enter-education,” “info-tainment,” and “edu-tainment” have been used in older literature as well as by literature from researchers not directly involved in the field. However, the terms have also been used for to denote educational media not qualifying as narrative-based E-E. “Edu-tainment” appears to be used more consistently outside E-E in the field of educational technology pertaining to instructional use of computers and/or computer games and simulations, generally addressing non-narrative uses of entertainment and technology. This potential confusion of terminology is one issue that should be addressed within the E-E field.

The pertinent E-E publications were (1) primarily concentrated in health and psychology journals and poorly represented in educational databases or journals, and (2) reported interventions or the application of theories to behavior-based outcomes only, such as discouraging risky sexual behavior (e.g. Buenting, 2006; Delgado & Austin, 2007; Rogers, Vaughan, Swalehe, Rao, & et al., 1999) or encouraging adoption of oral rehydration therapy (e.g. R. Abdulla, 2004). No literature was found that focused on the use of E-E methodology to teach an academic subject like math or geography. In fact, none of the few articles published on the E-E interventions *Voyage of the Mimi* (Bank Street College of Education, 1984) or its sequel *Second Voyage of the Mimi* (Bank Street College of Education, 1988) appeared in an E-E keyword search, which may indicate (1) a publication bias against E-E literature in educational journals and/or databases, or (2) a previously unexplored area for E-E research. Therefore, in the absence of research using E-E for academic concepts, as opposed to behavioral changes, the process of constructing this literature index reveals a large gap in the E-E literature or a new direction in which the field may grow.

The body of scholarly publications found in this study are published predominately in scholarly journals (56%), followed by chapters in edited books (19%), then dissertation or thesis (14%). Other publications types (reports, unpublished works, etc.) combined with books and online journals compose the remaining 11% of the publications (Figure 2-1). The annual trend in publications remained low from the period of 1977-1998, publishing fewer than eight per year, From 1999 to 2003, the field begins to experience growth with annual publication ranging from nine to 17. An

artificial spike of 39 publications appears in the year 2004 due to the publication of an edited book (A. Singhal, M. J. Cody, E. M. Rogers, & M. Sabido, 2004b), however the chapters in this book have been cited at least 291 times (as of October 31, 2010) according to Google Scholar. This publication, therefore, represents an important work in this field as evidenced by the fact that the majority of E-E literature is cited by less than 10 publications (Figure 2-2). Publication growth appears to trend upward after 2004 (Figure 2-3) dominated by journals articles in addition to a small increase in dissertation and thesis publications (Figure 2-4).

The E-E literature found in this study was classified by tone, research approach, and intervention genre. Tone of the publication speaks to the following categories defined as:

1. Applied – publications describing E-E interventions and their effects (i.e. examples of what has been produced)
2. Historical – publications reporting on the evolution of the field of E-E
3. Theoretical – publications which explore, posit, or generate explanations for how E-E influences audiences (i.e. how it “works”)
4. Visionary – publications proposing new directions for E-E

Publication tone (Figure 2-5) was evenly divided between Applied (48%) and the Historical and Theoretical (combined 47%) categories. Literature discussing new approaches to E-E (i.e. Visionary), e.g. interventions using non-traditional media, make up only 5% of the literature.



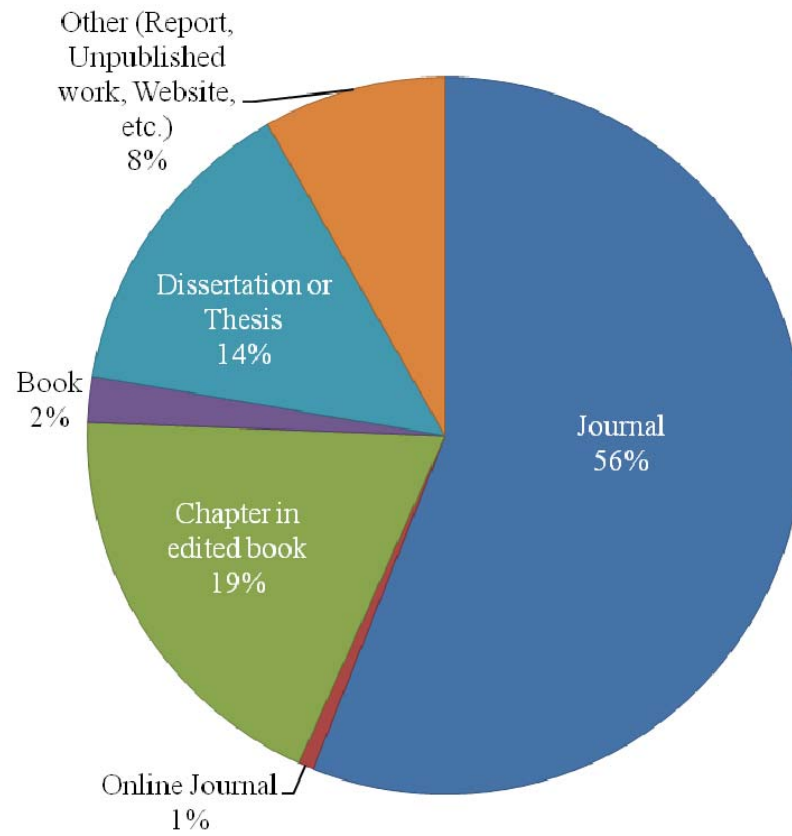


Figure 2-1  
*Proportion of Literature by Publication Type.*

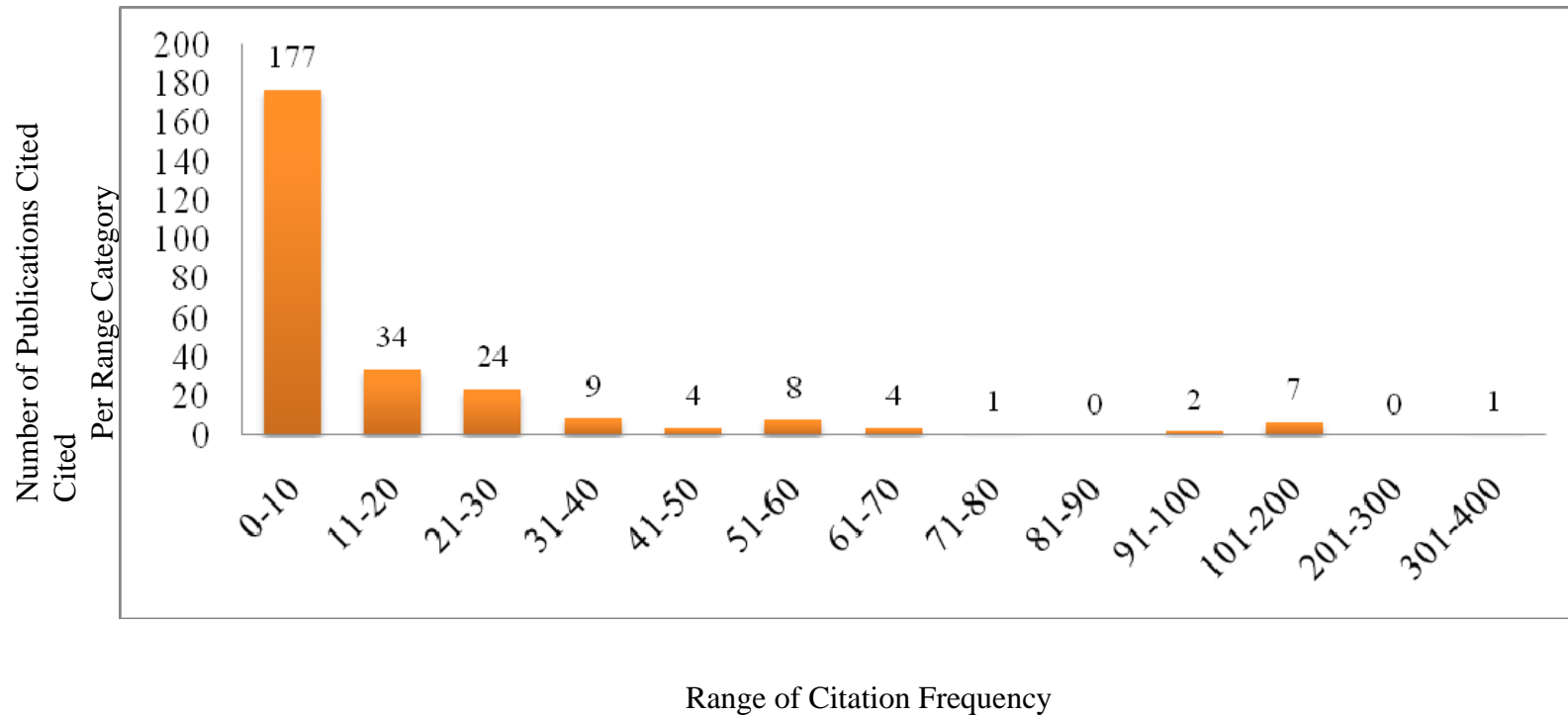


Figure 2-2  
*Frequency of Citation of Entertainment-Education Publications.*

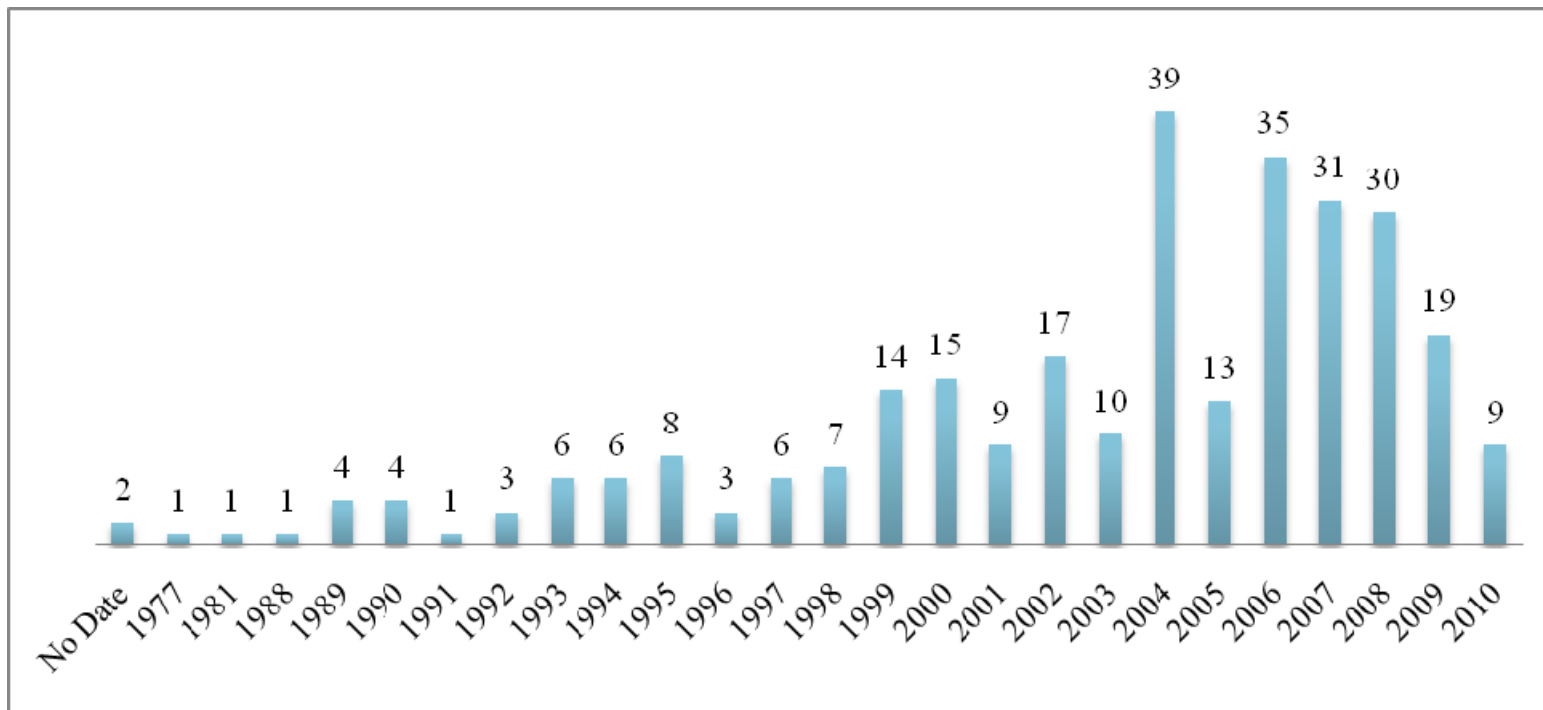


Figure 2-3  
*Frequency of Entertainment-Education Publications by Year.*

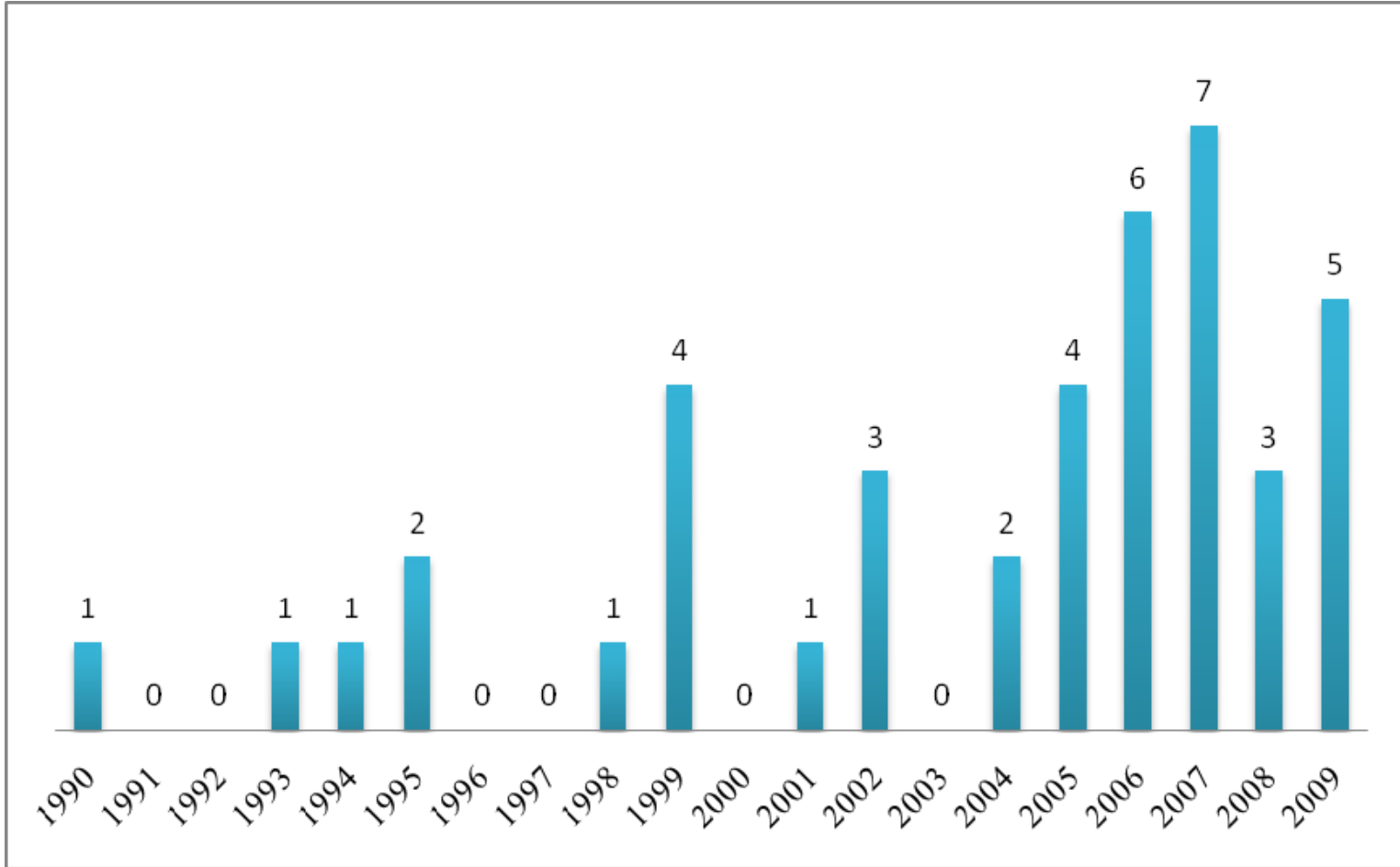


Figure 2-4  
*Dissertation and Thesis Publication by Year.*

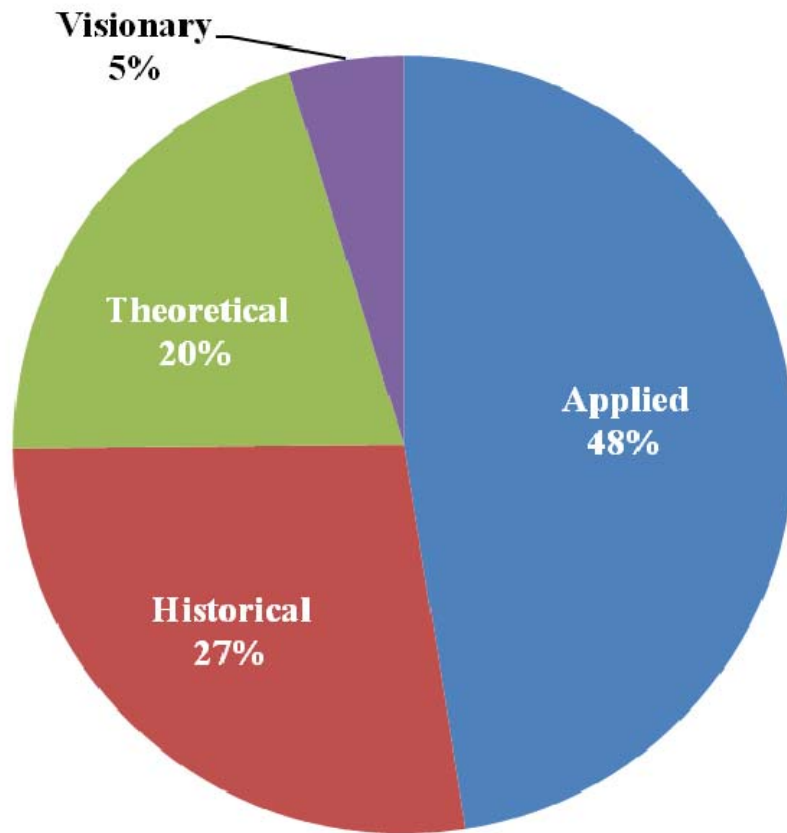


Figure 2-5  
*Proportion of Entertainment-Education Publications by Tone.*

The second classification criteria, research approach, inventoried literature by whether the study used a quantitative, qualitative, mixed methods, or quasi-experimental research design or if only a description of the results was reported (Figure 2-6). Qualitative or quantitative research designs dominate the field (46% and 38% respectively) with a few mixed methods or quasi-experimental approaches reported (2% and 1% respectively). Literature only providing results, usually in a narrative form composed 13% of the literature.

Lastly, coding for intervention genre (Figure 2-7) reveals a strong reliance on television and radio media to deliver health messages. Sixty-two percent of E-E interventions are delivered in the form of radio or television series plus an additional 16% delivered through a short run storyline spanning a limited number of episodes (one to four) in an existing (non-E-E) television series. E-E messages are primarily rooted in health education (Figure 2-8), comprising 60% of the target messages discussed in this body of literature. It should be noted that interventions whose target messages were not described by the publication authors were not included in this statistic; therefore there is a possibility that the number of interventions targeting health education could be higher.

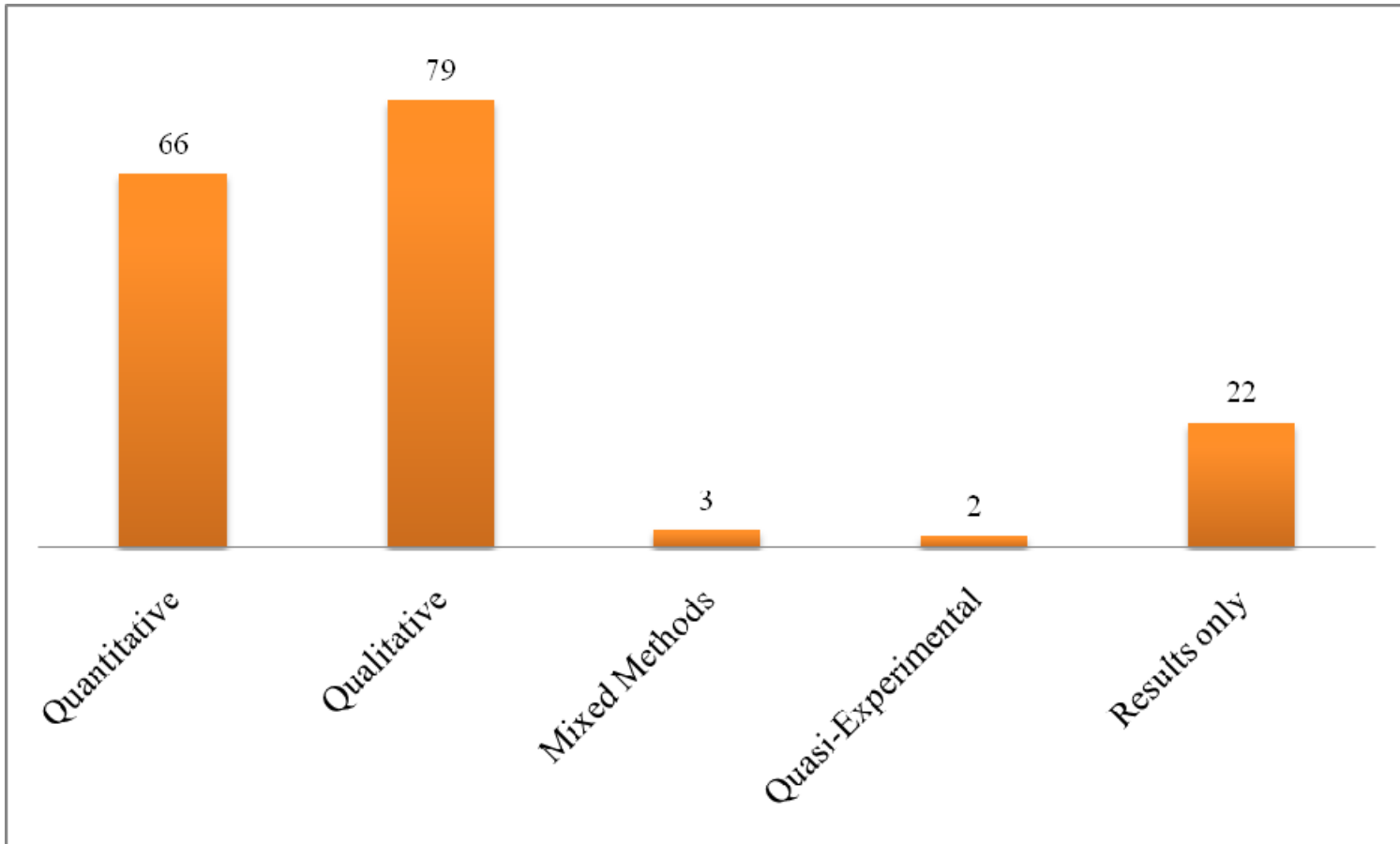


Figure 2-6  
*Frequency of Publications by Research Approach.*

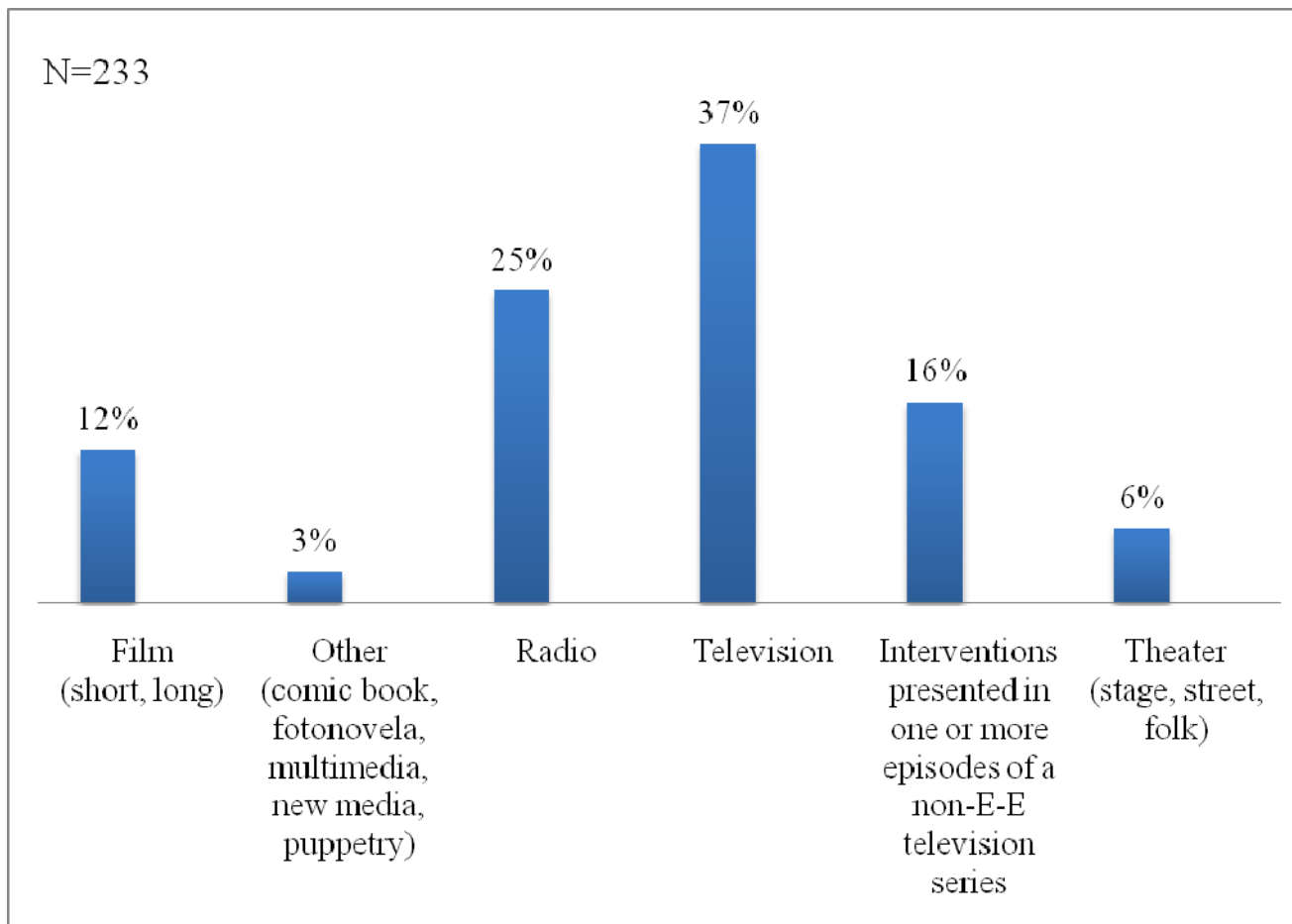


Figure 2-7  
*Proportion of Interventions by Genre.*



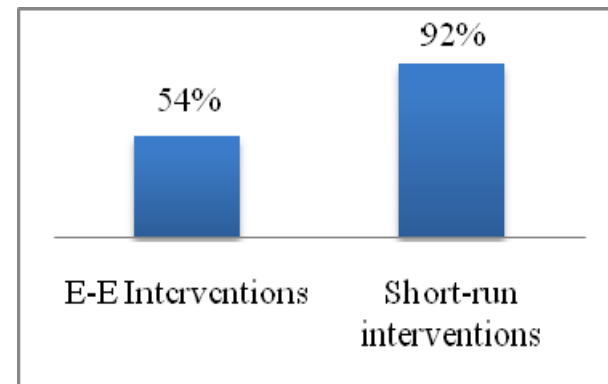
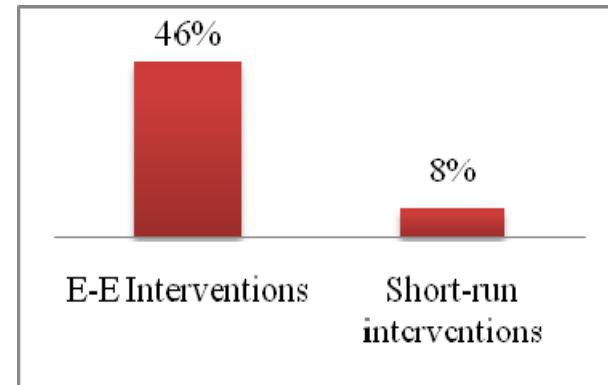
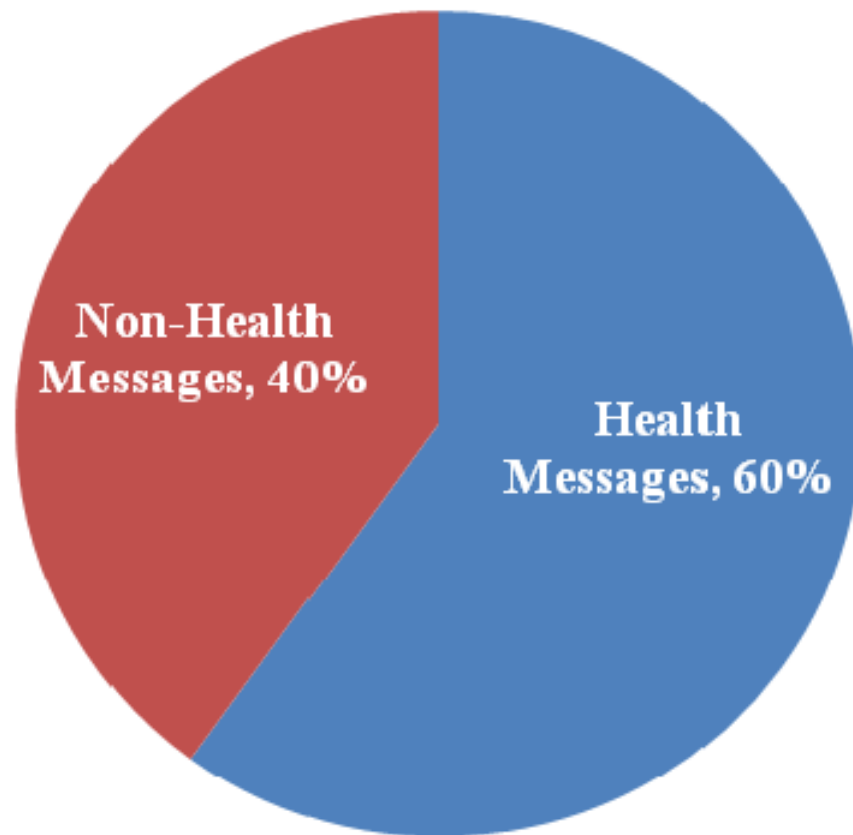


Figure 2-8  
 Messages in Entertainment-Education and Short-Run Interventions.

## Conclusions

As a result of this review, I offer the following suggestions to aid E-E researchers and the growth of the field:

1. *E-E researchers should use consistent terminology, specifically with the inclusion of the term “Entertainment-Education” and “E-E” as a key words when submitting articles for publication. Since it appears that “Entertainment-Education” and “E-E” have displaced other terms (e.g. edu-tainment, enter-education) as the field’s identifying labels, researchers should included these terms in the keyword section of the publication as well. This will aid search engines in identifying E-E specific publications.*
2. *Literature indexing database managers should update their index to utilize “Entertainment-Education” as a keyword associated with E-E literature. Since databases in this study returned all publications containing either the word “entertainment” or “education” in response to the keyword search of “Entertainment-Education”, it would appear that the hyphenated term is not currently recognized as a keyword, but rather as a combination of words producing irrelevant search results.*
3. *Information about film and television E-E interventions should be made available in a centralized Internet-based database. The field is a dynamic one which continues to grow as new interventions are developed. It is therefore important for scholars to have access to, and be able to contribute to the upkeep of, a database cataloging the interventions in the field, such as the one I created*

in this study. Existing resources such as the Internet Movie Database (IMDb) or Wikipedia could serve as the hosting venue. IMDb (IMDb.com, 2009) provides a searchable community-generated database of movies, television, and their cast and crew. Submission requests to have a title included in the database is free (free registration is required to access the submission form). I propose that E-E titles be tagged with “Entertainment-Education” keyword. In addition, episodes of television shows focusing on E-E storylines, e.g. healthy eating message “5 a Day” running across three episodes in season 10 of the U.S. medical drama *ER* (Episode 20: “Abby Normal”, Episode 21: “Midnight”, and Episode 22: “Drive”) should also be added, which is important for capturing E-E interventions targeting U.S. audiences. Alternatively, a Wikipedia (Wikipedia.com, 2010) page could be created specifically for E-E interventions, allowing for maintenance by the E-E scholarly community.

4. *The large gap in the body of literature resulting from research dominance of E-E in health communication presents an opportunity for the E-E methodology to be applied to other genres of learning besides health messages and behavior outcomes.* Teaching of academic subjects traditionally found in formal education (e.g. math, geography, science, etc.) represents fertile ground in which E-E can expand.

### **Index of Entertainment-Education Publications**

The resulting index of publications from this study is presented below. The numbers listed in each keyword category correspond to the bibliographic reference

found in Table 2-3 following the index. The companion catalogues of E-E interventions can be found in Table 2-4A and Table 2-4B and are cross-referenced by target country and primary topic.

**Activism, Activist, Advocacy** 3, 69, 70, 83, 93, 106, 121, 135, 160, 212, 242, 271, 278, 279, 280

**Adult education** 139

**Advertising technique** 44, 69, 168

**Affect** 84, 116

**Assessment (of interventions)** 39, 47, 75, 105, 114, 122, 141, 210, 216, 237, 253

**Attitudes** 7, 10, 50, 51, 58, 79, 81, 91, 116, 117, 133, 143, 156, 187, 192, 208, 242, 262, 263

**Values and behavior** 208

**Audience**

**Behavior** 111, 205

**Identification** 223, 229, 262, 263

**Involvement** 84, 167, 248, 249, 250

**Research** 87, 153, 272

**Response** 203

**Survey**

**Nielsen ratings** 107

**Frank N. Magid** 87, 272

**Television audience** 272

**Authenticity** 81

**Avatar** (in educational video games) 125

*see also* Simulation *or* Virtual Agent

**Behavior Change** 5, 41, 67, 68, 73, 88, 94, 110, 135, 170, 171, 206, 231, 250, 253, 278, 284

**Beliefs** 262, 263

**Bollywood** 241, 255

**Character education** 262, 263

**Child Brides** 224

**Children/Children's**

**Beliefs** 262, 263

**Television** 270

**Cognition** *see* Memory *or* Social cognition

**Cognitive**

**Change** 7, 25, 91

**Image mapping** 112

**Therapy** 104, 129

**Collaboration (between media and health industries)** 21, 23

**Collective space** 138

**Communication**

**Activism** 83

**Interpersonal** 70, 197, 248, 254

**Risk communication** 135

**Science communication** 157

**Strategies** 60, 219

## **Community**

**-based** 75, 247

**-level change** 197

**Listening** 163, 237

**Listening groups** 253

**Theater** 86

**Complex Systems** 215

**Composition** *see* Rhetoric

**Comprehension** 82

*see also* Cognition *or* Memory

## **Computerized**

**Decision Support System (CDSS)** 97

**Patient Decision Aid (CPtDA)** 96

## **Consumer**

**Behavior** 69, 153

**Survey** 153

**Continuing Education** 139

**Country**

*see also* Region

**Bangladesh** 35, 46, 54, 66, 89, 90, 211

**Beliz** 176

**Bolivia** 46

**Botswana** 73, 74, 109, 133, 156, 164, 199

**Brazil** 46, 118, 212, 213, 214

**Cambodia** 134

**Cameroon** 49

**Canada** 39, 61

**China** 11, 190, 282

**Colombia** 7, 46, 155

**Costa Rica** 228

**Cuba** 46

**Ecuador** 46

**Egypt** 1, 46, 211

**El Salvador** 46, 256

**England** 29

*see also* Region – United Kingdom

**Ethiopia** 13, 41, 45, 67, 73, 74, 123, 177, 192, 245, 246, 288

*see also* Rural – Ethiopia

**Finland** 186

**Gambia** 280

**Ghana** 73, 74, 159

**Guatemala** 46, 220

**Guyana** 37

**Haiti** 139

**Honduras** 46

**India** 11, 16, 25, 29, 32, 33, 46, 57, 59, 75, 82, 83, 89, 109, 122, 160, 161, 162, 163, 167, 175, 188, 190, 201, 210, 211, 212, 213, 214, 215, 216, 219, 220, 224, 225, 228, 229, 231, 232, 235, 236, 237, 242, 244, 248, 249, 251, 252, 254, 255, 278, 281, 287

*see also* Rural – India

**Indonesia** 29, 46, 206, 211, 228, 258, 259

**Israel** 81, 130, 211

**Jamaica** 29, 37, 211, 228, 229, 235

**Japan** 29, 205, 238, 239, 265

**Kenya** 4, 29, 33, 46, 114, 126, 211, 228, 229, 235, 236

**Kiribati, Republic of** 46

**Korea** 8, 9, 10, 46, 124

**Madagascar** 46

**Mali** 46

**Mexico** 11, 32, 33, 46, 169, 175, 182, 211, 214, 229, 236, 238, 242, 244

**Ciudad Juarez (City of Juarez)** 169



**Nepal** 46, 58, 89, 128, 150, 253, 260, 261, 262, 263

**Nicaragua** 44, 119

**Nigeria** 5, 33, 36, 46, 120, 178, 211

**Pakistan** 89, 258, 259

**Peru** 46, 190, 205, 211, 214, 218, 223, 229, 232, 235, 238, 242, 256, 280, 287

**Philippines, The** 44, 46, 209, 280

**Russia** 92

**Rwanda** 61, 158

**Senegal** 46

**Solomon Islands** 46

**South Africa** 46, 47, 68, 82, 162, 212, 213, 214, 225, 229, 231, 240, 268, 269,  
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**South Korea** 98

**Spain** 91

**Sri Lanka** 46, 253

**St. Lucia** 231, 276

**Sudan** 80

**Tanzania** 40, 46, 74, 82, 106, 142, 151, 187, 191, 229, 235, 242, 244, 253, 264,  
266, 267, 273, 274, 275, 277, 280, 287

**Thailand** 84, 132, 195, 196, 239

**The Netherlands** 19, 20, 21, 22

**Turkey** 189, 211, 291

**United States of America** 14, 29, 37, 39, 43, 51, 52, 53, 55, 57, 60, 63, 65, 69, 70, 71, 76, 77, 79, 82, 86, 87, 96, 97, 99, 100, 101, 103, 104, 105, 106, 107, 108, 109, 113, 116, 117, 121, 125, 131, 134, 136, 141, 143, 144, 145, 146, 148, 149, 153, 156, 165, 166, 168, 179, 181, 184, 186, 187, 188, 194, 198, 203, 207, 208, 211, 229, 231, 235, 242, 272, 279, 281, 284, 285, 286, 287, 290

**California** 186

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**Pennsylvania**

**Philadelphia** 241

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**Zambia** 74

**Zimbabwe** 29, 37, 72, 73, 74, 110, 211, 253, 280

**Cross Cultural** 116, 196

**Crowd** 158

**Cultural**

**Change** 269

**Context** 72, 290

**Proximity** 238

**Shareability** 195, 196, 238, 239

**Studies** 116, 198

**Culture** 58, 63, 64, 70, 72, 75, 85, 89, 112, 137, 178, 196, 235, 238, 258, 265

**Curriculum** 33, 68, 139

**Decision aids** 95, 96, 279

**Developing countries** 15, 26, 32, 126, 128, 140, 202, 211, 232, 236, 258

**Development Communication** 3, 89, 126, 140, 201, 258, 280

**Disabilities/Disabled** 262, 263

**Disease**

**Control** 75, 177, 284

**Prevention** 114, 123, 133, 186

**Dissent** 158

**Dissertation** 7, 19, 36, 55, 62, 68, 86, 92, 99, 104, 107, 113, 114, 117, 123, 125, 129, 131, 146, 151, 155, 157, 160, 166, 176, 182, 198, 200, 208, 211, 248, 256, 257, 263, 286, 290

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**Psychology** 125

**Technology** 68, 125

**Edutainment** 39, 95, 97, 151, 172, 268, 279

**Efficacy** 47, 60, 79, 84, 86, 99, 108, 113, 114, 122, 123, 125, 132, 162, 163, 181, 191, 229, 231, 235, 237, 245, 248, 249, 250, 263, 286

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**Empowerment** 160, 212, 213, 289

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**Ethical dilemma (of Entertainment-Education)** 34

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**Fear** 41, 98, 288

**Feminism** 119, 138, 200, 201

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**-tale** 255

**Media** 89

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**Theater** 75**Forum theater** 212, 213**Freirean pedagogy** 212**Games****Board** 113**Digital** 281**Serious** 99, 281**Video** 125, 180**Gender** 116, 160**and Development (GAD)** 200, 201**Equality** 137, 188, 216, 230**Genocide** 158**Giroux** 198**Globalization** 12, 59**Health****Behavior** 60 65, 66, 69, 120, 133, 150, 278**Beliefs** 47, 68, 98, 99, 108, 114, 123, 250, 278, 286**Communication** 1, 5, 13, 19, 20, 23, 39, 48, 51, 53, 57, 60, 70, 71, 75, 76, 81, 88, 96, 101, 110, 115, 131, 132, 136, 138, 141, 145, 147, 148, 150, 154, 165, 170, 173, 186, 189, 194, 199, 203, 206, 246, 251, 277, 279, 283, 288**Disparities** 70

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**Genre**

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**Cell phone** 61, 101

**Comic Book** 79, 137, 169, 184, 192

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**Cinema (feature, short)**

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*Angel Baby* 179

*At Dance* 91

*Bor Holo, Dor Kholo* 35, 211

*Earlier Yet Later* 91

*Heartlines* 68

*Iron Film* 289

*Karate Kids* 195, 196, 231

*Meena* 137, 231

*Moolaade* 80

*Passion of the Christ, The* 28

*Phir Milenge* 241, 255

*Red Card: Sammy's Final Match* 114

*Shared Hope* 289

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*Sonamoni* 211

*Starting Over* 120

*Warrior Marks* 80

*Yellow Card* 23, 36

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*Meet the Montoyas* 184

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**Mobile delivery (mobisodes)** 61

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*Journey of Life* 6, 41, 67, 123, 177, 245, 288

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*Lilin-Lilin di Depan* 6

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*Accompaname* 11, 33, 211, 232, 236, 238, 242

*Aik Hi Rastha* 259

*Akarumwaa Nechekuchera* 6, 29, 37, 211

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*Ana Zananna* 1, 211

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*Baixing* 11, 190

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*Cock Crow at Dawn* 33, 211

*Costa!* 20, 227

*Crossroads* 141

*Damakegne ou la Juste Mesure* 6

*East Enders* 42

*El Carruaje* 232

*El Combate* 232, 238

*Face to Face* 4

*Family House, The* 1

*Haath Se Haath Milaa* 235, 251, 254

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211, 228, 229, 231, 232, 235, 236, 242, 244, 252

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*Kembang untuk Nur* 6, 206

*Khushi Ko Sansar* 262, 263

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*La Tormenta* 222, 232

*Lacos de Familia* 118

*Ladrón de Corazones* 285

*Lazos de Sangre* 214

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Table 2-4A

*Entertainment-Education Interventions Alphabetized by Title.* Entertainment products designed specifically to teach a target concept or communicate a specific message (short run Entertainment-Education storylines in existing television programs are provided in Table 2-4B).

Title	English Translation	Country	Start Year	Media	Genre	Target Message
		Canada	1927	radio	drama	history; geography
		Canada	1939	radio	drama	agriculture
	Earlier yet later	France		short film	drama	HIV/AIDS education
	At dance	Spain		short film	drama	HIV/AIDS education
<i>A Child Is Crying There</i>		Turkey		television	documentary	family planning
<i>A Family History</i>		Appalachian region, United States		theater	one-act plays	diabetes
<i>A Flat in Downtown</i>		Egypt		film	drama	pro-social

Table 2-4A (continued)

Title	English Translation	Country	Start Year	Media	Genre	Target Message
<i>A Rainha do Sucata</i>	The Rubbish Queen	Brazil				
<i>A Story about Toni, Mike, and Valerie</i>		USA		multi-media	soap opera	HIV/AIDS education
<i>A Woman in Transition</i>		USA	2000	theater	drama	breast cancer
<i>Aahat</i>	An approaching sound	Pakistan	1992	television	drama	family planning
<i>Accompaname</i>	Accompany me	Mexico	1977	television	telenovela	family planning
<i>AIDS: The Hidden Enemy</i>		Tanzania		film	drama	HIV/AIDS education
<i>Aik Hi Rastha</i>	The only way	Pakistan	1993	television	drama	gender equality
<i>Akarumwa Nehekuchera</i>	Man is his own worst enemy	Zimbabwe	1988	radio	drama	family planning

Table 2-4A (continued)

Title	English Translation	Country	Start Year	Media	Genre	Target Message
<i>Alam Simsim</i>	(Egyptian version of Sesame Street)	Egypt	2000	television	children's	education
<i>Alang-Alang</i>	Wild grass	Indonesia	1994	television	drama	promoting education of female children
<i>Amakhosi</i>		Zimbabwe		radio	drama	family planning
<i>Amra Dujon</i>		Bangladesh		film	drama	family planning
<i>Ana Zananna</i>	I am grouchy	Egypt	1988	television	spot campaign	family planning
<i>Andrea: Time for Love</i>		Peru	1998	television	telenovela	sexual responsibility
<i>Angel Baby</i>		Australia	1995	film	drama	schizophrenia
<i>Apwe Plezi</i>	After the pleasure comes the pain	St. Lucia	1996	radio	soap opera	HIV/AIDS education; gender equality; domestic violence
<i>Archers, The</i>		United Kingdom	1951	radio	soap opera	agriculture
<i>Ashreat Al Amal</i>	Sails of hope	Sudan		radio	drama	reproductive health

Table 2-4A (continued)

Title	English Translation	Country	Start Year	Media	Genre	Target Message
<i>Ashreat Al Mal</i>		Sudan		radio		female genital cutting
<i>Aurat</i>	Woman	India		theater	drama	theater for empowerment
<i>Baixing</i>	Ordinary people	China		television	drama	gender equality
<i>Berdel</i>		Turkey		film	drama	equality of girls
<i>Bhoma</i>		India		theater	drama	theater for empowerment
<i>Bienvenida Salud!</i>	Welcome to health!	Peruvian Amazon	1997	radio	drama	family planning
<i>Bodylove</i>		USA		radio	drama	diabetes education
<i>Bor Holo, Dor Kholo</i>	It's dawn, open your door	Bangladesh		film	drama	literacy
<i>But Mother...</i>		Turkey		television	drama	family planning
<i>Butir Butir Pasir Di Laut</i>	Grains of sand in the sea	Indonesia	1977	radio	soap opera	family planning
<i>Caminemos</i>	Let's walk together	Mexico	1980	television	telenovela	sexual responsibility

Table 2-4A (continued)

Title	English Translation	Country	Start Year	Media	Genre	Target Message
<i>Changing the Rules</i>		USA	1980s	film		HIV/AIDS education
<i>Chuyen Que Minh</i>	My homeland	Vietnam	2004	radio	soap opera	integrated pest management
<i>Cock Crow at Dawn</i>		Nigeria	1980	television	soap opera	pro-development
<i>Consequences</i>		Zimbabwe	1988	film	drama	teen pregnancy
<i>Costa!</i>		The Netherlands		television	soap opera	health education
<i>Cuando Estemos Juntos</i>	When we are together			television	rock music video	abstinence
<i>Cut Your Coat According to Your Cloth</i>		Nepal	1994	radio	drama	family planning
<i>Damakegne ou la Juste Mesure</i>		Mali		television	drama	family planning
<i>Dehleez</i>	Threshold	India		radio	soap opera	teen issues
<i>Designated Driver Campaign</i>		USA	1988	campaign		drunk driving

Table 2-4A (continued)

Title	English Translation	Country	Start Year	Media	Genre	Target Message
<i>Dhimbiba</i>	Getting the best out of life	Ethiopia		radio	drama	
<i>DramAidE</i>		South Africa		theater	drama	HIV/AIDS education
<i>Dulcimina</i>		Jamaica	1967	radio	soap opera	social issues
Egyptian ORT campaign, The		Egypt	1983	television	spot campaign	oral rehydration therapy
<i>Eighth Day of the Week</i>		USA	1995	theater	drama	Alzheimer education
<i>El Asesino Invisible</i>	Invisible assassin	Mexico		comic book	drama	carbon monoxide poisoning education
<i>El Carruaje</i>	The carriage	Mexico	1970	television	telenovela	Benito Juarez and struggle for Mexico's freedom
<i>El Combate</i>	The battle	Mexico	1980	television	telenovela	literacy
<i>El Regalo de Salud</i>	Gift of health	USA		radio	spot campaign	nutrition
<i>El Sexto Sentido</i>	The sixth sense	Nicaragua		television	telenovela	



Table 2-4A (continued)

Title	English Translation	Country	Start Year	Media	Genre	Target Message
<i>Enfrentate</i>	Stop and think	USA		radio	soap opera	sexual responsibility
<i>Equatorial Trilogy</i>		Indonesia	1993	television	drama	family planning
<i>Face to Face</i>		Kenya		television		national development
<i>Fakube Jarra</i>	Wise man	Gambia		radio	drama	family planning
<i>Famili Blong Serah</i>	Sarah's family	Vanuatu	2000	radio	drama	social issues
<i>Family House, The</i>		Egypt	1992	television	drama	health education
<i>Family Oudenriijn</i>		The Netherlands	1987	television	comedy	road safety and environment
<i>Forewarned is Foretold</i>		Zimbabwe		radio		family planning
<i>Gaon Se Shahar Tak</i>	From village to city	India		theater	drama	Theater for Empowerment
<i>Ghaanti Heri Haad Nilaun</i>	Bite only what you can swallow	Nepal	1995	radio	drama	

Table 2-4A (continued)

Title	English Translation	Country	Start Year	Media	Genre	Target Message
<i>Haath Se Haath Milaa</i>	Hand in hand together	India		television	reality tv	HIV/AIDS prevention
<i>Handle with Care?</i>		Canada	1998	television	drama	breast cancer
<i>Hatyaare</i>	Killers	India		theater	drama	Theater for Empowerment
<i>Hawwa Ki Beti</i>	Daughter of Eve	Pakistan			soap opera	pro-development
<i>Heart and Soul</i>		Kenya	2002	multiple	soap opera	
<i>High Stakes</i>		Brazil			soap opera	alcoholism
<i>Hillcrest</i>		United Kingdom		radio		
<i>Hope Was Always There</i>		Turkey		television	drama	family planning
<i>Hopeful Village</i>		Jamaica	1963	radio	soap opera	integrated rural development
<i>Hum Log</i>	We people	India	1987	television	soap opera	gender equality
<i>Hum Raahi</i>	Fellow Travelers	India		television	soap opera	family planning

Table 2-4A (continued)

Title	English Translation	Country	Start Year	Media	Genre	Target Message
<i>Humraahi</i>	Come along with me	India	1992	television	soap opera	status of women
<i>Immersion Institute's Exploration: Sea Lions</i>		USA		film	immersive	science education
<i>In a Lighter Mood</i>		Nigeria	1986	radio	drama	family planning
<i>Iron Will</i>		Sahel region, Africa		short film	drama	HIV/AIDS prevention; condom use
<i>It's Not Easy</i>				film	drama	HIV/AIDS education
<i>Jan Natya Manch</i>	People's Theater Forum	India		street theater	drama	
<i>Jasoos Vijay</i>	Detective Vijay	India		television	drama	HIV/AIDS education
<i>Jeevan Saurabh</i>	Fragrance of Life	India	1988	radio	drama	teen issues
<i>Journey of Life</i>		Ethiopia	2001	radio	drama	HIV/AIDS education

Table 2-4A (continued)

Title	English Translation	Country	Start Year	Media	Genre	Target Message
<i>Kalajatha</i>		India		performance	drama	malaria control
<i>Karate Kids</i>		Thailand		film	drama	HIV/AIDS education
<i>Ke Wang</i>	Aspirations	China	1990	television	soap opera	social issues
<i>Kembang untuk Nur</i>	Flower for Nur	Indonesia	1999	television	mini-series	maternal mortality
<i>Khushi Ko Sansar</i>	Happy world	Nepal	2008	television	children with disabilities	disabilities
<i>Koko Close</i>		Nigeria		television	drama	
<i>Kotebra</i>		Mali				
<i>La antorcha encendida</i>		Mexico		television	soap opera	history of Mexico
<i>La Constitucion</i>	The constitution	Mexico	1969	television	telenovela	Mexico's constitution
<i>La Tormenta</i>	The storm	Mexico	1967	television	telenovela	French invasion of Mexico
<i>Lacos de Familia</i>		Brazil		television	telenovela	health education
<i>Ladrón de Corazones</i>		USA		television	telenovela	breast cancer
<i>Lawsons, The</i>		Australia	1944	television	drama	

Table 2-4A (continued)

Title	English Translation	Country	Start Year	Media	Genre	Target Message
<i>Lazos de Sangre</i>	Blood ties	Brazil		television	soap opera	
<i>Life at the Mimosa Hotel</i>		Jamaica	1984	radio	soap opera	promote tourism
<i>Life Challenge</i>		USA		new media	computer game	HIV/AIDS education
<i>Lilin-Lilin di Depan</i>		Indonesia	1999	radio	drama	maternal mortality
<i>Los Caudillos</i>	The leaders	Mexico	1968	television	telenovela	Mexican struggle for independence
<i>Los Hijos de Nadie</i>	The children of nobody	Mexico		television	telenovela	plight of street children
<i>Lotus on Muddy Lake</i>		Cambodia	1999	radio	soap opera	HIV/AIDS prevention
<i>Love in Jail</i>		Egypt		film	drama	pro-social
<i>Lucille</i>		Appalachian region, United States		theater	one-act plays	diabetes in Appalachian region of the U.S.
<i>Machine</i>		India		theater	drama	Theater for Empowerment

Table 2-4A (continued)

Title	English Translation	Country	Start Year	Media	Genre	Target Message
<i>Maisha</i>	That's Life	Tanzania	2000	television	drama	HIV/AIDS education
<i>Makgabaneng</i>	A rocky place	Botswana	2001	radio	soap opera	HIV/AIDS education
<i>Malhacao</i>		Brazil	1995	television	telenovela	teen issues
<i>Mama Olu</i>		Nigeria		television	spot campaign	
<i>McSpoons Family, The</i>		USA		puppetry	drama	reduce television viewing time of families
<i>Medisch Centrum West</i>		The Netherlands		television	drama	health education
<i>Meena</i>		South Asia		film	animated	gender equality
<i>Meet the Montoyas</i>		USA		Internet	fotonovela	diabetes education
<i>Meu Bem Querido</i>	My sweetheart	Mexico		television	telenovela	
<i>Moolaade</i>			2004	film	drama	female genital cutting
<i>Mopani Junction</i>		Zimbabwe		radio	drama	HIV/AIDS education

Table 2-4A (continued)

Title	English Translation	Country	Start Year	Media	Genre	Target Message
<i>More Time</i>				film	drama	HIV/AIDS education
<i>Ms. Rumors</i>		South Africa		street theater	drama	family planning
<i>Mulero</i>		Nigeria		print		
<i>Mulher</i>	Women	Mexico		television	reality tv	
<i>Nalamdana</i>	Are you well?	India	1993	radio	soap opera	family planning
<i>Naseberry Street</i>		Jamaica	1985	radio	soap opera	family planning
<i>Neighbors</i>		Israel		television	comedy	Arab-Jewish friendship
<i>Neria</i>				film	drama	gender equality
<i>Never Too Late</i>		Thailand		radio	soap opera	religious education
<i>Nggimpyo!</i>	Exclamation mark	Korea	2004	television	drama	literacy
<i>Nijaat</i>	Deliverance	Pakistan	1993	television	drama	family planning
<i>Nosotras las Mujeres</i>	We the women	Mexico	1981	television	telenovela	status of women
<i>Nshilakamona</i>	I have not see it	Zambia	1991	radio	drama	HIV/AIDS education
<i>Nunl Dduhyo!</i>	Open your eyes!	Korea	2004	television	reality tv	organ donation

Table 2-4A (continued)

Title	English Translation	Country	Start Year	Media	Genre	Target Message
<i>Oppassen</i>		The Netherlands	1992	television	family comedy	environmental education
<i>Oshin</i>		Japan	1983	television	soap opera	
<i>Our Neighbors, Ourselves</i>		Burundi		radio	drama	
<i>Palm Tree Climber, The</i>		Egypt		television film	drama	Schistosomiasis prevention; pro-social
<i>Passion of the Christ, The</i>		USA		film	drama	religious education
<i>Perro Amor</i>	Puppy love	Colombia		television	telenovela	HIV/AIDS education
<i>Phir Milenge</i>	We will meet again	India		film	drama	HIV/AIDS education
<i>Polite Society</i>		Mexico			soap opera	sexual responsibility
<i>Por Amor</i>	For love	Mexico	1981	television	telenovela	family planning
<i>Que Mihn Xanh Mai</i>	Forever green my homeland	Vietnam	2006	radio	soap opera	environmental conservation



Table 2-4A (continued)

Title	English Translation	Country	Start Year	Media	Genre	Target Message
<i>Que Pasa, USA?</i>		USA	1978	television	drama	English and Spanish language
<i>Radionovela da Camisinha</i>	Radio soap opera condom	Brazil		television	soap opera	HIV/AIDS prevention
<i>Raymond, the Sprayman</i>		Jamaica	1959	radio	soap opera	mosquito eradication
<i>Red Card: Sammy's Final Match</i>		Kenya	2003	film	drama	HIV/AIDS education
<i>Rruga MePisha</i>	Pine Street	Albania	1999	radio	soap opera	social issues
<i>Sangre Joven</i>	Young blood	Mexico	1990	television film	soap opera	family planning; AIDS; sexual responsibility; drug abuse
<i>Sauvons des Vies</i>		Mali		theater	drama	family planning
<i>Secret of Production</i>		Egypt		television		factory workers

Table 2-4A (continued)

Title	English Translation	Country	Start Year	Media	Genre	Target Message
<i>Secret of the Land</i>		Egypt	1989	television	situation comedy	agriculture
<i>Senda de gloria</i>		Mexico		television	soap opera	history of Mexico
<i>Service Brings Reward</i>		Nepal	1994	radio	serial	health care worker education
<i>Sexto Sentido</i>	Sixth sense	Nicaragua		television	soap opera	social change
<i>Shabuj Chaya</i>		Bangladesh	2000	television	drama	HIV/AIDS education
<i>Shared Hope</i>		Sahel region, Africa		short film	drama	HIV/AIDS prevention; condom use
<i>Shin Dong-Yub &amp; Nam Hee-Suk's Man II Man</i>		South Korea	2002	television	reality tv	
<i>Shop, The</i>		Sahel region, Africa		short film	drama	HIV/AIDS prevention; condom use
<i>SIDA dans la Cite</i>		Cote d'Ivoire		television	soap opera	HIV/AIDS education

Table 2-4A (continued)

Title	English Translation	Country	Start Year	Media	Genre	Target Message
<i>Simplemente Maria</i>	Simply Maria	Peru	1969	television	soap opera	
<i>Somos Diferentes, Somos Iguales</i>	We're different, we're equal	Nicaragua		multimedia	drama	social change
<i>Sonamoni</i>	Golden pearl	Bangladesh		film	drama	oral rehydration therapy
<i>Soul City</i>		South Africa	1994	radio and television	soap opera	health education
<i>Soul City IV</i>		South Africa	1999	radio and television	drama	domestic violence
<i>Sparrows Don't Migrate</i>		Turkey	1988	television	drama	family planning
<i>Starting Over</i>		Nigeria		film	drama	stigma
<i>Stella</i>		Jamaica	1967	radio	murder mystery	social issues
<i>Sterling Towers</i>		India		television	drama	HIV/AIDS education
<i>Suami SIAGA, The</i>	I'm an alert husband	Indonesia	1999			maternal mortality

Table 2-4A (continued)

Title	English Translation	Country	Start Year	Media	Genre	Target Message
<i>Sugar Bear</i>		Appalachian region, United States		theater	one-act plays	diabetes in Appalachian region of the U.S.
<i>Sugar Plays, The</i>		Appalachian region, United States		theater	one-act plays	diabetes in Appalachian region of the U.S.
<i>Super Book</i>		Russia		television	animated	religious education
<i>Taru</i>		India	2002	radio	soap opera	family planning
<i>Tembea Na Majira</i>	Move with the times	Kenya	1996	radio	soap opera	social issues
<i>Tinka Tinka Sukh</i>	Happiness lies in small things	India	1996	radio	soap opera	family planning
<i>Torre de Babel</i>	Tower of Babel	Mexico		television	telenovela	
<i>Tres hombres Sin Fronteras</i>	Three men without borders	USA	1990	radio	soap opera	HIV/AIDS education
<i>Tsha Tsha</i>		South Africa		television	drama	pro-social
<i>Tushauriane</i>	Let's discuss	Kenya	1987	television	soap opera	family planning

Table 2-4A (continued)

Title	English Translation	Country	Start Year	Media	Genre	Target Message
<i>Twaalf Steden, Dertien Ongelukken</i>		The Netherlands	1990	television	docu-drama	traffic safety
<i>Twende na Wakati</i>	Let's go with the times	Tanzania	1993	radio	soap opera	family planning
<i>Uga Uga</i>		Brazil		television	telenovela	
<i>Umubanyi Niwe Muryango</i>	Our neighbours, ourselves	Burundi		radio	soap opera	peaceful co-existence
<i>Un Mensaje a la Conciencia</i>	A message to the conscience	El Salvador	1964	radio		moral and spiritual messages
<i>Urunana</i>		Rwanda	1999	radio	soap opera	HIV/AIDS education
<i>Ushikwapo Shikamana; Ushikwapo Shikimana</i>	When given advice, take it; If assisted, assist yourself	Kenya	1987	radio	soap opera	family planning
<i>Vagina Monologues, The</i>		USA		theater	drama	violence against women

Table 2-4A (continued)

Title	English Translation	Country	Start Year	Media	Genre	Target Message
<i>Vamos Juntos</i>	When we are together	Mexico	1979	television	telenovela	responsible parenting
<i>Ven Conmigo</i>	Come with me	Mexico	1975	television	telenovela	literacy
<i>Villa Borghese</i>		The Netherlands		television	soap opera	health education
<i>Villa Madalena</i>		Brazil		television	telenovela	
<i>Warrior Marks</i>		Africa, multiple countries	1993	film	drama	female genital cutting
<i>Way of Life Show</i>		The Netherlands	1988	television	sports game show	health education
<i>What the Sea Says</i>		Egypt		film	musical	pro-social
<i>Wila/Yawa Kasta</i>	Ancestral bloodline	Bolivia		radio	drama	HIV/AIDS prevention
<i>Yamba-Songo: Les Cles de la Vie</i>	Keys to life	West Africa	1997	radio	drama	social issues
<i>Yeh Kahan Aa Gaye Hum</i>	Where have we arrived?	India		radio	soap opera	environmental education
<i>Yeken Kignit</i>	Looking over one's daily life	Ethiopia	2002	radio	drama	reproductive health

Table 2-4A (continued)

Title	English Translation	Country	Start Year	Media	Genre	Target Message
<i>Yellow Card</i>		Africa, multiple countries		film	drama	sexual responsibility
<i>Yo Amo a Paquita Gallego</i>	I love Paquita Gallego	Colombia		television	telenovela	HIV/AIDS education
<i>Youth for Real</i>		Zimbabwe		performance	drama	HIV/AIDS education
<i>Zeg eens A</i>		The Netherlands		television	soap opera	health education
<i>Zimachitika</i>	Such is life	Malawi	1997	radio	soap opera	social issues
<i>Zinduka!</i>	Wake up!	Tanzania	1991	radio	drama	family planning

Table 2-4B

*Short Run Entertainment-Education Storylines in Existing Television Programs.*

Title	Episode Name (provided by source publication)	Country	Medium	Genre	Storyline subject
<i>7th Heaven</i>		USA	television	drama	immunization
<i>All in the Family</i>		USA	television	situation comedy	prejudice
<i>All My Children</i>		USA	television	soap opera	bone marrow donation
<i>Beverly Hills, 90120</i>		USA	television	drama	skin cancer
<i>Bold and the Beautiful, The</i>		USA	television	soap opera	HIV/AIDS education
<i>Chicago Hope</i>		USA	television	drama	immunization
<i>Crossroads</i>		USA	television	drama	health education
<i>CSI: NY</i>		USA	television	drama	organ donation
<i>Days of Our Lives</i>		USA	television	soap opera	immunization
<i>ER</i>		USA	television	drama	immunization
<i>ER</i>	"You don't cut into cancer"	USA	television	drama	breast cancer
<i>ER</i>		USA	television	drama	syphilis
<i>ER</i>		USA	television	drama	cervical cancer
<i>ER</i>	"Man with no name"	USA	television	drama	breast Cancer
<i>General Hospital</i>		USA	television	soap opera	breast cancer
<i>Girlfriends</i>		USA	television	situation comedy	HIV/AIDS education



Table 2-4B (continued)

Title	Episode Name (provided by source publication)	Country	Medium	Genre	Storyline subject
<i>Goode Behavior</i>		USA	television	situation comedy	immunization
<i>Grey's Anatomy</i>		USA	television	drama	organ donation
<i>Grey's Anatomy</i>	"Let it be"	USA	television	drama	breast cancer
<i>Growing Pains</i>		USA	television	situation comedy	drunk driving
<i>Guiding Light</i>		USA	television	soap opera	immunization
<i>Happy Days</i>		USA	television	situation comedy	get a library card
<i>High Incident</i>		USA	television	drama	immunization
<i>House</i>		USA	television	drama	organ donation
<i>John Laroquette Show, The</i>		USA	television	situation comedy	immunization
<i>Maude</i>		USA	television	situation comedy	abortion
<i>Mr. Rogers' Neighborhood</i>		USA	television	children's television	immunization
<i>My Two Dads</i>		USA	television	situation comedy	drunk driving
<i>Nick Freno</i>		USA	television	drama	immunization
<i>Numb3rs</i>		USA	television	drama	organ donation
<i>NYPD Blue</i>		USA	television	drama	prostate cancer
<i>OC, The</i>		USA	television	drama	teen pregnancy
<i>Sabrina the Teenage Witch</i>		USA	television	situation comedy	immunization
<i>Savannah</i>		USA	television	drama	immunization
<i>Sesame Street</i>		USA	television	children's	education

Table 2-4B (continued)

Title	Episode Name (provided by source publication)	Country	Medium	Genre	Storyline subject
<i>Step by Step</i>		USA	television	situation comedy	immunization
<i>thirtysomething</i>		USA	television	drama	breast cancer
<i>Young and the Restless, The</i>		USA	television	soap opera	breast cancer

## CHAPTER III

### MANUSCRIPT #2:

#### DEVELOPMENT OF THE ABEE MODEL

##### **Introduction**

The use of popular culture tools for education is not a new concept (Apple & Apple, 1993; Barbara, 2007; Engstrom, 1995; Hinds, 1991; Lacayo & Singhal, 2008; Morgan, 2001). Americans growing up in the 1970s may remember the popular Saturday morning cartoon series *Schoolhouse Rock* (Yohe, 1973) teaching a variety of concepts from how adverbs work in a sentence to how a legislative bill is made into law. Others may remember the 1990s PBS game show *Where in the World Is Carmen Sandiego?* (Blumenthal, Curley, & Calderwood, 1991) focusing on basic geography knowledge, e.g. world capitals and landmarks. Examples like these may qualify as Entertainment-Education (E-E) since they are forms of entertainment developed with the intention to teach, however in a review of literature indexed in scholarly databases (Simms, 2010a) no articles about either of these shows were found when queried using the keyword “Entertainment-Education.” This absence may be explained by the traditional focus of E-E researchers and practitioners on communicating health messages and illustrates the gap in research which the present article seeks to address.

Regardless of the message, the power of E-E resides in its ability to present positive and negative role models to influence viewers in the adoption of activities impacting their health. This ability is facilitated through the power of narrative to touch

human emotions and resonate through identifiable characters (Singhal, Cody, et al., 2004b). Originally informed by Bandura's Social Learning Theory and its second generation Social Cognitive Theory (SCT), E-E utilizes role-modeling as a trigger for learning (Bandura, 2004) or as Slater (2002) characterizes it, through persuasion and social influence to explain the influential force of E-E to impact behavior in viewers. Behavioral change is beyond the scope of the present discussion but the connection between mechanisms for behavioral change theories and education research in learning theories would be an important area for future research. Instead, I wish to build upon current approaches of E-E to expand into the realm of academic learning by analyzing a successful entertainment product that comes close to the definition of E-E geared towards academic learning. This analysis is used to form a model for Academically-based Entertainment-Education (ABEE). To begin, I provide a background of E-E. Next, I introduce the development of the ABEE model through a grounded theory approach analyzing a successful television series that integrated mathematic concepts into its narrative engine.

### **Background of Entertainment-Education and Use in Geography Education**

#### ***Non-formal environment supporting formal education***

Both informal and non-formal education serve as vehicles for life-long learning (La Belle, 1982). Currently, the terms are used interchangeably; however it should be noted that there is differentiation between the terms. Informal education can be defined as learning that takes place outside of the structured classroom environment and in incidental day-to-day experiences (Scibner & Cole, 1973; M. Smith, 2005; M. K. Smith,

2001). Non-formal education composes the more intentional learning experiences one might find in museums or other entertainment-based venues (M. Smith, 2005; M. K. Smith, 2001). Using these definitions, an example of informal education may be found in a child accompanying a parent on a fishing trip and learning how to cast a line as they talk about life. Non-formal education examples related to geography may be found in the National Geographic cable television network (National Geographic, 2009), which provides programming primarily in a documentary-styled format. The recently announced Internet-delivered program *Geospatial Revolution* (Penn State Public Broadcasting, 2009) appears to follow in similar style by leading the viewer through an exploration of the technology and impact of geospatial technologies on current and future lives. On the other end of the program format spectrum are children's shows such as *Dora the Explorer* (Madden, Conrad, McWane, & Chialtas, 2000) and *Where in the World is Carmen Sandiego?* (Blumenthal, Curley, & Calderwood, 1991), both of which ended production years ago. Programs such as these present a single-dimensional treatment of geography education with the former delving into spatial vocabulary (such as near vs. far, inside vs. outside, etc.) and the latter presenting what one might remember from middle school geography such as the capitals of countries and their exports.

Despite efforts by geography education researchers to move school geography in the United States beyond rote memorization of place names and disconnected facts, a movement begun by Arnold Guyot in the late 1800s, the trend has not translated to non-formal venues as evidenced by programs such as *Carmen Sandiego* or the televised

*National Geography Bee* competition. In my opinion, there is a critical need for examples of full spectrum geography which demonstrate how what happens “over there” affects what happens “here.” Without the context provided by the principles of patterns and processes that are the life blood of the discipline, learning experiences become dry, dull, and utterly forgettable. Packaging geography education in a game show or a TV cartoon does build into the experience some level of engagement, but what if we could engage students – either child or adult, traditional or life-long learner – with geography concepts (or concepts from any academic discipline) in a deeper way? What if a tool existed to impact geographic literacy at a societal scale? The field of Entertainment-Education (E-E) has the potential to provide just that. Instead of telling a story *about* a subject, person, or phenomenon, such as in documentary-styled offerings or carrying the more traditional instructional feel of the children’s educational genre, E-E turns these approaches inside out and weaves an educational message into and throughout a fictional narrative. In other words, the story is not about the concept, serving solely as story context. Instead, the concept *drives* the story and serves as the story’s engine. With a prior emphasis of E-E in impacting behavior of intended audiences, academic concepts have not been a focus of the field. Therefore, the driving question for the present discussion revolves around the question, “How might Entertainment-Education be used to teach academic subjects?”

### ***Entertainment-Education (E-E)***

As a specific form of non-formal education, Entertainment-Education (E-E) has been used as a strategy in numerous countries and regions around the world to educate

viewers on concepts impacting a variety of social problems. For example, E-E interventions have been used to promote family planning in Tanzania (Poindexter, 2004) and Pakistan (Piotrow & de Fossard, 2004); to reduce infant mortality rates due to dehydration in Egypt (R. A. Abdulla, 2004); to model a non-confrontational intervention to stop instances of domestic violence in South Africa (Usdin, Singhal, Shongwe, Goldstein, & Shabalala, 2004); and to promote gender equality in countries throughout southeastern Asia (NcKee, Aghi, & Shahzadi, 2004; Singhal, Sharma, Papa, & Witte, 2004). In most cases to date, E-E interventions have been in the form of radio or television soap operas centered on the target message, however, the examples available in the literature do not currently reflect the broad definition of E-E, characterized by noted E-E researcher Dr. Arvind Singhal as “shaped by intentionality [to teach]” (Personal communication, December 3, 2009). Currently, the field of E-E is dominated by examples of radio and television interventions developed to communicate health-related information and practices in mostly Third World countries.

In the United States, E-E faces significant challenges for implementation possibly due to the steep cost of media production and the complexities of a media-saturated society. In recent years, several partnerships have formed between academically-based organizations (such as the Hollywood, Health & Society based at the University of Southern California) or the federal government (such as the Centers for Disease Control) and Hollywood to integrate health messages into storylines of existing entertainment products. For example, episodes of *ER* were written in cooperation with health education specialists to communicate the “5 a day” fruits and vegetable message

for healthy eating (Valente, 2007) and the importance of childhood immunization (Glik, et al., 1998). Another example may be found in the show *thirtysomething* when viewers followed the story arc of one of the main character's battle with breast cancer, a first of its kind in the 1980s (Sharf, Freimuth, Greenspon, & Plotnick, 1996). Interestingly, child-oriented examples, such as *Schoolhouse Rock* (Warburton, 1973), have not appeared in E-E literature yet fit the definition of E-E, i.e. having the intentionality to teach (Engstrom, 1995).

Regardless of the country of origin or destination, E-E seeks behavioral change in its target audiences. Based primarily in Bandura's Social Cognitive Theory (Sood, Menard, & Witte, 2004), E-E makes its impact through social modeling, whereby we learn from the successes or mistakes of others (Bandura, 2004) by modeling target messages using positive, negative, and transitional models. As Bandura (2004, pp. 83-84) explains:

Characters representing relevant segments of the viewing population are shown adopting the beneficial attitudes and behavioral patterns. Seeing people similar to themselves change their lives for the better not only conveys strategies for how to do it, but raises television viewers' sense of efficacy that they too can succeed....The personal and social benefits of the favorable practices, and the costs of the detrimental ones, are vividly portrayed.

Some educational research scholars posit that all learning, including academic learning, is social. For example, Gardner (2004) frames both social and academic learning as a process of changing one's mind, a change which can be ignited by emotional resonance



through other's experiences. Dewey (1938) argues the most impactful learning comes through experience while Vygotsky (1978) framed learning as culturally mediated and assisted through social interaction. If one accepts a view of learning as a socially mediated act, it should follow that E-E, an intervention which models learning and social behavior, could be used to model the learning of academic concepts by creating vicarious and situated learning experiences through fictional narratives.

It is within this context that I investigate how E-E can be adapted and used for academic learning in general, producing what I am calling the Academically-based Entertainment-Education (ABEE) model, and further modified or customized for geography education in the United States. This research carries the potential for greater implications not only to affect the collective geographic knowledge of U.S. society, but also contribute to the strengthening of the connection and bi-directional support between formal and informal/non-formal education (La Belle, 1982).

### **Developing the Academically-Based Entertainment-Education (ABEE) Model**

Understanding how an academically-based E-E (ABEE) product might be constructed requires an understanding of how narrative functions in traditional entertainment products. Such an understanding involves the anatomy of story structure, especially for film and television entertainment products. I suggest the key to creating ABEE resides in the use of story structure to communicate academic concepts through the language of the medium. In this section, I discuss the narrative basis for a potential ABEE model, learning through a narrative structure, and rationale for using grounded theory for the model development.

***Similar yet different: E-E and ABEE***

Using the narrative conventions of traditional radio, film, and television, E-E interventions have been primarily in the genre of soap operas, *telenovelas*, and other variations of dramas for approximately 30 years. At the heart of film and television writing is story structure rooted in Aristotelian poetics (Bordwell, 2008; Tierno, 2002). The critical component of this style of writing is the use of plot points, an action or event which changes the direction of the story. I suggest that the key to development of ABEE resides in the use of plot points to deliver academic concepts. This format will make the academic concept an integral part of the story as opposed to simply providing context. I further suggest that this integration will be essential for the educational efficacy of the ABEE product. This will also differentiate ABEE from traditional educational television, the latter which generally “emphasize[s] formal, classroom instruction and enrichment programming” (Zechowski, n.d.). By placing academic concepts within a fictional narrative and providing the distinctive “feel” of commercial television programs, ABEE creates a learning environment which integrates academic concepts into the language of the medium instead of simply using the medium as a delivery tool. However, since traditional E-E has not focused on academic concepts, there is to date no formula or model for creating ABEE. In fact, no examples can be found in the E-E literature that could qualify as ABEE. Candidates for ABEE have been found incidentally outside of the E-E literature, such as a regional game show about Pennsylvania history (Hinds, 1991) or the 1970s Saturday morning cartoon series *Schoolhouse Rock*. Both of these examples educate using the language of their respective mediums. However, while these

examples performed well with their target audiences, it is unclear how successfully either genre truly educated their consumers, and indeed such assessment is beyond the scope of this discussion.

I posit that extending E-E into a larger role as a teaching vehicle will require a vehicle with broader audience appeal than these examples provide. Therefore, due to a dearth of E-E examples having achieved popular consumption by American audiences or attainment as iconic pop culture status, it will be necessary to draw from the commercial entertainment industry to identify existing products having the *potential* to teach an academic subject in order to inform the development of my ABEE model. Thus, the analysis presented here will provide the data needed to construct a theory for ABEE. By using a grounded theory approach, whereby theory is developed from data, I will be able to adapt the model for the discipline-specific approach needed for geography-based ABEE products.

### ***ABEE model development***

A key component of this investigation is the identification of an entertainment product such as a television series that communicates science through a fictional narrative. I am focusing on fictional narratives since they form the heart of traditional E-E, as opposed to documentary-styled products which have a narrative structure but blurs the line between fact and fiction (see for example Nichols, 1983, 1988). Fictional narratives also provide an environment through which an emotional connection with viewers may be more easily made, compared to traditional educational television's instructional context. This emotional connection is posited as a vital component for

effecting lasting cognitive changes as argued by authors such as Gardner (1993; 2004) and Gladwell (2000). Gardner counts both logical and affective factors among the list of influencers causing mind change. He argues that these factors are successful because of the types of content the mind accepts: ideas, concepts, stories, theories, and skills. The stronger these factors connect with the mind's receptive triggers, not only increases the likelihood that one's mind will change (e.g. adopt the new view) but makes the change more durable. In Gladwell's terminology, the concept becomes "sticky."

E-E researchers have capitalized on what Gardner characterizes as mind change through the use of narrative entertainment, the structure of which provides opportunities for academic concepts to be integrated in ways that may promote learning. In general, film and television fictional narratives follow a writing convention rooted in the Aristotelian story structure of the "Hero's Journey," or some derivation of the concept, whereby the protagonist (the Hero) faces a crisis which propels him or her on a journey in order to resolve the problem. Along the way, there are twists in the plot, known as plot points (PP), which redirect the protagonist into seemingly impossible situations. The protagonist solves the problem, bringing an end to the journey and closure for the audience.

E-E has successfully utilized this storytelling technique to impact negative social behaviors in countries around the world. E-E interventions, primarily radio and television dramas, have been used to promote family planning in Tanzania (Poindexter, 2004) and Pakistan (Piotrow & de Fossard, 2004); to reduce infant mortality rates due to dehydration in Egypt (R. A. Abdulla, 2004); to model non-confrontational intervention

to stop instances of domestic violence in South Africa (Usdin, et al., 2004); and to promote gender equality in countries throughout the southeastern Asia region (NcKee, et al., 2004; Singhal, Sharma, et al., 2004). While E-E is rooted in Bandura's Social Cognitive Theory explicating changes in behavior are facilitated by viewing models of the target behavior, there has been little focus on academic learning by theorists outside of a treatment of group dynamics in the learning environment. This may be due to the differences in perspectives on the term "context." Cobb & Bowers (1999) elucidate the differences between two schools of thought. On one side are the cognitive theorists, concerned with the individual's internal cognition where learning is influenced by the context of the individual. On the other side are situated learning theorists who are concerned with the individual within the larger social group, where learning is influenced by the larger context. Social Cognitive Theory (SCT) provides a bridge between the two, by revealing how learning is influenced by the emotional connection facilitated by the transport of the viewer to the virtual context of the fictional narrative. The emotional connection facilitated by the narrative bridges the internal and external forces acting upon the learner/viewer to facilitate cognitive changes. Said another way, the life history of the viewer influences how the viewer connects with the narrative and it is this force against which the E-E narrative must compete. If the narrative has a strong enough resonance to overcome the viewer's prior experience, there will be a cognitive change, or in Howard Gardner's terms, a "mind change." Again, these terms refer to behavioral changes. Further research is needed to determine if such mind change can be facilitated for academic learning. However, the absence of such research does not

prevent the analysis I am conducting here. Since we have evidence of the impact traditional E-E methodology has had on behavioral outcomes and we have an understanding of the role narrative plays in these changes, we can look to research in learning which incorporates basic narrative structure to gain insight into expanding the E-E methodology to facilitate academic learning.

### ***Learning using a narrative structure***

Bjork and colleague's (R.A. Bjork, 1994; 2007; Robert A. Bjork & Richardson-Klavehn, 1989) investigation of interleaving teaching strategy resonates with Aristotelian approach to story structure. This teaching style, which Bjork (2007) terms "blocking and massing," interrupts instruction on the target concept by introducing non-target concepts. Experiments comparing learning by traditional instructional technique of presenting the concept in discrete units revealed the interleaved approach was significantly more effective based on student subject memory retention. The on-target/off-target instructional approach resembles the story structure of the Hero's journey in that as he/she travels through a challenge to find the resolution to the conflict or problem, unexpected challenges derail him or her from getting to the goal and against which the Hero must fight to get back on track. The derailment metaphorically maps to the transition between a block and mass portion of Bjork's design. Coming from the opposite end of the spectrum, we can also see the intentional and direct application of story structure to develop learning experiences through a model of instruction presented by instructional designers for the construction of classroom learning experiences (Parrish, 2008). In this approach, the student is seen as the Hero and the journey as the

learning process. Students are scaffolded, i.e. supported in their learning, toward plot twists that challenge what they know, propelling the student to deeper learning in order to solve the new challenge.

The research described below more fully investigates the role of story structure (Bordwell, 1986; Field, 2005; Tierno, 2002) in developing learning experiences through the methodology of Entertainment-Education. Several television series meet my definition of an ABEE intervention described previously. The U.S. television series franchise *The Voyage of the Mimi* and *The Second Voyage of the Mimi*, broadcast on PBS in the 1980s, presented science in the context of the story of a boy who spends his summer with his seafaring and whale researching grandfather. During their travels, they must use science to escape danger and solve other problems. Viewers watch the science unfold as the story unfolds in a 15 minute drama paired with a 15 minute documentary-styled “excursion” in which the actors, no longer in character, visit the real locations addressed in the drama. Written for a target audience of middle school students, these two series were designed with the intention of teaching through a drama, and therefore can be included in the E-E category. Created by the Bank Street College of Education, a private graduate school in New York City, the series used a constructivist approach through which to teach.

A second potential ABEE program ran in the decade prior to the *Mimi* series. The musical cartoon series *Schoolhouse Rock* aired on Saturday mornings between popular animated shows. *Schoolhouse Rock* was born when New York advertising executive David McCall noticed his pre-teen son could easily remember the lyrics to rock songs

but struggled with his times tables (Engstrom, 1995). Using the advertising tool of the “jingle,” McCall effectively created a teaching aid that set the times tables to music while telling a simple story (i.e. created a context). For example, the *Multiplication Rock* episode “Two, Elementary, My Dear” teaches counting by two’s as Noah puts animals on the ark. In “I’ve Got Six,” Motown provides the musical context creating the learning experience. One of the most visually memorable scenes can be found in “Figure Eight” when the number “8” rotates onto its side to form the symbol for infinity (Engstrom, 1995). The three minute episodes aired several times during Saturday morning cartoon programming block and were viewed by millions of American children during *Schoolhouse Rock*’s eight year run. These children, now adults, not only remember the lyrics 20 and 30 years hence, but are introducing them to their children through DVDs. Just how powerful was the impression made by *Schoolhouse Rock* on American youth? Engstrom (1995, pp. 101-102) provides examples reported by the series producers: a teenager at the beach sings the Preamble to the Constitution; 900 Dartmouth college students serenade one of the executive producers who was a guest speaker in 1990 with “Conjunction Junction;” Washington, DC agencies utilize “I’m Just a Bill” episode to teach staffers the process of a bill becoming law; immigrants credit the series with helping them pass the US citizenship exam and with learning English; and a junior high school student hums the Preamble to the Constitution during a test, using it as a mnemonic device. While research corroborates the effectiveness of music as a mnemonic device (Engstrom, 1995, p. 101), Huston, Watkins, and Kunkel point to



*Schoolhouse Rock* as spotlighting television's "enormous potential for teaching academic, cognitive, and social skills" (cited in Engstrom 1995, p. 103).

Even while expressing a distaste for school, children will devour entertainment products situated in a school setting, such as the television series *Beverly Hills 90210* (Spelling, 1990) or *Saved by the Bell* (Engel & Tenowich, 1989), or the books series by prolific British children's authors Enid Blyton and Elsie Oxenham (Weber & Mitchell, 1995). Indeed, there are many examples of programming in recent years with educational content that resonates with students. Public Broadcasting System (PBS) programming such as *Bill Nye, the Science Guy* (1993), *Where In The World Is Carmen Sandiego?* (1991), and *Wishbone* (1995) were popular series in the U.S. that delivered educational content focusing on science, geography, and literature, respectively. Each show took a different narrative approach: *Bill Nye* demonstrated chemistry and physics concepts through experiments and explanation, in effect telling the "story" of the scientific concept; *Carmen San Diego* presented geography in the context of tracking an international thief in a game show format; *Wishbone* used the narrative of a dog who retells the life lessons and situations of his boy-owner through the fantasy re-enactment of similar situations found in literary classics.

Other examples such as *Sesame Street* (Cooney, 1969) and *Between the Lions* (Mullen, 2000) serve as touchstones of success in utilizing the visually and culturally relevant medium of television to teach literacy. In fact, research suggests the fantasy element found in these programs may be the key. An incidental lesson gleaned from one study commissioned by the head of research for *Sesame Street* found that very young

children lost interest in the segments where live adults and children were present without a Muppet. Interest was re-established once a Muppet entered the scene (National Literacy Trust, 2005). The story-situations presented in these programs aid learning by providing situational context needed for language to develop. Through the *in situ* visual demonstration of action to define vocabulary, children learn from a variety of language styles and people, including figures of speech (Davies, 1989, p. 18). Davies points to a 1976 Swedish study which demonstrated that with primary school children, pictures are more effective at demonstrating causal processes than words alone.

With such a body of previous work suggesting the role entertainment can play in education, it may not be difficult to imagine the role it can play in a specific field or subfield, such as geography education. Television in particular may prove to be an invaluable tool for this field. As a discipline, geography relies heavily on visual representations, requiring students to utilize representations in both a physical venue, such as maps and other geographic tools, as well as in their mind's eye, such as mental maps and spatial thinking cognitive tools (National Research Council, 2006). Furthermore, vocabulary is an important part of geography education; the development of a geographic vocabulary is required for one to become geographically literate. It is therefore conceivable that programming based on models such as *Sesame Street* or *Blue's Clues* (Kessler, 1996) could be used to develop geographic vocabulary in young children.

### *Mechanisms for learning*

According to Harvard psychologist Howard Gardner, there are a number of “levers” that work in concert to change both individual and collective minds (Howard Gardner, 2004). These levers are important tools for changing a society’s view. In particular, the levers of Resonance (the affective component of human cognition), “Redescriptions” (representation in compatible formats), and Real World Events (events near or far that affect many individuals where they live) are prime tools for changing the collective mind of large-scale, heterogeneous groups. These levers may be used to teach concepts through the use of stories (narratives). In fact, we see this as a common phenomenon already in existence in American advertising. Through the use of a resonating “story” or concept, the viewer is “educated” on which product to purchase to obtain the goal of the “story,” usually the perception of a higher quality of life or solution to a problem.

Interestingly, the use of media to educate a society, as is the impetus of E-E, has met greater usage outside of the United States. This disparity may be due to the complicated structure of the U.S. entertainment system itself complicated by its historic shyness from products considered “educational.” As with many PBS series, entertainment products labeled “educational” generally do not receive the audience share that U.S. network broadcast series attract. Entertainment production in the U.S. requires an enormous financial investment, which may help explain why E-E targeting U.S. audiences has been limited to short run story lines over the course of a single or handful of episodes in existing television series especially soap operas (V. Beck, 2004).

However, there is one successful primetime network television series that approaches the conceptualization of E-E I use in this study. While not explicitly intended to *teach* mathematics but instead uses real math (Scholastic Administrator Magazine, 2006) in fictionalized contexts, the CBS television series *NUMB3RS* (Heuton & Falacci, 2005b) uses math to drive the story and therefore may provide insight into how an academic concept can be woven into the structural support of the narrative, creating a learning experience similar to what was proposed by Parrish in instructional design and serving also as a model for future ABEE products. Therefore, *NUMB3RS* serves as a model upon which a grounded theory for ABEE may be developed.

### ***NUMB3RS television series***

In the CBS television drama *NUMB3RS*, a genius math professor named Dr. Charles Epps assists his FBI agent brother, Don Epps, to solve crimes using advanced math techniques. When I first watched the pilot in 2005, I was intrigued by its bold use of math concepts and the choice of demonstrating the concept in an accessible way rather than a “dumbed down” approach for a non-math audience. I am admittedly a fan of the show and have seen every episode through its sixth and final season, which wrapped in mid-March 2010. While some may point to this as a potential research bias, this level of familiarity with the show made identifying its unique story mechanism possible. However, what was not evident from casual observance of the show is how this structure works. Therefore, this analysis seeks to understand how math is integrated into, and used to construct, each episode of the show.

The series' use of math concepts to drive the story is apparent even upon casual viewing of a single episode and this characteristic comes closest to my definition of teaching *through* entertainment, by using the characteristics of the medium as the conduit for communicating a message central to the ABEE model being developed here. As a couple of the show's writers told me, they wanted to integrate math into the story's "DNA." Being a part of the proverbial genetic makeup of the story, math becomes a vehicle for driving the story. To understand how this works, we first need to understand dramatic story structure.

### ***Dramatic story structure***

I mentioned before that, regardless of the medium, story structure follows a general form dating back to Aristotle. In teleplays, screenplays written for television, the hero's journey is played out in four or five acts. The show generally begins with the Teaser containing an inciting incident, such as finding a dead body. During Act One, the first clue is found and by the end of the act turns into a cliff hanger, such as the clue seemingly pointing to the murderer, but in Act Two we are confronted by a twist of the cliff hanger from Act 1, for example the murder suspect is found dead. In Act Three the real villain's identity is discovered and Act Four centers on the hero's race to catch the baddie before reaching his/her big evil goal, such as blowing up Los Angeles (R. Port, personal communication, March 18, 2010).

The mechanism for propelling the story forward and progressing from act to act are *plot points* which present an obstacle to be overcome or discovery of important information that sends the hero in a different direction. Webber (2002) uses the

metaphor of falling rocks to illustrate the primary function of plot points – to force our hero to react. These twists in the story are what keep us as viewers on the edge of our seats and are in fact critical for audience engagement. Plot points are therefore the mechanisms for driving the story.

Since *NUMB3RS* uses the academic subject of mathematics as a key component of its story, it is a natural candidate for informing the development of a model expanding the Entertainment-Education methodology into the realm of academic learning. I posit that for an ABEE product to find a place in U.S. entertainment market, it is more likely to be successful if constructed in the same vein as network television shows such as *NUMB3RS* rather than shows like *Voyage of the Mimi* I described earlier, which has much lower production value and lacked the narrative structure commonly found on network television. For this reason, the former program will be the focus of this analysis to understand how academic subjects can be used to drive a narrative.

### **Materials and Methods**

I began the process of data collection in order to analyze *NUMB3RS* in December 2009 by watching the first five seasons of the show available on DVD as well as the sixth season's shows that had aired and were available on iTunes as of January 12, 2010, all totaling 114 episodes. In this preliminary analysis, I summarized the activity in each scene, noting (1) plot points, (2) math concepts mentioned or elucidated, and (3) visual representations of the math concepts. After watching the pilot on the first DVD, the use of metaphor to make the abstract and advanced math concepts used in the show more concrete emerged as an important mechanism of the "language" of the show. Therefore,

I added metaphor/analogy as the fourth category in my preliminary analysis. I then tallied the number of plot points that were rooted in math (see Figure 3-1 for an example scene from the show's script) in each episode, which ranged from zero to four (Figure 3-2). Wanting to find the episodes with the most robust use of math-as-story-driver, I chose for my full analysis the episodes having three or more math-driven plot points (MDPP), narrowing down the list to 13 (Table 3-1).

Next, I contacted the Writer's Office of *NUMB3RS* to request the final production scripts for the 13 episodes culled from my preliminary analysis. It took a couple of weeks for my request to receive final approval, having to proceed from the Writer's Office all the way to the CBS Legal Department, before I was given the PDF files for each of the requested scripts. Unfortunately, several of the scripts provided were not the final shooting versions, but were up to the 6<sup>th</sup> revised draft and possibly one or two drafts away from the final shooting script. Since the series wrapped production shortly after I received the scripts in mid-January 2010, I was not able to obtain the final versions. However, I found no substantive differences between the draft scripts and the aired episodes that would confound this analysis.

NUMB3RS #305/42 "The Mole" 2nd WHITE Rev 9-07-06 16.  
 13 CONTINUED: 13

CHEN  
 I'll speak with the Ambassador, see  
 what I can do...

---

14 INT. FBI - WAR ROOM -- NIGHT 14  
 Don, Megan enter, find David. Scene 14, Episode  
 #305 "The Mole"

DAVID  
 What'd the Consulate General say?

MEGAN  
 That he didn't know her very well.

DAVID  
 (joking)  
 Well, he's either telling the truth  
 or the Chinese have a pretty  
 liberal hiring policy...

DON  
 What's up?

DAVID  
 Credit card had a bunch of charges  
 to night clubs, lingerie shops and  
 the occasional "adult" store.

MEGAN  
 Not exactly the image her neighbors  
 painted...

DON  
 Run her with LAPD Vice. Narco too.  
 See what else she was hiding.

MEGAN  
 We still don't know if this girl  
 was even murdered.

Charlie enters --

CHARLIE  
 Actually, we do. As promised, I  
 have your answer about whether this  
 was an accident.

DON  
 Charlie, what'd you skip classes?

(CONTINUED)

Figure 3-1  
 Annotated Scene Featuring a Math-Driven Plot Point. Episode #305 "The Mole" (Port,  
 2006b)<sup>1</sup>, Scene 14.

<sup>1</sup> All script pages are used with permission from CBS Studios and the individual writers.



NUMB3RS #305/42 "The Mole" 2nd WHITE Rev 9-07-06 17.  
 14 CONTINUED: 14

CHARLIE  
 Lunch... and dinner... Do you guys  
 have a sandwich or something?

DON  
 We'll send out. What do you got?

Charlie starts to hook up his laptop.

CHARLIE  
 Well, at first I was using a steady  
 motion algorithm to try to  
 determine the victim's movement at  
 impact. But my results were  
 inconclusive.

Math concept

DAVID  
 But you persevered.

Charlie walks and imitates the motion he describes.

CHARLIE  
 I imagined walking... the motion of  
 her feet... Then it became obvious,  
 curtate cycloid.

Math concept

MEGAN  
 Curtate cycloid, of course.

CHARLIE  
 Think of someone's stride like the  
 moon orbiting around the Earth...

**AUDIENCE VISION --**

**We see an animated moon...**

CHARLIE (V.O.) (CONT'D)  
 As the moon moves around the Earth  
 and the Earth moves around the sun,  
 the moon traces out a curtate  
 cycloid curve in space.

**The moon spins and circles the Earth...**

CHARLIE (V.O.) (CONT'D)  
 When you walk it's really a series  
 of little circles rotating inside a  
 larger circle.

**An animated heel swings on an arc past the knee....**

Audience Vision is  
 the show's  
 convention of  
 cutting away from  
 the characters to  
 provide visual  
 demonstration or  
 animation of a  
 math concept.

Math concept  
 explained through a  
 word picture, visually  
 demonstrated with  
 the character  
 (Charlie) narrating  
 off-camera in a  
 "voice over" (VO).

(CONTINUED)

Figure 3-1 (continued)

14 NUMB3RS #305/42 "The Mole" 2nd WHITE Rev 9-07-06 18.  
CONTINUED: 14

CHARLIE (V.O.) (CONT'D)  
The heel orbiting backward, then  
forward past the knee is a small  
circle within the larger circle of  
walking...

**RESUME SCENE**

CHARLIE (CONT'D)  
From there, I could probabilistically  
determine the leg motion of your  
victim at the point of impact.

MEGAN  
And this helps us how?

CHARLIE  
The marks on her legs that the  
vehicle's lights made, they're  
high.

DON  
High?

CHARLIE  
The bumper of the vehicle was  
rising on impact.

DON  
So, the car was accelerating.

MEGAN  
Which means this was no accident.

Math concept produces  
revelation that changes  
the direction of the story  
(i.e. plot point).

END OF ACT ONE

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Figure 3-1 (continued)

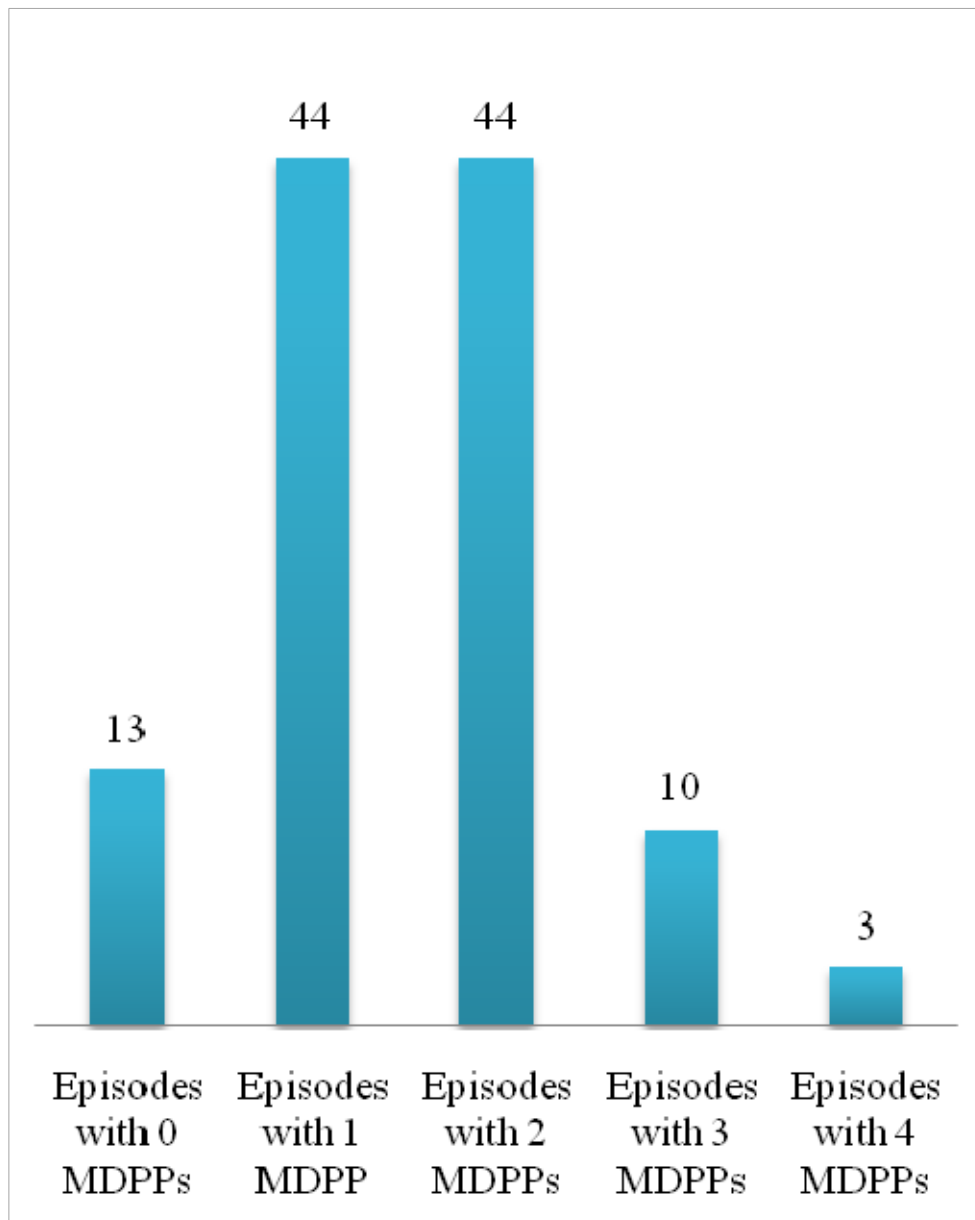


Figure 3-2  
*Episodes with Math Driven Plot Points (MDPPs).*

Table 3-1  
*Episodes Selected for Analysis.*

Episode Name	Season	Consecutive # and Episode	Writer	Math Driven Plot Points (MDPPs)
Guns and Roses	2	220/Ep. 33	Robert Port	3
Rampage	2	221/Ep. 34	Ken Sanzel	3
The Mole	3	305/Ep. 42	Robert Port	3
One Hour	3	317/Ep. 54	Ken Sanzel	3
Democracy	3	318/Ep. 55	Cheryl Heuton & Nick Falacci	3
Trust Metric	4	401/Ep. 62	Ken Sanzel	3
Hollywood Homicide	4	403/Ep. 64	Andrew Dettman	3
In Security	4	406/Ep. 67	Sean Crouch	3
Checkmate	4	414/Ep. 75	Robert Port	3
Conspiracy Theory	5	509/Ep. 88	Robert Port	3
Convergence	2	207/Ep. 20	Cheryl Heuton & Nick Falacci	4
Pandora's Box	3	319/Ep. 56	Andrew Black	4
Ultimatum	6	608/Ep. 110	Robert Port	4

Proceeding with a full analysis, I read each script and produced a scene-by-scene summary noting uses of math concepts and analogy or metaphor, which led to the discovery of the show's visual style convention. First, when a visual demonstration of a math concept is provided, they are noted in the scripts as "Audience Visions" (e.g. Figure 3-3). Second, when visually communicating Charlie's sudden cognitive connection of math to the situation (often without an explanation given to the audience), where the audience is given a visual glimpse inside Charlie's thought process, are called "Charlie Visions" (Figure 3-4). Since both are vehicles for visual communication and were generally paired with instances of analogy or metaphor, both were added as individual categories in my full analysis. To capture instances of using metaphors and analogies, I also created an umbrella category, "word picture" defined by Godawa (2009, p. 194) as "words that paint a picture in the mind rather than appeal to some kind of abstract reasoning." These modifications to my coding structure allowed for the emergence of a pattern of interplay between the show's visual and verbal communication of math concepts. Finally, using a modified visual notation system after Johnson (2006), I plotted the data by Scene and by Act to illustrate the linear relationship of the target qualities to the overall story structure (See Appendix A for all selected episodes).

NUMB3RS 318/55 "Democracy" BUFF Rev 2/21/07 43. 38  
 38 CONTINUED:

OSWALD (CONT'D)  
 Wait, this is better. You know how they stack champagne glasses and fill them with champagne?

ENTER AUDIENCE VISION:  
 The classic pyramid of champagne glasses.

OSWALD (V.O.) (CONT'D)  
 You only pour the champagne into the top glass but it overflows into all the other glasses.

The champagne pours over the top and into the glasses below.

BACK TO SCENE

OSWALD (CONT'D)  
 Requires resources applied in only one location, but it spreads.

ALAN  
 (sotto voice)  
 Good God, another one.

CHARLIE  
 You mean the conspiracy starts from a single source but can spread.

Alan goes to the board with Jason Brasher's name.

ALAN  
 That's right, because the Supervisors oversee the county budget. They approve everything. Including voting equipment the county buys.

DON  
 Brasher could make sure the county keeps buying rigged machines.

CHARLIE  
 And with LA County's huge population, rigged machines here could make the difference in a statewide election.

The four look at each other, realizing the implications.

DON  
 He's not just after a Supervisor's seat--

Word picture to be visualized

Begin Audience Vision

End Audience Vision

(CONTINUED)

Figure 3-3  
 Annotated Scene Featuring an "Audience vision". Episode #318 "Democracy" (Heuton & Falacci, 2007), Scene 18.

NUMB3RS #207/20 "Convergence" Goldenrod REV 10/3/05 36.  
 23 CONTINUED: (2) 23

AMITA  
 That's exactly my point.

Charlie looks at her.

CHARLIE  
 You think we should try to make  
 time for certain things?

Amita stands up.

AMITA  
 I think when it's right, the time  
 will be there.

CHARLIE  
 I hate it when you use logic.

AMITA  
 Sure you don't want some pie?

CHARLIE  
 No, I need to think. Somehow  
 Marshall's analysis, and this FBI  
 case, are tangled up in my head.

Amita nods, leaves. Charlie gets up, goes down to look the  
 boards filled with equations and notes. Sees the words "poly-  
 nuclear growth model" above a drawing of a pyramid-shape --

---

**ENTER CHARLIE VISION**

**The pyramid shape becomes a pyramid-shaped asymptotic matrix  
 -- a huge complex structure of lines and points -- which  
 morphs into a -- tower structure, a cellular tower.**

**Overlay of images -- cell phones menus, hexagonal cell zones,  
 a signal path into space to a geosynchronous satellite --**

---

24 **EXT. FBI - DAY** 24

Charlie intently talking to Don and Megan as the three walk.  
 Charlie pulls out his cell phone.

CHARLIE  
 Don, do you realize what's in here?

DON  
 Other than a lot of unanswered  
 voice mails, no.

(CONTINUED)

Figure 3-4  
*Annotated Example of a "Charlie Vision". Episode #207 "Convergence" (Heuton & Falacci, 2005a), Scene 23.*

## Results

My analysis of *NUMB3RS* seeks to understand how this entertainment product communicates a scientific concept and integrates it into the story structure. It is not intended to assess the quality or educative value of the series. Having not had formal training in screenwriting, it is possible that what I would consider to be a plot point in a story may differ from that of professional screenwriters. However, since my goal is ultimately to understand the show from a viewer's point of view, and since a casual viewer would most likely lack such formal training, the absence of this skill should not be considered a liability in this analysis.

By reducing episodes to their elemental parts, a fascinating pattern of writing convention has emerged, primarily through the use of metaphor partnered with a visual demonstration. This convention was used almost exclusively to drive the story in a new direction as opposed to simply providing context for the story. In other words, rarely in these episodes was math used non-incidentally to the forward motion of the story. Furthermore, even though *NUMB3RS* has a specific style, my analysis shows this style is not formulaic across all episodes of the series. The same plot structure is not used across all episodes. Some episodes relied more heavily on (1) character development, (2) communicating math concepts and how they work (verses math functioning simply as context), or (3) utilizing math as a plot point. In other words, math as a story engine was used neither predictably nor consistently throughout the series.

The 13 selected scripts are as a group different from the rest of the series but do not differ from each other in terms of MDPPs. Interestingly, while the variance in the



number of MDPP is low within this group, the MDPP do not occur at comparable points in the story across this selection of episodes. This suggests that the episodes are not formulaic in the use of MDPP.

### **Discussion**

The inventory of word pictures in Table 3-2 demonstrates the importance of metaphor in communicating abstract concepts to the audience of *NUMB3RS*. Academic curiosity could tempt us to analyze these metaphors and the context in which they reside for learning efficacy. How well do they teach math? To what degree do viewers of *NUMB3RS* grasp the higher math concepts presented in the show? However, since the show was not created with a pedagogical intent, such an analysis would be purely academic. Even so, this series demonstrates an important concept that may be foundational to an Academically-based Entertainment-Education model. *NUMB3RS* translates abstract concepts for a general audience through the language of metaphor. The key is “language,” the conduit through which ideas are transferred. Whereas math concepts can be made accessible to a non-math audience through metaphors and analogies, another subject might be poorly served by this approach. I suggest that a subject such as geography, which is steeped in a history of observation and description, i.e. a visual discipline, may be better served through a visual language or a narrative device featuring role modeling provided by Bandura’s social cognitive theory. Regardless of the narrative device used, ABEE built on the foundation of my grounded theory approach will utilize plot points centered on concepts from the chosen academic field to be communicated.

Since MDPPs appear at different locations in the story in each of the selected *NUMB3RS* scripts, the use of math within the structure of the story can be considered independent of the traditional Hero's Journey for this television series. The use of word pictures are the vector through which math is woven into the story of each episode.

Table 3-2

*List of Math or Logic Concepts Paired with a Word Picture.*

Episode Name	Concept	Word Picture
Guns and Roses	Acoustic fingerprint	Sound waves
	Doppler Effect	Bat's radar
	Statistical matrix	Figure skater can statistically win even with deductions for mistakes
	DNA haplotypes	House blueprints
Rampage	Inequality bounding	Dogs chained in a yard
	Brownian Path	Pool table
	Self-organizing criticality	India's change to set time by an observatory
	Tesseract	Tesseract is not really a tesseract
	Backtaing-Wisenfeld sand pile	Hourglass sand pile
The Mole	Kertate Cycloid	Moon orbiting earth
	Igenfaces	Color blindness test
	Combinatorial optimization	Rubric's cube
One Hour	Exploit	Luggage stickers from destinations
	Pooling equilibrium	Cake cutting algorithm
	Logic maze	Labyrinth game

Table 3-2 (continued)

Episode Name	Concept	Word Picture
	Metadata	Zip code
Democracy	Perpetuating aspect of nanotechnology	Overflow of champagne in a glass pyramid
	Voting on tampered voting machines	Building a model from instructions
Trust Metric	Set covering deployment	Placement of lighthouses on coastline
	Trust metric	Fuzzy logic of describing an ice cube
	Eric Strauss' room	Finding a fugitive's "dark space"
Hollywood Homicide	Refracted image; Archimedes' principle; Game theory risk and response;	Reassembling a shattered gumball machine
	Game theory risk and response	Jackal threat to lioness and cub
In Security	Application of path analysis	Rat in maze
	Value Shaded Reasoning	Figure ground image
	CARD analysis	Growing tree with branches
	Morphological image cleaning algorithm	Paleontology dig
Checkmate	Temporal link analysis	Cutting a diamond
	Supervised multiclass labeling	Cadaver dogs
	Backwards induction	Rosetta stone
Conspiracy Theory	Forensic video reconstruction	Emperor penguin
	Simpson's Paradox	Baseball
	Desorption electrospray ionization	Fireworks

Table 3-2 (continued)

Episode Name	Concept	Word Picture
Convergence	Data mining	Jigsaw puzzle
	Calendars	
	Emergence Theory	Ant farm colony
	Three-dimensional trilateration	Cell phone towers
	Deep current set theory	Ocean currents influencing weather
Pandora's Box	Wavelet-based deconvolution algorithm	Photographer with cheap camera
	Strange Loop Theory	MC Essher's lithograph The Stairs
Ultimatum	Pursuit Evasion	Snake hunting fish
	Game Theory	Two people decide how to split \$100
	Longitudinal socializing model	Hide and seek children's game

The composition of word pictures appears in the selected episodes in one of three configurations: (1) a metaphor or analogy elucidated with a visual narrative (labeled as “Audience Vision” in the scripts); (2) a metaphor or analogy explained through a physical demonstration by the actor; or (3) a metaphor or analogy explicated through the natural dialog of the scene (See Appendix B).

***Word picture with a visual narrative – the “Audience Vision”***

In the first configuration, word pictures are presented to the audience with a visual narrative accompanied by the actor’s voice narrating what is seen and its metaphorical or analogous meaning. This treatment manifests itself as a visual cut-away from the show, yet is still tied to the scene. It is analogous to a map featuring a corner inset for a close-up view of a target area. Within the script, this cut-away is designated as

an “Audience Vision.” For example in the “Hollywood Homicide” episode (Dettmann, 2007), the FBI team has deduced that months before being murdered, a victim had been blackmailing a member of a Hollywood star’s entourage, however this puzzles Charlie. While it might seem plausible that the blackmail was the trigger for the murder, Charlie evokes Risk and Response Analysis of Game Theory to reframe the murder as an extreme reaction to the blackmail. Charlie explains by introducing the word picture of a lioness and her cubs being circled by a hungry jackal. The scene inside the FBI office then cuts away to the visuals of the Audience Vision. We see in live action a jackal circling a pride at a distance yet in plain view of the lioness. She keeps an eye on the intruder but remains reclining with her cubs in the grass. As the visual narrative runs, we hear Charlie narrating the scene. He explains that as long as the jackal stays an acceptable distance from the cubs, the mother lion tolerates the jackal’s presence. Next we see the jackal moving closer to the cubs as Charlie explains that when the jackal moves to a physical distance that crosses the lioness’ comfort zone, the animal’s presence becomes an unacceptable threat. We see the lion swiftly kill the jackal as Charlie continues, “In turn, the lion’s response becomes lethal” (Dettmann, 2007, pp. 45, Scene 39). The visual narrative ends and we return to the FBI office. Now on camera, Charlie posits the blackmail involving knowledge of the sale of DVDs of soon-to-be-released movies could be considered a low risk act. Something else must have triggered the murder. In other words, there is more to the story; this word picture serves as a plot point to send the story in a new direction.

***Word picture presented through a physical demonstration***

In a second category, the writers of *NUMB3RS* present word pictures via a physical activity of one of the actors. In “Pandora’s Box” (Black, 2007, pp. 21, Scene 13), when a Park Ranger is found dead from a gunshot on the ridge of the Angeles Crest Forest near the wreckage of a downed corporate jet, the FBI is called in to investigate. Charlie uses the debris field to mathematically predict the location of the Flight Management Computer. However, when his predictive model produces consistently short distance calculations, yet with the correct trajectory, Charlie realizes the plane had to have been heavier than reported on the flight manifest. He demonstrates his discovery to the team by grabbing a muffin and throwing it to the ground where it explodes on impact. The resulting crumb debris field provides the visual aid. He explains if the muffin had contained heavier objects such as nuts, the debris field would have had a different pattern. Nuts are heavier and with more mass would have traveled farther. Charlie reveals that the debris field from the plane is more spread out than his calculations predict it should be. There had to have been something else on board, something that *someone* chose not to reveal. Now we have a new twist in the plot. What was on the plane and where is it now?

***Word picture presented through natural dialogue***

Word pictures were also occasionally present in the natural dialog between characters. In “Convergence” (Heuton & Falacci, 2005a, pp. 19-20, Scene 11), FBI Agents David Sinclair and Colby Granger arrive at Charlie’s office to find the math professor memorized by the workers of an ant farm moving through the maze of

passages sandwiched between two sheets of glass he holds in his hands. Charlie states, “Emergent Theory. The whole is greater than the sum of its parts. Individually, ants have limited capabilities, but the colony can be viewed as a single, complex organism. But you aren’t here to talk about ants, are you?”

***ABEE model summary***

There is the danger that development of an Academically-based Entertainment-Education model based on a single exemplar may result in a model with limited applicability, however it does present a strong base upon which to grow the model. Working from a unique and successful television series provided two key components necessary for an ABEE model that could be successful in the U.S. entertainment market. Those components are (1) academic concepts seamlessly integrated into the story, and (2) what Hollywood calls “high concept,” a story premise that can be easily described in a sentence or two. As with E-E in general, ABEE products cannot lose sight of the importance of “entertainment value”, and as they say in Hollywood, story is king. Therefore, while keeping “story” at the forefront, the ABEE model can be summarized as having the following characteristics:

*1. Speaks in the language of the medium through role modeling and translates academic concepts through word pictures.* As visual mediums, film and television provide environments to primarily “show” as opposed to “tell.” A common instruction for screenwriters is “Don’t tell me. Show me.” Regardless of the medium, fictional narratives create a “lived experience” when well crafted stories engage the audiences’ emotions and imagination. Generally, when the medium is used simply as a delivery

conduit for a message, the format becomes dominated by instruction or lecture, which is commonly found in distance education and instructional programming on PBS, for example. By utilizing the language of the medium through fictional narratives and facilitated by word pictures, ABEE creates a lived experience to which audiences can identify.

2. The plot points that drive the story are themselves driven by academic concepts. Utilizing the context of film and television story structure ensures that academic concepts do not languish as context but instead become the story. By using academic concepts at story loci responsible for challenging the viewer and unfolding the story, the story not only unfolds *with* the academic concept but also *because* of the academic concept.

3. Plot points serve to scaffold audiences to reach a narrative and educative conclusion. In the same way that plot points serve to send the narrative story into a new direction, usually by presenting an obstacle the hero has to overcome in order to reach his/her goal, ABEE uses plot points to challenge what the viewer knows about the target academic subject. In Vygotskian terms, the ABEE plot point challenges the viewer. The subsequent path the story takes after each plot point provides the support to scaffold the viewer to obtain the target academic concept the ABEE product is designed to teach.

### **Conclusion**

Since television shares basic writing convention with cinema, both being rooted in Aristotelian poetics, it would follow that use of academic concepts at plot points to drive the story would be applicable across either of these traditional and linear media



environments. Due to the high cost of producing traditional media (e.g. film or television), opportunities to implement and test the ABEE model are limited. However, scholars can look to non-traditional media, especially Internet-based environments, which can be produced and consumed with significantly less monetary investment than traditional media and since my primary focus is in developing E-E interventions to teach geography concepts, I would be remiss in not addressing the relatively new and non-linear tool for geographic exploration that is free to anyone with access to the Internet, such as Google Earth (GE). GE has indeed emerged as a popular tool for both the expert and the novice to explore the world. Yet since GE is primarily a visual environment, with the primary “text” being satellite imagery and aerial photography at various scales stitched together into a mosaic providing a visual representation of the earth’s surface, I would argue that this visual medium requires visual literacy skills and a critical eye to utilize in a deeper, educative manner. This is due not only to the way the global imagery is constructed, but also to its subject. While a novice may view GE and easily recognize the objects represented, e.g. mountains, urban landscapes, rivers, etc, or what could be characterized as the individual pieces of a puzzle, a novice may not be able to understand how those pieces are related as a greater whole. Such is the domain of geography, which is concerned with the patterns and processes forming and occurring on the surface of the earth. While millions of people have viewed imagery in GE both in formal educational environments (as a classroom activity or scholarly research tool) as well as non-formal environments (home or other recreational use), we do not yet have scholarly research on the differences between novices’ and experts’ use or the degree to

which causal experiences with GE evoke learning. Such gaps in the literature do not, however, preclude an exploration of new approaches to the educational use of GE.

In the next chapter I explore the virtual world of GE as a learning environment and the implicit need of expert intervention in order for a novice to acquire deeper knowledge in this non-formal environment. The ABEE model developed through this chapter can be translated from the linear and textual environment of traditional media to the dynamic, interactive, and non-linear environment of new media. In applying ABEE to new media, I present an avenue for developing learning experiences that can be “driven” by a novice, yet embody the educative value provided by an expert.

## CHAPTER IV

### MANUSCRIPT #3:

#### ABEE AND NON-LINEAR MEDIA

##### **Introduction**

The development of non-linear entertainment venues, found in the genre of computer games and simulations, may provide a new direction for investigating the use of narrative in educational experiences. Previously, theories such as Social Cognitive Theory (Bandura, 1986; Pajares, 2009) have been used to explore the role of narrative in learning and applied within both formal and non-formal educational contexts (e.g. Dittmann, 2004; Fu, Chan, & Yip, 2009; Martin, 2004; Udornpim & Singhal, 1999), the latter has focused primarily on the linear media of film, television, and radio and subsequently producing the field of Entertainment-Education (Sabido, 2004). Entertainment-Education (E-E) seeks to impact social problems by developing soap operas or other dramatic forms of entertainment as interventions designed to teach audiences about a targeted health education message by modeling positive and negative behavior through the protagonist and antagonist characters (see Singhal, Cody, et al., 2004b for intervention examples and a history of the field). Extension of the E-E methodology to teach academic concepts (as opposed to focusing on behavioral outcomes) has been achieved through the development of Academically-based Entertainment-Education (ABEE) model (Simms, 2010b), which utilizes the “language” of the medium to communicate academic concepts by weaving them into the fabric of

the story at critical points in the plot. Through ABEE, academic concepts function as more than context for the story. Academic concepts are used to drive the story through the screenwriting convention of *plot points* defined as the junctures in filmic narratives where the story twists and sends the protagonist along a different path as he/she continues towards his/her goal.

However, with advances in technology making interactive and nonlinear media widely available through the Internet in recent years, “new media” is changing the landscape of entertainment in the United States, first seen in the decline of newspaper subscriptions and television/radio news broadcast ratings as consumers shift to the Internet delivery vehicle (O’Leary, 2009). Irrespective of form, new media is quickly becoming a dominate player on the communication stage and becoming a tool for education as well. Therefore, in this article, I explore the research question “How can the Academically-based Entertainment-Education (ABEE) model be used in the non-linear environment found in new media?” by utilizing Google Earth as my medium. I begin by elucidating each of the components contributing to this research environment including the ABEE model, the language of film, and the language of Google Earth. Next, I present a scenario of how the ABEE model may manifest in the non-linear environment of GE by translating the traditional media-informed components of the model to their nonlinear media counterparts. Lastly, I conclude with implications of this research and possible future research directions. To begin this discussion, I review the recent changes in the landscape of geography education.

### ***Geography education in the new millennium***

During this decade, geography education has experienced a kind of technology renaissance. Prior to the year 2000, geographers trained in the use of complicated geographic information systems (GIS) and global positioning systems (GPS) were needed to analyze and interpret geospatial data to parse patterns and interpret processes appearing or impacting the landscape. From city planners to wildlife ecologists, geospatial experts were a specialized group of professionals who “read” the landscape using geospatial techniques, not unlike a radiologist reading and interpreting an X-ray or ultrasound. However with the release of the virtual globe Google Earth (GE) in 2005 and the subsequent release of open-source GIS products, novice or citizen geographers sometimes referred to as “neo-geographers” (Turner, 2006) now have access to the same tools that were once too expensive for all but professionals and corporations. GE has emerged as a geospatial powerhouse in terms of popularity due to its ease of use and global coverage of imagery. As of 2008, the software application had been downloaded 350 million times (Taylor, 2008) and geography educators around the world have incorporated the technology into curricula (e.g. Google Earth Lessons, 2009; Kluge, Patrick, & Fermann, 2007; Patterson, 2007).

### ***New media***

While new media, such as GE, distinguishes itself from traditional media in many ways (Wardrip-Fruin & Montfort, 2003), I am primarily focused on its interactivity and non-linearity for this discussion. GE (Figure 4-1) provides interactive and non-linear experiences by virtue of the user interface. Users are able to navigate

around the mosaic of images forming the globe, zoom in or out, manipulate the layers of data that can be viewed, and create new layers of content. Google Earth not only provides a “stage” comparable to film and television upon which to develop ABEE products, but it also serves as an excellent medium through which to study and teach geography (e.g. Patterson, 2007; Schultz, Kerski, & Patterson, 2008).

Because of new media’s nonlinear and interactive nature (Moulthrop, 1991) it may communicate in a different language from traditional linear media (Ryan, 2004). First, the interactive experience creates a narrative expressed in a way that partially transitions authorship away from the creator and into the hands of the viewer. In other words, the viewer does not idly consume new media; he or she interacts with it and this interaction, according to reader-response critics (Benton, 1996, p. 72), constructs meaning. Thus, new media transforms the entertainment consumer into a user who makes choices which drive the experience. Second, the global imagery produced by and provided through Google Earth constructs a visual narrative possessing power and voice (Simms & Carpenter, 2010) since the mosaic image is constructed of smaller images which vary in resolution and other characteristics. While scholars have heralded Google Earth as a tool for science, education, and “the masses” (A. Beck, 2006; Lisle, 2006; Patterson, 2007), the imagery Google Earth constructs has not been analyzed using visual methodologies such as approaches taken by Rose (2001) and others who treat objects within images as text. Whereas a content analysis of Google Earth would be a direction for future research, it may not be a suitable approach for this discussion. Instead, I am interested in approaching the dynamism of Google Earth, which is more

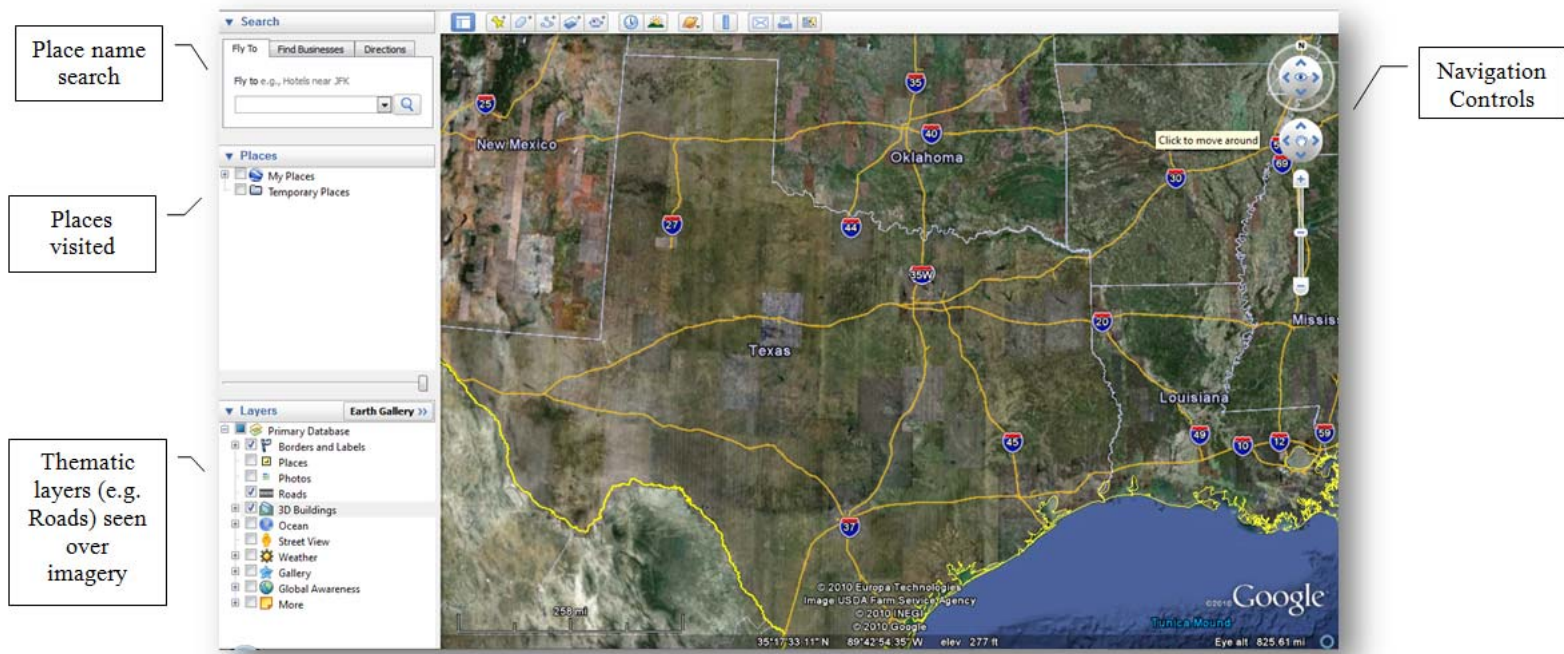


Figure 4-1  
*Google Earth Interface.*

closely related to film than to still photography.

### **Purpose and Research Question**

In this article, I explore the language of film and compare it to the language of Google Earth. This exploration and comparison will lead to a discussion of how narrative functions within and through Google Earth. For the purpose of this discussion, I am referring to “narrative” as a tool for communication as opposed to a form of language. In this context, film can be characterized as communicating through storytelling (dialogue-dependent) narrative while Google Earth communicates through visual narrative. Next, I discuss how plot points, the driving mechanism of Academically-based Entertainment-Education model (ABEE), can be adapted to work within the Google Earth environment to develop novice-driven learning experiences facilitated by a non-linear environment. This approach is guided by the following questions: How might the narrative and linear mechanics of plot points (the filmic narrative convention for driving the story or plot) manifest in a non-linear environment? How might the non-linear version of plot points be used to direct a learning experience under the user’s navigational control? How can this model be used to develop educational experiences in non-linear media?

### **Background**

#### ***Language of film***

Although narrative manifests in varying ways in each of traditional media formats, for this discussion I treat “narrative” in terms of film. Specifically, I utilize David Bordwell and Kristin Thompson’s (2008) conceptualization of filmic narrative to



guide the following discussion because of the similarities Google Earth possesses to cinema, which will also be discussed in turn. According to Bordwell & Thompson (2008) (referred to as “B&T” from here on), narrative structure in film (Table 4-1) is composed of story and plot, which have compositional elements of space, time, and

Table 4-1  
*Comparison of Characteristics of Film, New Media, and Google Earth.*

Film	New Media	Google Earth
Cinematographic qualities	Interactive	Aleph characteristic
Mise en scene	Internet-based	Interactivity
Narration	Labyrinth	Internet-Based
Space	Navigation	Spectacle
Spectacle		Virtuality
Story and plot		Virtuosity
Time		Visually-dependent

narration. The story is composed of narrative events, while the plot “describe[s] everything visibly and audibly present in the film” and includes the story (Bordwell & Thompson, 2008, p. 76). In other words, plot may be considered the explicit experience while story captures the implicit events not seen on screen, e.g. events occurring in a gap of time over which the film jumps in presentation or a character’s backstory. B&T divide narrative into three aspects: causality, time, and space (pp. 77-80). Characters are generally the agents “triggering and reacting to events” and these “actions and reactions contribute strongly to our engagement with the film” (p. 78). These authors frame

audiences as active consumers of narrative content. B&T point out "...in constructing the film's story out of its plot, the viewer is engaged in trying to put events in chronological order and to assign them some duration and frequency" (p. 80). B&T further describe time as present in narrative as a mechanism to order events, e.g. mentally rearrange film narratives that utilize flashbacks or flash-forwards, and as a mechanism of the film experience, e.g. the time span of filmic events is compressed or expanded to fit in the film's running time. For example, most feature-length Hollywood films run 90-120 minutes, yet the stories they tell can cover events spanning a couple of days to a lifetime of its characters. Next, B&T refer to space as the narrative's locations as well as the screen space utilized in each scene.

Mechanically, films may utilize two techniques for moving the story forward. First, narration serves as the cues provided by the plot to supply or withhold information to create suspense or expectations. It is "the plot's way of distributing story information in order to achieve specific effects. Narration is the moment-by-moment process that guides us in building the story out of the plot" (Bordwell & Thompson, 2008, p. 88) and can be accomplished by a character in the story or documentary-style unseen commentator. Second, the story is moved forward through scene progressions, the boundaries of which are the physical cut to a new location (p. 97).

Lastly, B&T describe a film in terms of its *mise en scène* showing an unplanned/uncontrolled characteristic. How the scene is framed including staging, lighting, costume, etc., which can be positively impacted by serendipity, for example when director John Ford took advantage of the added visual spectacle provided by an

approaching thunderstorm in the background of a scene in *She Wore a Yellow Ribbon* (p. 112). Due to cultural differences in defining realism, Bordwell & Thompson caution against using this term, choosing instead to focus on the functions of *mise-en-scene* in the films because in one context *mise-en-scene* may be used to create an impression of realism while another may use it for different effects. B&T list effects of comic exaggeration, supernatural terror, or beauty, for example, may be culturally defined or informed. As these authors suggest, analysis of *mise-en-scene*'s function should be in relation to the total film, i.e. how *mise-en-scene* is motivated, developed, or otherwise works in relation to other film techniques (Bordwell & Thompson, 2008, p. 113).

Finally, *mise en scène* also reflects the role editing plays in assembling the scenes into the final narrative. For example, "editing usually serves not only to control graphics and rhythm but also to construct film space....Editing permits the filmmaker to juxtapose any two points in space and thus imply some kind of relationship between them" (Bordwell & Thompson, 2008, p. 227). *Mise-en-scene* will be an important characteristic to consider in Google Earth which will be addressed in terms of composition of setting, props, lighting, and staging (movement and performance) to draw the viewer's attention, to emphasize meaning, and to create emotion. This characteristic will be address later in this discussion.

Lastly B&T show how the language of film operates through cinematographic qualities. The filmmaker "controls not only *what* is filmed, but also *how* it is filmed. Cinematographic qualities involve three factors: (1) the photographic aspects of the shot, (2) the framing of the shot, and (3) the duration of the shot" (Bordwell & Thompson,

2008, p. 162). The combination of narration, cinematography, and *mise en scène* compose the language of film.

### *Spectacle and baroque*

In film, these elemental parts function together to produce the entertainment product that Angela Ndalians (2004) ties to the “spectacle” of the baroque period of Western art. During the baroque period, artists produced works that “evoke[d] emotional states by appealing to the senses, often in dramatic ways...[often using the qualities of] grandeur, sensuous richness, drama, vitality, movement, tension, emotional exuberance, and a tendency to blur distinctions between the various arts” (Pioch, 2002). Dutch painter Jan Vermeer’s work *The Geographer* (currently held at the Städel Museum in Frankfurt am Main, Germany) provides an example of the baroque style (Figure 4-2). Notice the richness of materials represented in his painting such as the opulence of the tapestry draping the desk. Vermeer depicts a man gazing out of a window viewing the three dimensional world yet working with a two dimensional presentation (a map). Vermeer’s use of “conspicuous exclusion”, whereby the glaring absence creates the presence of the omitted (Berger 1972, p. 244), invites the viewer to consider the idyllic as a parody. Vermeer’s light illuminates the repositories of knowledge in *The Geographer*: the maps lying on the work surface and the floor, the Geographer in thought, the globe on the cabinet (Bird 1999, p. 120). There is a shadow cast on the back wall that can logically be inferred as originating from the configuration of the globe and cabinet, also mimics the pose of the Geographer. Bird (1999, p. 120) points to this shadow as a representation of a “haunt[ing] by an(other), a different geometry that



Figure 4-2  
*Vermeer's The Geographer (Wikipedia Commons, 2005).*

decenters, where vision is frustrated and something darker, something ‘unconscious’, enters in”. Bird (1999) describes Vermeer as “depicting ‘thought’ itself”:

Vermeer was painting as the discourses of science, philosophy and medicine and their respective apparati were reformulating the concept of the subject, and the mind/body dualism was shifting in favour of the embodied subject and an altered conception of an active, interior consciousness production – not merely reflecting – external reality. Leibniz, following Spinoza, pictures the mind as analogous to a curtain, its gently oscillating folds representing ‘innate knowledge’. The ‘monadic’ subject’s privacy and interiority constantly breaks against the materiality and chaos of the physical world (Bird, 1999, p. 119).

Bird’s use of the emotion-imbued term “haunting,” evokes a sense of drama in this painting which characterizes the baroque style of the 17<sup>th</sup> century.

### *Language of Google Earth*

Modern scholars have used the baroque style as a lens to analyze modern media. For example, Angela Ndalians argues “mainstream cinema and other entertainment media are imbued with a new-baroque poetics” (Ndalians, 2004, p. 5), framing cinema as possessing the same “aesthetics of astonishment” (she credits Tom Gunning with the term) as its static ancestor, whereby both demonstrate “a baroque concern with exhibitionism, virtuosity, spectacle, and active audience engagement” (Ndalians, 2004, p. 181). The “baroque concern” is further inculcated through contemporary effects, which share “the tradition Gunning has characterized (via Sergei Eisenstein) as the “cinema of attractions” (Ndalians, 2004, p. 182), yet is expressed in “technologically

and culturally different ways.” (Ndalianis, 2004, p. 5). The combination of visual, auditory, and text is expressed in Google Earth in a way made possible only through digital media and parallels neo-baroque’s “means of using the image in ways that may transport users to a new period of technological reenlightenment” (Ndalianis, 2004, p. 6). In the case of Google Earth, this new technology provides the ability to view every part of the Earth’s surface at one time, and in levels of detail never before possible, with the ability for users to overlay data or annotations. These abilities work together to create the narrative space in Google Earth.

With technology at the root of the neo-baroque characterization, Ndalianis suggest how narrative is being changed, and extended, by this new era stating:

Entertainment forms such as computer games, comic books, theme parks, and television shows have become complexly interwoven, reflecting the interests of multinational conglomerates that have investments in numerous media companies. One media form serially extends its own narrative spaces and spectacles and those of other media as well. Narrative spaces weave and extend into and from one another, so much so that, at times, it is difficult to discuss one form of popular culture without referring to another. In turn, this phenomenon has given rise to theoretical catchphrases that are believed to be specific to our era—an era of the simulacra and the fragmentation of ‘meaning’ (p. 33).

I argue this cross-reference of narrative forms is necessary for Google Earth to be utilized in the manner which I am proposing with ABEE. In fact, Google Earth presents Ndalianis’ “three most familiar metaphors that conjure images of the new experience of

narrativity...navigation, the labyrinth, and the Web....” (Ndalianis, 2004, p. 122).

Google Earth is dependent on the Web; while the software application itself resides on the user’s computer, the imagery and most content layers are streamed to the user over the Internet<sup>2</sup>. As an interactive medium, Google Earth users control the navigation of the visual scene, zooming in and out, “flying” here and there, and manipulating the layers of visual images (data) to create his or her desired experience and meaning. But the characteristic of Google Earth that appears to be the most captivating for casual users is the seemingly endless possibilities for exploration of the global imagery. Although organized into a logical sequence that forms a three-dimensional mosaic, the experience of interacting with Google Earth creates a labyrinth by virtue of the user’s ability to zoom in or out and navigate in all cardinal directions. In exploring Google Earth myself and in observing others, both adult and child alike, it is not uncommon for users of Google Earth to become disoriented when viewing unfamiliar locations. Becoming engrossed in exploration, I have gotten lost, unsure what part of the world I ended up in. It takes zooming out to a broader perspective to reorient myself. It is in this ability to change one’s position in altitude in addition to latitude and longitude which creates an implicit three-dimensional maze. As one navigates in the X, Y, and Z planes of three-dimensional space in GE, greater or lesser detailed imagery is presented to the user, contributing to the spectacle of GE. The spectacle of GE maps directly to Ndalianis’ point about cinema having the ability to lure audiences “into the characters, objects, and

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<sup>2</sup> Google Earth does allow imagery to be cached on the user’s computer to work in “off-line mode”, but the point remains that updates to the content, not to mention the original initiation of the application, requires Internet connectivity.



environments that are contained within the ‘box’ of the computer or television screen: We emotionally, empathically, and perceptually enter the microcosmic worlds of virtual reality through our direct interaction with them” (Ndalianis, 2004, p. 151). Instead of a fascination with characters, Google Earth users may be experiencing a fascination with places and the things found there. I argue that these places and things are the building blocks needed to construct a narrative and create an ABEE experience teaching geography concepts through the “language” of the visually-dominant new media of GE.

Primarily, GE possesses the characteristic of what Mirzoeff (1999) calls “virtuality”, whereby “what is not real, but rather realistic, appears as real” (Simms & Carpenter, 2010, p. 135). If, as Ndalianis contends, virtuosity is an integral feature of neo-baroque, then Simms and Carpenter (2010) elucidate the neo-baroque qualities of GE. They argue that the image of the earth presented by GE is not a single image but instead is a composite of smaller images assembled into a large mosaic. These smaller images vary in age, spatial resolution, and visual quality. When one zooms into a location, it is not uncommon to find a clear boundary between images with one taken in a different season from its neighbor or possessing a higher or lower visual resolution. Such variation occurs throughout GE and is part of its nature. In order to facilitate dynamic zoom ability of GE, the user is not actually zooming into the same image. Instead, he/she is visually experiencing something similar to the illusion of animation that a flipbook provides. When one “flies” from outer space down to one’s backyard, GE delivers multiple images beginning from the grand view provided by a satellite image to subsequently larger resolution images (the larger the spatial resolution, the less real

estate is in view) and ending with aerial photography as opposed to magnifying a picture to obtain finer details. GE is more like viewing a sequence of individual pictures of a person where we see the full length of their pose, to a medium shot picture (composed of their head and torso), to a head shot picture (from the shoulders up), to a close-up picture (face), to an extreme close-up picture (just their eyes).

Moving beyond virtuosity and virtuality, GE shares another characteristic with the neo-baroque. Ndalianis describes neo-baroque and baroque periods as using technology to push the perceptual boundaries of audiences by:

...collapsing and testing the boundaries that separate representation from reality and confronting viewers with technological tours de force. In the virtuoso construction of represented realities, audiences are invited to engage self reflexively with the works' technical and technological processes of construction. Furthermore, the (neo-)baroque constructs spectacles that strategically make ambiguous the boundaries that distinguish reality from illusion (Ndalianis, 2004, p. 105).

Further contributing to the virtuality effect, GE creates the illusion of three-dimensional landscapes through the use of a mathematical model of the earth's surface undergirding GE's three-dimensional representation of the imagery. The three-dimensional effect of the landscape, allowing a user to feel as if they are flying through the Grand Canyon or diving underwater to navigate the Pacific ocean's floor, is facilitated by overlaying imagery onto a mathematical mesh like one lays strips of gluey paper over chicken wire to make a paper maché piñata. The peaks and valleys of the model of the earth's surface

push and stretch the imagery to emulate three-dimensional relief (Fig. 4.3). This type of representation and the ability to see any part of the world in a way that is impossible in the natural, directly maps to Ndalianis's description of neo-baroque as complicating the "classical spatial relations through the suggestion of the collapse of the representational frame" and engaging the audience in a new spatial relationship with the viewed object since "rather than providing a statically ordered perspectival arrangement, the center continually shifts, the result being the articulation of complex spatial conditions" (Ndalianis, 2004, pp. 152-153).

Whereas neo-baroque "instigates participatory spectatorial positions through dynamic compositional arrangements," GE instigates participation through a dynamic user interface where the audience "drives" their own experience. In this way, navigation is truly in the hands of the GE user. Consider the parallel with Ndalianis' (2004) point:

With borders continually being rewritten, (neo-)baroque vision provides sensorial models of perception that suggest representational worlds that lose the sense of one center. Rather, the center is now to be found in the position of the spectator. Given that (neo-) baroque spectacle provides polycentricity and multiple shifting centers, the spectator, in a sense, is the only element in the image/viewer scenario that remains centered and stable. The audience's perception of an active engagement with the image orders the illusion" (pp. 152-153).

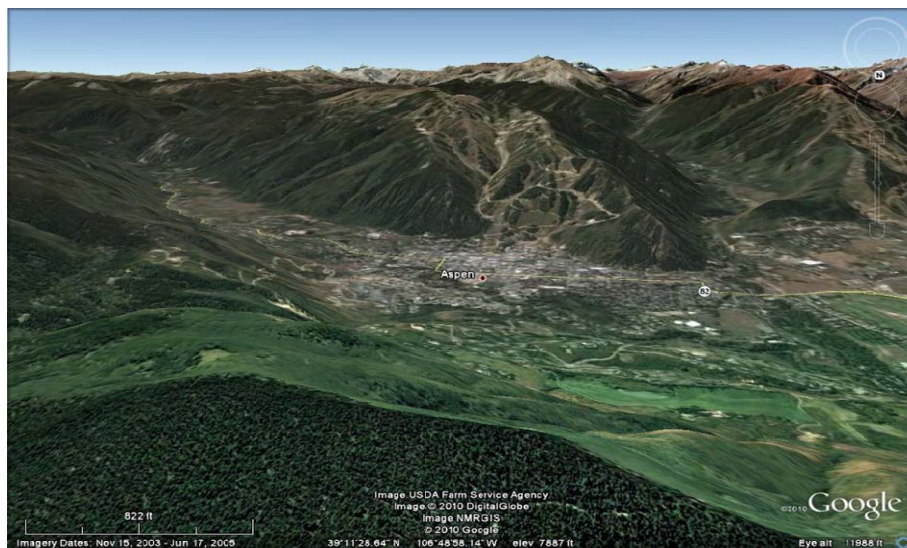
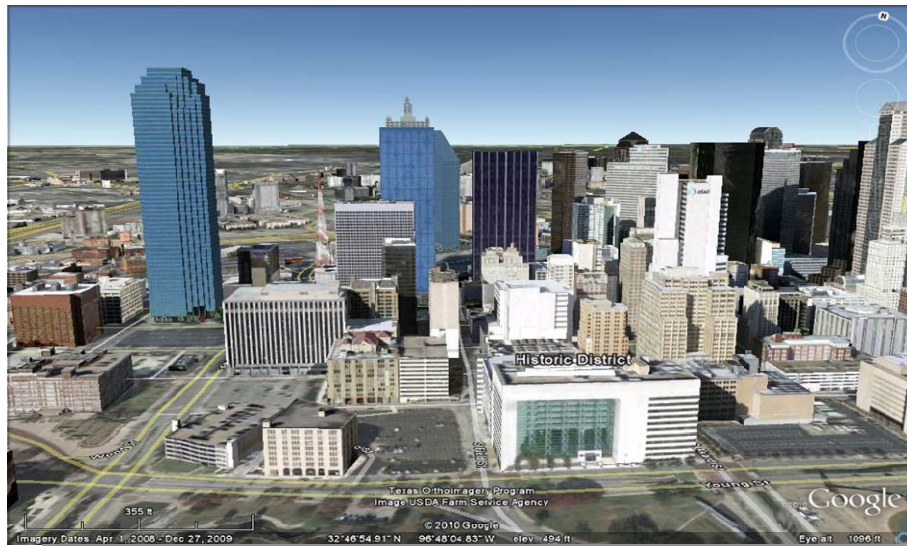


Figure 4-3  
*Enhanced Imagery from Google Earth.* Images of Dallas, Texas (top) and Aspen, Colorado (bottom), populated with three-dimensional models acquired on November 24, 2010 demonstrate how Google Earth enhances satellite imagery and aerial photography through simulated topography and models of buildings.

In this statement, Ndaliansis' concept crystallizes the connection between GE and neo-baroque and therefore how it functions as an entertainment medium like film and television. Since GE's representation of the world is a constructed image not unlike the constructed cinematic image, GE functions as a narrative medium similar to film and television. However, the narrative base of GE differs from film and television. Even though film and television are visual media, they are driven by text-based narrative made explicit through spoken dialogue. If one mutes a film or television program, the full narrative's detail and story nuance, may not be conveyed. While scholars such as Mirzoeff (1999, p. 10) would disagree with my statement, I point to the silent films of cinema's earliest days as support. In the absence of sound, silent films utilized text (written words) to aid the audience in understanding the story. In this respect, the narrative modality of GE may communicate more similarly to that of silent films, but instead of featuring actors and sets, GE presents an experience where landscape features serve as the actors and as the stage upon which three-dimensional buildings and annotated "placemarks"<sup>3</sup> (Fig. 4.4) are placed. However, if we treat GE as a space in which a narrative can reside, we need to elucidate the mechanism through which GE communicates.

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<sup>3</sup> Placemarks are visual notation icons (in the form of a pushpin) used to mark a location (Google Inc., 2009).

A placemark with a pushpin icon, expanded to reveal text.

A placemark with a tab icon, unexpanded to hide text.

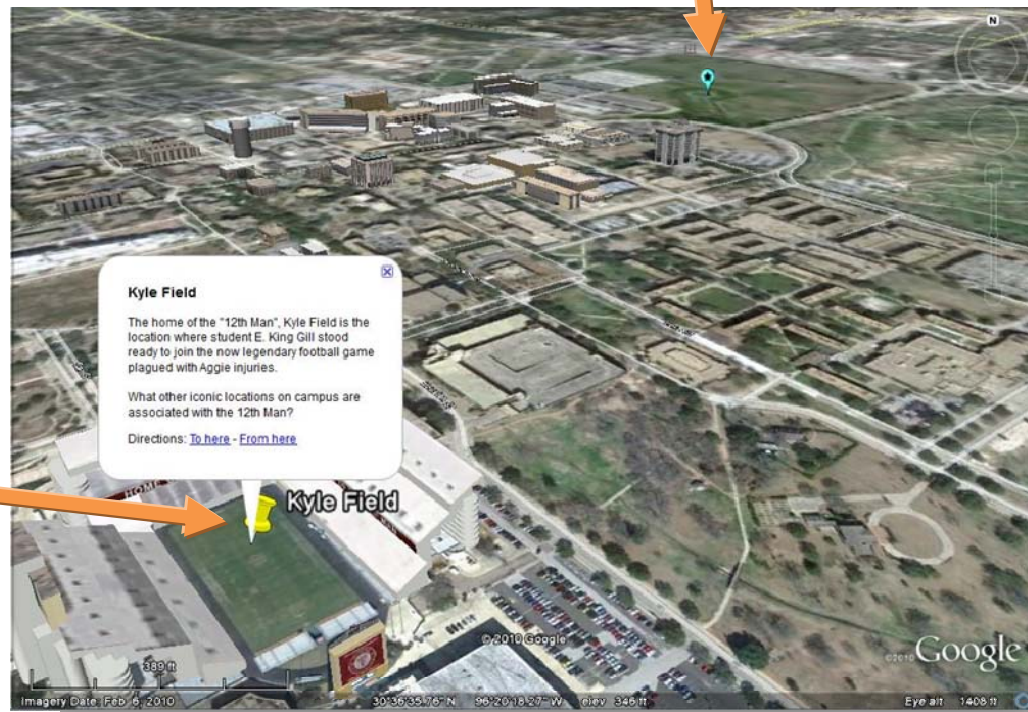


Figure 4-4  
*Placemarks in Google Earth.*

### *Non-linear narrative*

Despite the differences which I have thus far pointed to between traditional media and new media, the characteristic of narrative remains the same. Ryan (2004) defines narrative text as:

...one that brings a world to the mind (setting) and populates it with intelligent agents (characters). These agents participate in actions and happenings (events, plot) which cause global changes in connected states and events that captures a segment in the history of a world and of its members (p. 337).

Differences between the two media genres can be found in the way they each embody narrative. New media presents experiences that traditional media cannot, primarily through interactivity. For example, websites provide interactivity by allowing the user to click on text, commonly called hypertext (Deemer, 1994; World Wide Web Consortium, n.d.), imbued with the ability to navigate to a new page or other content. As Ryan describes:

...hypertexts are networks of textual fragments, called “lexia” or “textrons,” connected by links. Readers move through the text by clicking on buttons, and, since most fragments contain many buttons, readers have a choice of many different itineraries. The significance of this multiplicity has been an object of endless theorizing. Of special relevance to our topic is the claim that, since every reading follows a different path, hypertext is capable of endless self-regeneration. I call this interpretation the Alephic conception of hyper text, by analogy with ‘The Aleph,’ the short story by Jorge Luis Borges in which the scrutiny of a

cabalistic symbol enables the experience to contemplate the whole of history and of reality, down to its most minute details. The Aleph is a small, bound object that expands into an infinity of spectacles, and the experience could therefore devote a lifetime to its contemplation. Similarly, hypertext has been conceived as a matrix that expands into a multitude of texts, as readers unravel new strings of signs from its finite database of discrete lexia (Ryan, 2004, p. 340).

Ryan's alephic conception applies to virtual globes like GE. Because of the ability to click on a location and zoom into a closer view, every pixel in GE could be read as a hypertext link<sup>4</sup> and as such could "[become] a machine for the production of stories, just as the grammar of a language is a machine for the production of sentences" (Ryan, 2004, p. 340). In this discussion, however, I am not concerned with the implicit narrative that each image possesses or the narrative created by the juxtaposition of imagery to form the GE mosaic (see Simms & Carpenter (2010) for a treatment of GE imagery in terms of voice and power). Instead, my interest here is in exploration of GE as a stage upon which narrative is performed. In order to engage in such a treatment of GE, I present the following section to consider the characteristics of the stage itself and the ways in which it influences the performance of the narrative.

### ***The dual nature of Google Earth***

The co-dependent characteristics of visuality and nonlinearity give GE its unique structure when compared to traditional media. First, GE is a visually dominant medium

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<sup>4</sup> Google Earth may more appropriately be called hypermedia, defined as "hyper text which is not constrained to be text" (World Wide Web Consortium, n.d.) such as images or sound. However, to avoid confusion in this discussion, I will use hypertext to refer to all linked media, be it text or image.



that presents imagery of the earth and other celestial objects locked in time like traditional photography. Because GE is devoid of text (aside from annotated placemarks residing in a layer placed over the GE imagery), it presents a visual narrative that communicates in a different language from dialogue-dominant film, television, or radio. Second, GE possesses an interface that facilitates interactivity for the user that can be used to present either a linear experience similar to film or television or a nonlinear experience driven by the user. Such interactivity and ease of use position GE as a tool for geographic exploration providing unprecedented access to global imagery that would otherwise be financially prohibitive for most U.S. citizens. While there is a growing body of evidence that GE can bring some aspects of science to the masses (e.g. A. Beck, 2006; Cuff, Hansen, & Kang, 2008; Goodchild, 2007) creating “citizen scientists”, others are questioning the reliability of data generated by (presumably) untrained volunteers (Flanagin & Metzger, 2008). While it may be true that GE provides an intuitive user interface making exploration possible by those untrained in satellite image interpretation, scholars have not explored the efficacy of GE as an *unaided* educational tool, that is to say without the support of expert instruction. I suggest that just as one cannot easily learn to read without guided instruction, it may also be the case that one cannot learn to “read” the landscape simply by viewing images in GE. While no published research is currently available on the teaching efficacy of GE, educators may intuit that some level of expertise is required to make effective learning experiences. Therefore, it may be necessary to augment GE with a tool that serves as a proxy for the presence of an expert yet retain the quality of having the novice drive the experience.

This is the role that ABEE can fill. Providing a narrative layer on top of the GE experience to facilitate a deeper learning experiences than what is provided by aimless or undirected exploration. To a small degree, several organizations are already doing this by providing Google with thematic placemarks annotated with information about crises occurring at various world locations (currently found under the Global Awareness layer), e.g. United States Holocaust Memorial Museum (USHMM) placemarks with details of genocide in villages damaged or destroyed in Darfur, Sudan; Unicef placemarks detailing places struggling with water and sanitation issues; or World Wildlife Fund's conservation projects placemarks. When viewed as a group, placemarks function as conventional narrative text placed on top of a visual environment. I propose there is a narrative space present in GE that is not being utilized. Earlier I described GE as a stage upon which a narrative can be acted through the placement of three-dimensional objects, as well as the landscape features themselves serving as actors. It is within in this conception of visual narrative, maintaining visual as such instead of treating the visual as text, which I am proposing ABEE will function.

### **Translating ABEE for Non-Linear Environments**

Building upon Entertainment-Education's behavioral change model and through analysis of episodes of the American television series NUMB3RS, Simms (2010b) defines one way that entertainment can potentially be used as a teaching vehicle. She explicates how the writers of the show used mathematic concepts as key components of the story's plot to twist it in a new and surprising direction. These critical junctures of the story, termed "plot point", create the surprise and suspense needed to engage

audiences. By using math concepts to facilitate this engagement, Simms recognizes the potential for any academic concept to be used in a similar way as well as the potential to exploit this writing technique in order to multiply the potential teaching efficacy of the linear medium. However in a non-linear environment, the story is not necessarily consumed by the audience in order from start to finish. Since the consumer is in navigational control of his/her interaction with the non-linear environment, the consumer (as opposed to the author) may construct a different story each time they initiate the entertainment product by deciding what part of the story to consume and when, similar to the Choose Your Own Adventure (CYOA) books (Chooseco, 2010; Wikipedia, 2010) where at critical parts of the story, the reader has the choice of selecting from among three or four possible choices. For example, the hero needs to find the missing piece of her map marking the location of her kidnapped best friend. She now faces a fork in the road. The reader can (a) take the left path and pay the mysterious guard a toll to cross the river (go to page 23), (b) take the right path and talk to the woodland creatures (go to page 36), or (c) double back and rummage the pockets of the nemesis she just defeated (go to page 42). Because the reader chooses which direction the story will go, he or she becomes a co-creator with the author. In the non-linear environment of visually dominant new media such as GE, where text is minimal or non-existent, the concept of narrative and plot points require a measure of translation in order for the ABEE model to be applicable. In the case of GE, narrative may be expressed in the visual experience, similar to someone recounting their memory of walking through a new town and the sights and people they encountered. By using a tool in GE called “placemarks” (refer

back to Figure 4-4), an icon (such as a pushpin) functions as a hyperlink to bring up a window of text or images communicating something about that location, one can create an experience similar to the CYOA book . However, as a “go here, then go there” directive, this approach may be missing the surprise factor implicit in well crafted filmic narratives. One approach to this problem may reside in something originating from programmers of computer software and games who wanted to secretly leave their “mark” within their work.

### *Easter eggs and virtual surprises*

More common in computer video games, “Easter eggs” are virtual surprises that are revealed when the user executes a set of actions in a video game or website, e.g. the Konami Code sequence of key strokes in the order of Up, Up, Down, Down, Left, Right, Left, Right, B, A, Enter key (N.A., 2010a). For instance, executing the Konami Code at the Marvel Comics website (<http://marvel.com>)<sup>5</sup> will bring up a graphic of a squirrel ready for battle (Elliott, 2010). While there are other possible keystroke combinations or actions (N.A., 2010b; Nagy-Farkas, 1997; Wolf & Wolf, 2010c) that may uncover an Easter egg, not all instances of software or webpage surprises qualify according to Nagy-Farkas (1997, pp. 13-14). He requires a feature to (1) be undocumented in the software’s documentation, (2) be embedded by the original programmers, (3) be reproducible by more than one person, (4) not be malicious (i.e. not a computer virus or Trojan), and (5) be entertaining (that is to say, do more than enhance functionality or other practical

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<sup>5</sup> As websites are redesigned, Easter eggs may disappear. The Marvel Comics website is one example. I visited the site in November 2010 and found the Konami Code no longer launched this Easter egg on the landing page.

application). Today, the term is used in popular culture to refer to surprises and oddities appearing in film, television shows, and other entertainment products (Wolf & Wolf, 2010b). For example in the classic movie *Arsenic and Old Lace*, actor Cary Grant collects his thoughts while resting next to a grave headstone inscribed with the name Archie Leach, which is Cary Grant's birth name (Wolf & Wolf, 2010a). Regardless of the context in which it is used, the overall effect and connotation of the term Easter egg is the same. The discovery of an Easter egg provides a surprise for the user/viewer and these surprises could provide a vehicle for infusing filmic narrative techniques into the visual environment of GE. Just as an element of surprise is used in filmic narratives through a writing convention called plot points, I propose that the concept of Easter eggs can be used in a similar way. Whereas plot points serve as a writing convention in film and television to spin the story in a new direction, often by presenting an obstacle that the protagonist must overcome in order to reach the goal, I believe Easter eggs can be utilized to catalyze exploration as well as shape educational learning experiences in a non-linear environment. Utilizing the concept of story narrative to design curriculum put forth by Parrish (Parrish, 2008), where the student sits in the role of the Hero, the curriculum becomes the Hero's journey and plot points serve to challenge students, propelling them to deeper learning. Easter eggs can also serve as scaffolding tools for the learning experience, becoming the nonlinear counterpart to plot points used in traditional media. This dual role of Easter eggs, I believe, could be critical in facilitating a novice-driven learning experience.

So far, I have described the characteristics of GE and related them to traditional media to demonstrate the potential of this non-linear environment serving as a narrative space. I have described GE as a proverbial stage upon which a narrative can play with the items in the landscape of the imagery serving as the actors and the user's exploration creating the narrative. I have also mapped Easter eggs as the non-linear counterpart to plot points in traditional (linear) narrative. These are the pieces needed to manifest my vision of ABEE in a non-linear environment, however I have not yet described how these pieces fit together to actually create a narrative. Just as a film must "run" in order for the story to be accessible, so too must a non-linear story be set into motion. I am reminded of Pinar's (Pinar, 2004) theory that curriculum is not delivered but experienced as suggested by its etymon *currere*, Greek for "to run the race;" the process of learning is just that, a process. This word imagery evokes teaching and learning as being in motion, however just as it is difficult to learn to ride a bicycle while stationary, it is difficult to describe narrative in a non-linear environment because of its inherent characteristic of being created as the user interacts with the medium (i.e. is in motion). Writers of a form of non-linear theater called hyperdrama experience a similar challenge and this concept can serve as an analogue for what I am trying to achieve with ABEE.

### ***Hyperdrama***

Charles Deemer (2008a) characterizes hyperdrama as a theater experience which "challenges the single vision of traditional theater" by exploding the narrative into multiple branches occurring simultaneously, inviting the audience to become spectators

mingling on stage as the actors perform. Deemer (2008b) illustrates with the analogy of a family gathering:

Imagine your last family Thanksgiving dinner. Imagine that all of the people there are actors, speaking lines written by a playwright (mostly). The play, then, spreads throughout the house (which is the "theater") with scenes happening in the kitchen as the meal is prepared, in the den as guys watch football, in a bedroom as a private family squabble develops -- all these scenes and others happen at once. This is hyperdrama. And the audience? Drop them into the house like invisible voyeurs, able to wander around and through the action at will (Deemer, 2008b).

GE can be viewed as a living stage that presents a visual narrative of places and processes occurring on Earth's surface for the user who is "able to wander around and through the action at will" to use Deemer's words. To the user with little experience viewing imagery taken from an overhead "bird's eye view", the spectacle of the medium may overpower. I equate this phenomena with the "hiding in plain sight" anecdotal similar to when it is difficult to find your car keys you know are somewhere in your cluttered room. In GE, it may be difficult for inexperienced users to interpret the imagery and deduce patterns and processes, thereby restricting the potential of building knowledge of geography concepts. This is where I believe ABEE can be used to enhance the educational experience as a mechanism to direct, intrigue, or otherwise prompt the novice or casual user of GE to "dig deeper."

### **ABEE in Google Earth – Model in Motion**

Figure 4-5 provides one possible view in a snapshot of the motion of the ABEE model in a non-linear environment. The hyperdrama concept provides the mechanism to drive the co-creation of the learning narrative with the user by allowing the user to navigate to any placemark at any time. Within the hyperdrama, plot points manifest in the form of a network of Easter eggs and placemarks enticing the user to continue along the hero's path provided by Parrish's learner-as-hero. In addition to helping the user understand the visual narrative of the imagery, the placemarks provide cognitive support for the user. By utilizing the language of the medium, in this case the visual communication of satellite imagery and user-controlled navigation, ABEE serves as a bridge between entertainment and pedagogy to leverage the best of both worlds. Through a marriage of entertainment and education, ABEE provides an adaptable toolset for developing learning experiences deliverable through mass media not only supporting formal education, but potentially filling gaps formal education cannot. The manifestation of this model is demonstrated in the following scenario.



Expanded placemark

NASA provided content



Figure 4-5  
Example of ABEE Components.



Figure 4-5 (continued)

### ***How Easter eggs might look in Google Earth***

Users mesmerized by the GE experience may have enjoyed exploring for the sake of exploration just as in exploring a real landscape, for example a beach or wilderness path. When something catches your eye, you might stop to investigate. If you discover something surprising, like a beautiful seashell or witness wildlife in their natural habitat, there may be a natural sense of satisfaction and motivation to keep exploring for the chance of finding another surprise. Within the virtual landscape of GE, educators might insert Easter eggs to construct such surprises and leverage them for educational intrigue. Consider the following scenario:

*Imagine while exploring GE, you find yourself navigating around the three-dimensional buildings of Las Vega, Nevada. You “fly” around and between the extravagant structures and zoom out to around 4,000 feet for a great vantage point of the entire city and beyond. On the horizon to the east you notice something. It’s a shiny exclamation mark beckoning you to interact with it. Clicking on it transports you to 14,000 feet above a portion of the Grand Canyon in Arizona and a placemark window opens up. You read a cryptic message: “Wet feet twist into white dotted green.” You navigate along the river’s path at around 2,000 feet for the best view and notice many places along the shore where the bright white rocks and sand are dotted with trees. However, nothing remarkable has caught your eye to decipher the message. Returning to the placemark, you decide to try again, this time navigating just above the river’s surface (could that be the “wet feet” reference?). Twisting through the canyon, you see features you*

*noticed previously, but just around another bend, a shiny arrow appears. It points to the shore populated with a stand of trees. The arrow is an Easter egg whose reveal was facilitated only because you were navigating at its triggering eye altitude. You turn into the direction of the pointer and follow the narrow feeder canyon to another placemark. Opening it you read the next clue: "Turn around and look up." As you do, you are taken up to the elevation of a breathtaking vista and you notice the jagged, rocky landscape cut by the river. A host of placemarks appear along the Colorado River below. As you explore them, you read about the rock formations and their ages, the formative work of the river on the landscape, and the millions of years it took to provide you with this spectacular view. You also read about the river's headwaters and where the river begins and ends outside of the Grand Canyon. After exploring a few placemarks, you notice another shiny exclamation mark on the horizon. Clicking on it sweeps you across the ocean and positions you facing the Nile Delta on the Mediterranean shore of Egypt. The placemark opens and you read: "Divide and conquer." Navigating up the Nile River, you notice green agricultural activity undulating in an echoing pattern along the river's banks creating a starkly contrasting division with the hues of the adjacent desert landscape. Along the route, you stop to investigate the fingers of agricultural activity penetrating the desert. The label for the city of Edfou gives interesting information provided by GE. Areas around Edfou seem to have a linear feature, a kind of backbone. Maybe it is an irrigation system allowing the desert to be "greened". Could this*

*be the “divide and conquer” clue? You keep navigating upstream, investigating placemarks along the way. You come to Kum Ombo and notice the patterns formed by the agricultural fields and other land use. You continue south, noticing the sudden reduction in agriculture at city of Aswan. The GE label for Aswan provides a Wikipedia link where you learn it is one of the driest places on Earth. An exclamation mark appears as you approach the Aswan Dam. It reveals the explanation of how the double dam structure is used to control the river and store water. It also delivers the next mystery: “I am feed by international white and blue.” You continue upriver, crossing into Sudan finding yourself at Khartoum where the Nile is formed by two smaller rivers, the Blue Nile and the White Nile. You navigate to each river’s source; the Blue Nile to the east ends (or should I say begins) at Ethiopia’s Lake Tana. The White Nile flows from Lake Victoria in Tanzania. Realizing this lake is fed by several rivers, the ultimate origins of its waters come from Rwanda. Wait, there are a couple of other exclamation marks shining on the horizon. One in Liberia and the other further away to the east. You click the distant one which sweeps you over the landscape to China, settling at the headwaters of the Yellow River...*

In this hypothetical scenario, the exploration of the GE landscape is driven by Easter eggs in the form of placemarks that are hidden until the user navigates close enough in GE to trigger them to be revealed. The strategic placement of placemarks along rivers draws the user’s attention to the visual scene and the text provided within the placemark serves to encourage further exploration. Each placemark serves as the equivalent of a

plot point by both directing and potentially redirecting the user's attention to the visuals the creator of the placemarks aims to target. In this scenario, the educational target could be the rivers and how their situated contexts bi-directionally influence the landscape on the river (straight verses sinusoidal) and the impact of the river on the landscape (canyon verses estuary). Entered into the mix is human activity which impacts rivers (e.g. dam construction changes the landscape, provides irrigation which facilitates changes in landuse), as well as is influenced by rivers (e.g. settlement and agriculture facilitated by access to water).

While I am not suggesting that this depth of learning can or will be achieved simply through observation of images in GE, I do contend that Easter egg placemarks have the potential to scaffold users toward deeper learning through observation in the way plot points could in filmic narratives described by Simms (2010b). Such an observation-based form of teaching geography is not a new concept. It was championed as early as the mid-19<sup>th</sup> century by geographer and educator Arnold Guyot (Moore & Wilcox, 1932). Guyot was a proponent of "journey geography" whereby students learn not through rote memorization of place names, but rather as if taking a journey, for example down the Mississippi River:

From this, the cradle of the Mississippi, flows a little brook so small that you could easily leap across it, and not deep enough to prevent your wading through it. You would hardly believe that the little stream would become, on its way to the ocean, a great river large enough to carry vessels and steamboats through our country. Now it cannot carry even a little boat, and we must walk beside it as we

continue our journey along its course (p. 13 from *Primary Geography* as cited by Moore & Wilcox, 1932, p. 43).

With today's technology, virtual journeys can be crafted nonlinearly and controlled by the student/user of GE. Easter eggs provide surprise and intrigue designed to inspire further exploration and engagement into the mystery they present. They serve as a proverbial carrot along the path of discovery, and thereby as a type of plot point in this visual narrative to direct the user's focus while facilitating a natural progression through the narrative by sending the user (via the narrative of the exploration) to a different location and deeper into the discovery and learning process. Easter eggs allow the user to drive the experience, while providing direction and attention to what an expert might point out during a traditional teaching situation. Notice that the novice is still driving the experience and retains control of which direction to explore and which Easter egg to engage and when, resulting in an experience similar to Choose Your Own Adventure children's book series previously described. Such nonlinearity in this form of narrative is undergirded by borrowing from nonlinear form of theater called hyperdrama.

### **Conclusion**

Utilizing the visual and non-linear environment of GE, ABEE could support delivery of geography education outside the formal context of the classroom. The application of ABEE to GE may share conceptual resemblance to Type II uses of technology in education (Carpenter & Taylor, 2006; Gaytan, 2006) in that GE has already been used to create innovation in teaching (e.g. Goodchild, 2008; Google Earth Lessons, 2009; Jenkins, 2009; Kluge, et al., 2007), however I am not approaching this

subject from a formal education (classroom or instruction) perspective. In this discussion, I am interested not in improving teaching with its explicit instructional modality (not to say that classroom teaching is not important), but rather I am interested in how instruction can manifest in non-formal environments, thereby providing implicit instruction. In this environment, ABEE could work within the user-driven context to provide a learning experience embedded in GE, maintaining a native feel to the user. Files containing placemarks developed around the ABEE model could be served either through GE (i.e. embedded in), similarly to current sponsored content, or as independent KML files<sup>6</sup> on the developer's website or server. I have presented a scenario to demonstrate the use of the ABEE model as a "narrative" approach translated to a visual environment of GE, where the "text" is the imagery being explored and intended to teach through observation with placemarks hidden as Easter eggs, which also serve to catalyze exploration fueled by interest in solving the presented riddle. With an understanding of the ABEE model, an educator could create learning experiences similar to those proposed here. Teachers, activists, students, citizen scientists, or anyone with the desire to educate could create impactful experiences in GE through the ABEE model. In return, users of GE might benefit from new knowledge and could be scaffolded towards higher levels of geographic literacy. Future research could explore the application of game theory and interactive game design to transform the experience from a causal exploration to an intentional search or goal quest resembling game play of current video and computer games.

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<sup>6</sup> Keyhole Markup Language (KML) is the file format of Google Earth placemark files.



## CHAPTER V

### CONCLUSIONS

In this dissertation, I have traversed a path that connects the past and the future of Entertainment-Education by expanding its territory beyond the area of health education in which it has been used extensively to date. At the heart of the E-E methodology is the use of narrative, which is leveraged to provide a learning experience for entertainment consumers. Humans learn through observation, and learn more effectively when motivated through an emotional connection to the subject or the role model presenting the subject, be it a classroom teacher, a colleague, or an entertainment “star” (Bandura, 1986; Gardner, 2004; Sabido, 2004). By categorizing the existing body of literature in Chapter II, I have revealed not only the difficulty of finding appropriate literature upon which to base a literature review to address the question of how E-E might be used to teach academic concepts, but also used the metaphorical negative space revealed by creating a literature index to illuminate an area into which E-E can grow. This literature index revealed an interesting paucity of the use of E-E in communicating science or other formal education subjects, indicating a large territory into which the discipline could be expanded. With an E-E background established, I discussed in Chapter III the development of a model for using the traditional E-E methodology in a new arena, that of academic learning. Accomplished through analysis of a successful U.S. television series, I have developed an approach to using academic subjects to drive E-E stories, creating what I call an Academically-Based Entertainment-Education (ABEE) product or intervention. Lastly, in Chapter IV, I applied this new model to the non-linear

environment of new media as a way of understanding, and in some ways redefining, ABEE in a user-driven entertainment venue.

### **Implications for Geography Education**

When used for geography education, ABEE holds the potential to produce learning experiences that not only leverage the power of the entertainment medium, but do so utilizing the narrative of both text and visual modalities. I can imagine using ABEE to develop film and television products in a variety of contexts and styles such as:

1. An animated show in the style of *Blue's Clues* for preschool-aged children that develops spatial thinking skills through the adventures of a bird. Instead of looking for clues from the eyelevel of Blue the Dog, my geography version would explore for clues from the bird's eye-view providing viewers with experience in interpreting the landscape and identifying objects from an overhead perspective.
2. A prime-time television adventure series where a strong female protagonist uses her analytical geography skills to understand and combat social injustices and environmental dangers.
3. A layer in GE providing exploration adventures with hidden Easter eggs leading gamers to view landscape features, the synthesis of which lead to development of the essential skills and knowledge recommended in the National Geography Standards (Geography Education Standards Project, 1994).

Because ABEE is rooted in narrative, and stories are creative products as flexible and expansive as the human mind, I suggest that the possibilities ABEE presents for teaching

geography are just as limitless. Neither is ABEE limited to geography but could be utilized for any academic subject or concept.

### **Implications Beyond Geography Education**

ABEE was not created within a disciplinarian vacuum. Instead, it was derived from a mathematics-based television show that utilized math and logic not as context but as a narrative driver. By remaining context-independent, ABEE can potentially be used to communicate academic concepts from any discipline. The story becomes about how the concepts function as opposed to a story being rooted in a math setting. For example, contrast the television series *NUMB3RS*, about a mathematician who uses his math genius to solve crimes (math drives the story; any discipline could be substituted for math) with the movie *A Beautiful Mind*, about the challenges mathematician's battle with mental illness (math as context; any infirmity could be substituted for mental illness).

### **Future Research**

The model developed here can be refined through analysis of other television programs which integrate academic subjects into their narratives. It may also be refined through use, for example in assessing educative efficacy of ABEE interventions. Unless similar programs to *NUMB3RS* are identified, refinement of the ABEE model may be possible only through use and assessment of ABEE interventions themselves through a trial and error approach. However, this situation does not represent a lost cause. Remembering that *Sesame Street* was a trailblazer and subsequent shows such as *Blue's Clues* have refined, and in some ways changed, the model for children's entertainment-

based literacy education, the development of efficacious ABEE programs and subsequent model refinement may require following a similar path.

Specifically for geography, one possible area of further research might be an investigation of U.S. television writing convention where storylines are divided into the “A story” (primary plot) and the “B story” (secondary or subplot separate from the action of the primary plot) (Epstein, 2006). The A story encompasses the main story line for the episode usually using the show’s main characters. Nuances of characters are often revealed or developed through the B story. For example, each episode of *White Collar* (Eastin, 2009) finds protagonist Neil Caffrey, a convicted white collar criminal helping FBI agent Peter Burke catch bad guys as the primary storyline, but the B story serves a clue needed for Neil to discover who killed his girlfriend Kate. In a variation, Disney Channel’s *Phineas and Ferb* presents a more equal treatment of the A and B storyline. Each episode finds older sister Candace doing her best to bust her younger brothers, Phineas and Ferb, for building wild inventions leading to grand adventures (A story) while the family pet platypus, Perry, sneaks away to perform his secret agent duties to stop the evil Dr. Doofenshmirtz from taking over the tri-state area (B story). While these two storylines are completely unrelated, they always merge at the end of the episode when Perry destroys Doofenshmirtz’s evil contraption but not before it destroys Phineas and Ferb’s grand invention just before Candace is able to deliver her mother to the scene to catch the boys in the act.

The writing convention of related-yet-separate storylines in television serials offers an interesting mechanism through which geography may be presented in its full

spectrum of relationships (e.g. connecting patterns with processes, and vice versa, instead of just presenting one or the other). With geography's dual nature of patterns and processes, it is conceivable that the equal treatment of A and B storylines could be utilized to focus on both aspects of a geographic concept with the end of the episode uniting the two, just as the writers of *Phineas and Ferb* do. In doing so, a television show could leverage the power of role modeling by the main character(s) to present how a geographer thinks as revealed through the action of the narrative.

The implications of this research path could reach far beyond geography education. As a potential outlet for educational outreach, ABEE interventions offer the potential to support formal education as well. Some innovative classroom teachers and college professors already find uses for film, television, and other forms of art and popular culture to either demonstrate academic concepts or to tie concepts to the world outside of the classroom. ABEE offers the potential to provide popular cultural artifacts that are more closely aligned with educational concepts. In this way, ABEE serves as a bridge linking the classroom to the lived experience, the formal to the informal. A healthy respect for both will be crucial for ABEE to succeed in a media-saturated society. In conversations I have had with entertainment industry professionals, it appears a bias exists associated with "educational" activities. That is not to say that Hollywood is intentionally "anti-education," but only that, in my experience, the adjective "educational" seems to be immediately associated with children's programming or public broadcasting. I believe ABEE would be severely limited in impact if it were restricted to this genre. Instead, I believe its greatest impact, will be seen if applied to

broader entertainment. The possibility of such application is in fact why I began this study with the analysis of *NUMB3RS*, a highly successful network television show.

Similarly, within the field of education, there may be a bias against entertainment as evidenced by the on-going debate over the existence of an intrinsic mechanism for learning within media (see "Media use in education," 1992 for a summary of the strong media verses weak media debate). Since ABEE merges entertainment and education, as opposed to layering one on top of the other, ABEE interventions may also usher in an era where the existing biases in entertainment against education and in education against entertainment are retired on both sides or at least revised significantly. When such a bi-directional relationship becomes established and manifested in for example ABEE-based television or film capable of building geographic literacy, I believe both industries (entertainment and education) will receive a significant benefit, but society as a whole will reap the larger reward.

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## APPENDIX B

## SCENES FROM SCRIPTS

Script pages for scenes from 7 of the 13 episodes<sup>7</sup> selected for analysis are presented here to show how the writers used math and logic concepts within the show. I have provided annotations to illuminate components relevant to this discussion.

## Episode #207 Convergence

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## Episode #220 Guns and Roses

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<sup>7</sup> Script excerpts are used with permission from CBS Studios and the individual screenwriters. Due to time limitations, I was not able to seek permissions from writers of all 13 episodes.

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## Appendix B (continued)

## Episode #207 "Convergence" (Heuton &amp; Falacci, 2005a), Scene 4

NUMB3RS #207/20 "Convergence" Goldenrod REV 10/3/05

5.

ACT ONE

4

**INT. FBI - WAR ROOM - DAY**

4

Begin  
Scene  
4

Don, Megan and Charlie, with an assemblage of evidence from SEVEN HOME INVASIONS. PHOTOS, family pictures, lists of stolen items, family contacts -- A HUGE GRID OF INFORMATION.

DON

LAPD asked for our assistance after the fifth home invasion. There's no useful forensics. They have weapons but haven't fired them in any of the seven robberies.

MEGAN

All the victim families live in exclusive neighborhoods, own expensive, valuable items. They have home security systems, but the attacks come right when they're arriving home -- when they've deactivated the system.

Charlie looks at the evidence board, seeing the faces of the victims, some badly beaten. Don steps up beside him -- indicates two photos -- two middle-aged MEN, dead.

CHARLIE

Who are they?

DON

Fathers. Both of them fought back, trying to protect their families.

Charlie turns away.

DON (cont'd)

We need to know how they're picking the homes. We've been using traditional methods.

MEGAN

But so far there's no commonalities between the families, other than all are wealthy.

DON

You have any other ideas?

(CONTINUED)

## Appendix B (continued)

## Episode #207 "Convergence", Scene 4 (continued)

NUMB3RS #207/20 "Convergence" Goldenrod REV 10/3/05 6.  
 4 CONTINUED: 4

Concept

CHARLIE  
 I would try **data mining**. A mathematical system for analyzing information --

MEGAN  
 Right, Army Intelligence uses it to identify possible terrorist activity --

DON  
 How would it work?

CHARLIE  
 I design an algorithm based on the crimes, it analyzes all the data and identifies correlations.

DON  
 Okay, we'll get you what we have on the seven families --

MEGAN  
 -- where they live, go to school, shop, dine out, who cleans their pools, repairs their cars --

CHARLIE  
 I'll need more than that.

DON  
 More on the families --?

CHARLIE  
 More on everything, all crime stats for the past six months for the county.

MEGAN  
 Won't that much data make it harder to find what you're looking for?

CHARLIE  
 The opposite -- more data means more chances to find something.

A beat as he searches for a way to explain --

CHARLIE (cont'd)  
 When you do a **jigsaw puzzle** --

Begin word picture

(CONTINUED)

## Appendix B (continued)

## Episode #207 "Convergence", Scene 4 (continued)

NUMB3RS #207/20 "Convergence" Goldenrod REV 10/3/05 7.  
 4 CONTINUED: (2) 4

ENTER AUDIENCE VISION:

Begin visual demonstration

A table top, maybe 10-20 pieces of a 500-piece puzzle.

CHARLIE (V.O.) (cont'd)  
 You start with a few pieces, the  
 rest are in the box --

See a BOX filled with hundreds of puzzle pieces --

CHARLIE (V.O.) (cont'd)  
All those pieces eventually fit the  
 picture -- all the pieces you need  
 and nothing more comes in the box.

The PIECES come together to create the complete PUZZLE IMAGE  
 (a beautiful, idyllic home).

CHARLIE (V.O.) (cont'd)  
 But with a real-world problem, the  
 pieces -- the data -- doesn't come  
 preselected -- presorted.

The PIECES fly apart again and end up back in the box.

CHARLIE (V.O.) (cont'd)  
 Using data-mining to find links in  
 real life -- it's like trying to  
 solve a jigsaw puzzle when the  
 pieces you need are mixed in with  
 pieces from many other puzzles.

FOUR ADDITIONAL, DIFFERENT PUZZLES appear -- break apart --  
 and the pieces fall into the BOX.

CHARLIE (V.O.) (cont'd)  
 Now, if you grab a few pieces from  
 the box --

A hand reaches into the box, grabs a fistful --

CHARLIE (V.O.) (cont'd)  
 -- most won't fit. You've got to  
 go through the entire box and pick  
 out the pieces that fit your  
 puzzle.

A selection of pieces rise out of the box, fall onto the  
 table, arrange back into a finished puzzle image.

(CONTINUED)

## Appendix B (continued)

## Episode #207 "Convergence", Scene 4 (continued)

NUMB3RS #207/20 "Convergence" Goldenrod REV 10/3/05 8.  
 4 CONTINUED: (3) 4

**BACK TO SCENE:** End visual demonstration

CHARLIE (cont'd)  
 The algorithm goes through it all,  
 pulls out what fits together.

Explanation

DON  
 I'll get you our Uniform Crime  
 Reports... End scene

5 **INT. FBI - INTERVIEW ROOM - DAY** 5

Megan with MRS. BLOOM, wife of the murdered Dr. Bloom. She's composed, but shows effects of trauma.

A FOLDER on the table. Photos, items from the Bloom House. Pearl necklace, gold figurine, watch.

MRS. BLOOM  
 These things, most have been in our families for years. That was my grandfather's watch.

She fights not to cry --

MRS. BLOOM (cont'd)  
 I don't care about any of that -- but Richard. He was only trying to protect our son --

MEGAN  
 I know, Mrs. Bloom. I'm sorry.

MRS. BLOOM  
 He just couldn't bear to see people hurt. It's why he became a doctor.

She gets a hold of herself.

MEGAN  
 I know this is hard... But I need to know whether this lamp is an authentic period piece?

He shows her a PHOTO of a Dirk Van Erp lamp. Brass and mica.

MRS. BLOOM  
 Yes, it was made by Dirk Van Erp. It's one of a pair.

Her voice goes quiet.

(CONTINUED)

## Appendix B (continued)

## Episode #207 "Convergence" (Heuton &amp; Falacci, 2005a), Scene 8

NUMB3RS #207/20 "Convergence" Goldenrod REV 10/3/05 14.  
7 CONTINUED: (3) 7

LARRY  
Your status singled you out.  
People scrutinize your work because  
of your reputation.

CHARLIE  
And that's why he's doing it, to  
ruin my reputation. The Eppes  
Convergence made me. If it's  
wrong, then what am I?

Larry's a touch annoyed --

LARRY  
(half to himself)  
A brilliant young theoretician with  
an ego problem?

CHARLIE  
What?

Charlie's cell rings -- he picks it up, listens -- hangs up.

CHARLIE (cont'd)  
I gotta go -- the computer lab says  
the algorithm for Don's case kicked  
out some findings --

He heads out --

LARRY  
Wisdom and genius -- rarely present  
in equal abundance.

8

**INT. FBI - WAR ROOM - DAY**

8

Begin  
Scene  
8

Charlie tapes up a SCROLL of PRINTOUT on the windows. A LINE  
of CALENDAR DAYS in linear progression. He's also put up  
several normal calendars. He stands back to take it in for a  
moment. Then dives forward and circles days with a marker.

Colby at the door, looking in. Don and Megan walk up.

COLBY  
Your brother's starting to freak me  
out a little.

DON  
Just a little?

Don smiles, walks up to Charlie.

(CONTINUED)

## Appendix B (continued)

## Episode #207 "Convergence", Scene 8 (continued)

NUMB3RS #207/20 "Convergence" Goldenrod REV 10/3/05 15.  
8 CONTINUED: 8

DON (cont'd)  
What's up?

CHARLIE  
Calendars are wonderful analog  
mathematical tools. They create a  
universal timeline for societies  
by interpreting astrophysical  
movement.

Begin word  
picture

MEGAN  
What are you talking about?

CHARLIE  
A calendar isn't based on easily  
divisible factors. They originally  
tried to make them like that -- 360  
days divides evenly, but it doesn't  
match what you see in the night  
sky. So ancient calendars would  
add an extra month every eight  
years or tack on five extra --

Don steps closer to the PRINT-OUT -- looking -- at seven  
days marked in RED, five in BLUE.

DON  
This is on the home invasions?

CHARLIE  
Once I got the data mining  
algorithm up and running, I started  
a Fourier analysis of the  
chronology -- the dates and times --

Concept

COLBY  
We looked for a timeline pattern,  
we couldn't see one --

CHARLIE  
Because you didn't look in the same  
way my analysis looks --  
(pointing to the printout)  
The red days are known attacks,  
blue days are when the analysis  
says there should be attacks, but  
there aren't. What I want to ask  
is: How do you know there aren't?

DON  
No home invasions on those dates --

(CONTINUED)



## Appendix B (continued)

## Episode #207 "Convergence", Scene 8 (continued)

NUMB3RS #207/20 "Convergence" Goldenrod REV 10/3/05 16.  
8 CONTINUED: (2) 8

CHARLIE

But maybe these same guys commit other types of crimes.

MEGAN

You mean, not just home invasions --

Explanation

DON

So, if we identify new crimes, maybe we find new evidence.

CHARLIE

I think you should look for crimes by gunmen fitting the same description, occurring in the times I've marked in blue.

MEGAN

Charlie, the pattern -- can it tell us when to expect the next attack?

CHARLIE

Patterns like this are clearer in hindsight, but difficult to use as predictors. There's an erratic frequency -- some robberies a few days apart, followed by a break, then one or two hits, followed by shorter breaks --

DON

Anything would help --

Charlie takes a minute to think, hard, then goes to the printout -- points --

CHARLIE

This is my best guess -- it's possible the next attack could occur in as soon as three days.

End scene

END OF ACT ONE

## Appendix B (continued)

## Episode #207 "Convergence" (Heuton &amp; Falacci, 2005a), Scene 11

NUMB3RS #207/20 "Convergence" Goldenrod REV 10/3/05 19.  
 10 CONTINUED: 10

MEGAN  
 We do -- the Porsche robbery. One of the guys on the crew fired into the air to scare the owner.

DAVID  
 We find that bullet -- maybe we could match it --

COLBY  
 Hold on. Find a bullet fired straight up? That won't be easy.

DON  
 But not impossible. Find the cops who first responded to the call.

DAVID  
 They would have done a neighborhood canvass to try to ID the type of round that was fired.

DON  
 (to Megan)  
 Talk to the carjack victims. And let's see if we can run down the lead from the antique store owner, find this fence named Roley.

11

**INT. CHARLIE'S OFFICE - DAY**

11

Begin Scene 11
----------------------

Charlie sits at his work table. Watching an ANT FARM.  
 David and Colby walk in, see Charlie transfixed.

Begin word picture
-----------------------

DAVID  
 Bad time?

Charlie looks up -- surprised but not embarrassed.

CHARLIE  
 No. Come in. I'm waiting for a new run of the data mining program.

They enter, look at the ants. Charlie points.

Concept
---------

CHARLIE (cont'd)  
 Emergence theory. The whole is greater than the sum of its parts.  
 (MORE)

(CONTINUED)

## Appendix B (continued)

## Episode #207 "Convergence" (Heuton &amp; Falacci, 2005a), Scene 11 (continued)

NUMB3RS #207/20 "Convergence" Goldenrod REV 10/3/05 20.  
 11 CONTINUED: 11

CHARLIE (cont'd)  
 Individually, ants have limited capabilities, but the colony can be viewed as a single, complex organism. But you aren't here to talk about ants, are you?

COLBY  
 Actually, we have a little bet. David here thinks you might be able to help us find a needle in a haystack.

DAVID  
 A bullet in Brentwood, to be exact.

COLBY  
 Checking the time periods where you said there might be related crimes, we found three carjackings. There was gunfire at one.

DAVID  
 We find that bullet, maybe we can match it to a gun.

Charlie gets up, goes to a chalkboard.

CHARLIE  
 The bullet -- was it fired parallel to the ground, or at an angle?

DAVID  
 According to the crime report --

He points a finger straight up --

DAVID (cont'd)  
 -- into the air. Not sure of the exact angle.

CHARLIE  
 And what type of gun?

David and Colby exchange a look --

COLBY  
 We don't have that for sure, either.

CHARLIE  
 Okay, so we'll be working with at least two variables --

(CONTINUED)

## Appendix B (continued)

## Episode #207 "Convergence", Scene 11 (continued)

NUMB3RS #207/20 "Convergence" Goldenrod REV 10/3/05 21.  
 11 CONTINUED: (2) 11

He starts writing an equation --

End scene

12 INT. FBI - WAR ROOM - DAY 12

Megan gets off the phone as Don comes over. She's got files and printouts around her.

MEGAN

That was the third carjack victim. Just like in the home invasions, these guys knew about specific valuables. They took his watch, even though he had it hidden under his jacket. They made Victim two give up a \$55,000 ring.

DON

Were the victims followed, forced to pull over?

Megan goes to the board, puts up a report for each victim.

MEGAN

No. Carjack Victim One locked his keys in his car. Called Triple A on her cellphone. Only ten minutes later, these guys show up.

She puts up a second report.

MEGAN (cont'd)

Victim 2 got lost, entered the destination into her navigation system. Victim 3 ran out of gas, called his on-board assistance service, spoke to a real operator. But again, the robbers got there first -- with a can of gas.

DON

They're eavesdropping on cellphone calls?

MEGAN

Maybe, but that wouldn't explain their knowledge of the victim's possessions. And, the victims have different phone systems.

DON

Well, they're tapping into these victims somehow.

(CONTINUED)

## Appendix B (continued)

## Episode #207 "Convergence", Scene 26

NUMB3RS #207/20 "Convergence" Goldenrod REV 10/3/05 39.  
 25 CONTINUED: 25

DAVID  
 It's a 44 slug.

26

INT. EPPES HOUSE - GARAGE - DAY

26

Begin Scene 26
----------------------

Charlie and Larry bent over a work table. Alan walks in.

ALAN  
 Charlie, you see my cell phone? I  
 can't find it anywhere -- *oh no.*

On the table is a CELL PHONE -- completely dismantled.

CHARLIE  
 We'll put it all back together.

ALAN  
 You couldn't use one of your own?

LARRY  
 I refuse to allow the small quiet  
 moments of my life be invaded by  
 these devices of distraction.

CHARLIE  
 I need mine.

ALAN  
 You know I'm not a house-bound  
 retiree anymore. I'm starting a  
 new business. A cell phone might  
 come in handy, don't you think?

CHARLIE  
 You'll have it in a hour. Or two.  
 We just wanted to take a look at  
 the GPS chip.

ALAN  
 And why would you need to do that?

LARRY  
 Every new phone is embedded with a  
 tiny chip that acts as a global  
 positioning receiver.

CHARLIE  
 It's my theory that the home  
 invasion robbers are using them to  
 track their victims.

Problem
---------

(CONTINUED)

## Appendix B (continued)

## Episode #207 "Convergence", Scene 26 (continued)

NUMB3RS #207/20 "Convergence" Goldenrod REV 10/3/05 40.  
 26 CONTINUED: 26

ALAN  
 How would that work?

CHARLIE  
 A cell phone is essentially a radio --

Begin word  
 picture

**ENTER AUDIENCE VISION**

Begin visual demonstration

Graphic representation of a cell phone & the chip inside.

CHARLIE (V.O.) (cont'd)  
 Whenever it's on, it's sending  
 radio signals. To let cell towers  
 know where the phone is -- so a  
 person can move from one cell zone  
 to another without losing a call.

Graphic representations of cell zones and towers.

CHARLIE (V.O.) (cont'd)  
 At the same time, the GPS chip  
 receives signals from outer space.  
 Specifically from at least three  
 geosynchronous satellites.

Graphic representations of satellites in geosynchronous  
 orbits -- THREE SATELLITES beam signals down to earth.

Concept

CHARLIE (V.O.) (cont'd)  
 Using a geometric method called  
 three dimensional trilateration,  
 the GPS chip uses the signals from  
 the satellites to calculate its  
 exact location on earth.

Fast representation of a trilateration calculation --

CHARLIE (V.O.) (cont'd)  
 This information is transmitted  
 constantly from the cell phone to  
 cell towers.

**RETURN TO SCENE:**

End visual demonstration

CHARLIE (cont'd)  
 The data can be used by police and  
 emergency services. Also for  
 roadside assistance, tracking truck  
 fleets -- even lets parents keep  
 tabs on teenage children.

(CONTINUED)

## Appendix B (continued)

## Episode #207 "Convergence", Scene 26 (continued)

NUMB3RS #207/20 "Convergence" Goldenrod REV 10/3/05 41.  
 26 CONTINUED: (2) 26

LARRY

Too Big Brother for me -- that's why I refuse to own a cellphone.

CHARLIE

But intercepting these signals is beyond the grasp of most criminals.

ALAN

Well, I'll tell you this. If all my years of supervising urban infrastructure has taught me anything - there's always a work-around solution.

CHARLIE

You're right -- and somehow they managed to get into the system.

End scene

27 **OMITTED** 27

28 **EXT. UPSCALE HOUSE - SHORT TIME LATER - DAY** 28

Police officers and detectives in and out the front door. David and Colby arrive.

29 **INT. UPSCALE HOUSE - CONTINUOUS** 29

They walk in -- as in the teaser, signs of violence and disarray. They go into a living room.

Coroner's Investigator works over two bodies, an older COUPLE. A MAN sprawled on the floor. A woman across an overstuffed chair. The MAN beaten to death.

Megan and Don talk. David and Colby come up to them.

MEGAN

Married couple, 74 and 77. From the evidence, looks like the man struggled with the robbers.

DON

They beat him to death, then strangled the woman. Two older people who couldn't have put up much of a fight.

MEGAN

They're acting more frequently, and killing more readily.

END OF ACT THREE

## Appendix B (continued)

## Episode #207 "Convergence" (Heuton &amp; Falacci, 2005a), Scene 31

NUMB3RS #207/20 "Convergence" Goldenrod REV 10/3/05

42.

ACT FOUR30      **INT. FBI - FORENSIC TECH ROOM - DAY**      30

CLOSE ON: Computer MONITOR display of a MAGNIFIED IMAGE of the .44 BULLET. The partial metal jacket slightly deformed. Striation marks visible on the sides.

FBI BALLISTICS SOFTWARE runs -- looking for matches with bullets registered from other crimes.

WIDER: Megan, David & Colby over a TECH's shoulder.

MEGAN

Let's hope the bullet you found is the one from the carjacking.

DAVID

Not a lot of bullets lying around Brentwood.

MEGAN

Yeah, it's more of a slash your throat kinda neighborhood.

COLBY

We're gonna run the slug through the ATF's Bullet Trap data base... See if we can trace the gun it was fired from to a previous crime.

MEGAN

We need a lead. After eight hits, they think they're invulnerable, that we can't stop them. They'll be more reckless, more dangerous.

31

**INT. LARRY'S OFFICE - DAY**      31

Larry at his board. Not math, but odd shapes and symbols. A physicist conceptualizing. Charlie comes to the door.

CHARLIE

Can I bounce some ideas off you?

LARRY

I heard on the radio -- two more people killed by the robbers Don's trying to catch.

CHARLIE

Yeah. It's bad.

Begin Scene 31
----------------------

(CONTINUED)



## Appendix B (continued)

## Episode #207 "Convergence", Scene 31 (continued)

NUMB3RS #207/20 "Convergence" Goldenrod REV 10/3/05 43.  
 31 CONTINUED: 31

LARRY

The data mining hasn't given you any specific connections you can work with yet?

Problem

CHARLIE

Hard to say. One commonality the analysis keeps highlighting is cell phones -- but everybody has cellphones.

Charlie goes to the board and quickly draws eight circles -- and then lines from them that lead to a common point--

CHARLIE (cont'd)

Then there's a second commonality --

-- where Charlie draws an X.

CHARLIE (cont'd)

-- that has no defined value. The algorithm's identified that all families have rare, collectible items. All insured.

LARRY

Ask Amita to look over your program. She's the best coder we got.

CHARLIE

I don't think that's where the problem is. Besides, she's always talking with Penfield.

LARRY

Well, he is a brilliant mathematician, and a good conversationalist.

CHARLIE

Oh great, another member of the Penfield Fan Club. Why don't you all get t-shirts or something?

LARRY

Yes, well, I heard that his analysis of the Eppes Convergence was a bit -- pointed.

(CONTINUED)

## Appendix B (continued)

## Episode #207 "Convergence", Scene 31 (continued)

NUMB3RS #207/20 "Convergence" Goldenrod REV 10/3/05 44.  
 31 CONTINUED: (2) 31

CHARLIE

Sure, he's bright, he's got insight. But he's so full of himself, so annoyingly *confident*.

Larry raises his eyebrows, Charlie imitates Marshall.

CHARLIE (cont'd)

"Certainly in extending the calculation for  $S$  to an infinite unitary group -- it would be obvious that my genius would mandate, upon my death, the inclusion of my brain in the Smithsonian."

Charlie laughs. Larry's looking past him -- at Penfield standing in the doorway with Amita.

MARSHALL PENFIELD

Actually, I'd prefer someone take my brain on a road trip -- like they did with Einstein's.

AMITA

Hey, Charlie --

CHARLIE

Hey.

AMITA

Charlie, Marshall and I went to your office looking for you, and we kinda saw what you had up on the chalkboard --

MARSHALL PENFIELD

You have one problem I found interesting as it relates to my main field -- **set theory**.

Concept

He goes up to where Charlie's standing, looks at his rough graph of eight circles, eight lines leading to a point.

MARSHALL PENFIELD (cont'd)

This is the same thing, right?

CHARLIE

Could be -- why?

(CONTINUED)

## Appendix B (continued)

## Episode #207 "Convergence", Scene 31 (continued)

NUMB3RS #207/20 "Convergence" Goldenrod REV 10/3/05 45.  
 31 CONTINUED: (3) 31

AMITA  
 Marshall's new research at  
 Princeton is in set theory,  
 something he calls "deep current"  
 sets --

Concept

CHARLIE  
 (warily)  
 And what are those?

MARSHALL PENFIELD  
 Connections between groups that are  
 hard to detect, but that can affect  
 all the other sets. Kinda like how  
 currents beneath the surface of the  
 ocean influence weather patterns in  
 the atmosphere.

Begin word  
 picture

Charlie stares at Marshall, then at his simple diagram.

CHARLIE  
 You mean there's something  
 underneath that we can't see --

Begin visual demonstration

**AUDIENC VISION** -- a generic weather map -- a half dozen air  
 currents swirling different directions above an ocean --

CHARLIE (V.O.) (cont'd)  
 Things that seem to have no  
 connection -- are linked by a  
 common factor.

Shifting to focus on the ocean where a wide current flows,  
 perspective shifting to show that it's responsible for  
 kicking off all the small air currents above --

BACK TO SCENE:

End visual demonstration

CHARLIE (cont'd)  
 Have you developed methods of  
 analysis that help you define the  
 unidentified connections?

MARSHALL PENFIELD  
 Oh yeah, sure. Even if I can't  
 tell you where the deep current is,  
 I can tell you were to look.

Off Charlie's look of intensifying interest --

End scene

## Appendix B (continued)

## Episode #220 "Guns and Roses" (Port, 2006a), Scene 12

NUMB3RS #220/33 "Guns and Roses" Cherry REV 3-22-06 14.  
 11 CONTINUED: 11

ANNIE  
 She was having problems at home.

MEGAN  
 With her husband?

ANNIE  
 Two ATF Agents maintaining a  
 relationship isn't exactly the  
 easiest thing to do in our  
 business.

MEGAN  
 Got it... So, how serious were the  
 problems?

ANNIE  
 Pretty serious I think. Something  
 he did backed her in a corner. I  
 don't know what it was, but she  
 said she was thinking of calling it  
 quits with him.  
 (off Megan)  
 They don't call it eating your gun  
 for nothing. Do they?

12

INT. FBI - BULLPEN - DAY

12

Begin  
Scene  
12

Megan talks with Don.

MEGAN  
 Not sure if this is what you wanna  
 hear, but based on what her team  
 told me, it looks like Nikki Davis  
 killed herself.

Charlie walks in --

CHARLIE  
 Sorry. But I'm not as convinced.  
 Not doubting your expertise, but  
 I've been looking through Nikki  
 Davis's file. She was a leader in  
 her community, outstanding agent.

MEGAN  
 Who was experiencing a pretty bad  
 depression.

CHARLIE  
 Which is a fairly strong negative.  
 But look at her file.  
 (MORE)

(CONTINUED)

## Appendix B (continued)

## Episode #220 "Guns and Roses", Scene 12 (continued)

NUMB3RS #220/33 "Guns and Roses" Cherry REV 3-22-06 15.  
 12 CONTINUED: 12

CHARLIE (cont'd)  
 Commendation after commendation.  
 Recently made supervisor, strong  
 parental support... siblings. All  
 of that should have outweighed any  
 transitory depression... Imagine  
 figure skating...

Begin word  
 picture

**AUDIENCE VISION --**

Begin visual demonstration

**A pair of figure skaters glide and spin across the ice.**

CHARLIE (V.O.) (cont'd)  
 When figure skaters perform a  
 routine judges multiply the scores  
 on the jumps by a difficulty  
 factor...

The duo performs a synchronized flip jump...

CHARLIE (V.O.) (cont'd)  
 -- if the difficulty factor is  
 large enough, even with a  
 mistake...

And fall.

CHARLIE (V.O.) (cont'd)  
 And subsequent deductions... the  
 skaters can still win the  
 competition.

The duo waves to the crowd, medals around their necks.

**BACK TO SCENE**

End visual demonstration

CHARLIE (cont'd)  
 All the positive features in  
 Nikki's life multiply her natural  
 coping ability by a certain factor.  
 This weighs against the depression.  
 I think we should look at it  
 further.

Tying word  
 picture to  
 math  
 concept

DON

Look, I'm the first to admit that I  
 don't want to believe Nikki killed  
 herself, but I need more than math,  
 Charlie. If I rule that her death  
 was a homicide, I need evidence.

David walks in.

(CONTINUED)

## Appendix B (continued)

## Episode #220 "Guns and Roses", Scene 12 (continued)

NUMB3RS #220/33 "Guns and Roses" Cherry REV 3-22-06  
 12 CONTINUED: (2)

16.  
 12

DAVID

I may have it... Nikki's husband's flight from Texas arrived, only he wasn't on it.

DON

What do you mean, not on it?

DAVID

I checked the manifest. He never got on the plane.

MEGAN

Guy finds out his wife's dead and he doesn't fly home?

DAVID

Ran a trace of his cell.

Hands Don a copy of the report.

DON

Five-two area code, that's Mexico.

DAVID

Night of Nikki's death, Davis was in Mexico City not in Texas like he was supposed to be.

(then...)

I also traced her phone. All calls for the last forty-eight hours.

DON

And?

David looks at Megan.

DAVID

One number popped out. Page two.

Don flips the page, stares at the sheet. Silent.

DAVID (cont'd)

Last person she called Don, it was you.

Off Megan, Charlie, then Don --

End scene

END OF ACT ONE

## Appendix B (continued)

## Episode #220 "Guns and Roses" (Port, 2006a), Scene 19-20

NUMB3RS #220/33 "Guns and Roses" Cherry REV 3-22-06 27.  
 18 CONTINUED: (2) 18

ALAN (cont'd)  
 You know, we were lucky it never  
 came to that, but I would have  
 understood if she'd chosen to. I  
 wouldn't have blamed myself.  
 (off Don)  
 You understand what I'm saying?  
 (beat)  
 Do you?

DON  
 I've got to get going. See ya  
 later dad.

19 INT. NIKKI'S BEDROOM - DAY

CLOSE ON GUN - BOOM!

PULL BACK TO REVEAL -- David lays in Nikki's bed... a Sig-  
 Sauer (blanks) in his hand points at the ceiling.

The room is identical to the way it was when Nikki died  
 including an open window. Except:

IN A SIDE ROOM --

Charlie and Larry stare at a plasma split screen that shows a  
 digital oscillograph. On the top is the ACOUSTIC FINGERPRINT  
 of the original recording. On the bottom is the acoustic  
 fingerprint of the test gun shot. They record the gunshot on  
 their laptop. Everyone wears headphones and goggles.

LARRY  
 Still doesn't match. Are you sure we set  
 up the microphones outside correctly?

CHARLIE  
 Double-checked them myself.

LARRY  
 And we can't discount that in an  
 experiment such as this, there's an  
 extreme level of difficulty.

David walks over...

DAVID  
 Why's that?

CHARLIE  
 Because there was an open window,  
 the sound envelope and how the  
 waves reached the microphones  
 require complex calculations.

Note: Scene 19  
 sets context for  
 word picture in  
 Scene 20.

(CONTINUED)

## Appendix B (continued)

## Episode #220 "Guns and Roses", Scene 19-20 (continued)

NUMB3RS #220/33 "Guns and Roses" Cherry REV 3-22-06  
 19 CONTINUED:

28.

19

LARRY

In an auditory sense, a gunshot is fairly unique... as it produces a short, but intense sound impulse.

DAVID

Which is why we wear earphones at the range.

LARRY

Exactly. The blast strains the capacity of the human ear, which detects noise more efficiently and distinguishes sounds from a much wider spectrum than even most audio equipment.

DAVID

And how's this gonna help me with a timeline?

CHARLIE

If we can re-create this original acoustic fingerprint, then we'll have matched it to the sound that was recorded by three separate LAPD officers. Forensic acoustic experts did this in the JFK assassination to determine if there was a gunman on the grassy knoll.

Charlie look at photo of Nikki's crime scene.

CHARLIE (cont'd)

Everything appears to be exactly the same.

LARRY

Were the curtains open or closed?

DAVID

Does that matter?

CHARLIE

Cloth doesn't reflect as much sound back as glass.

Larry looks at the acoustic fingerprint on the plasma.

(CONTINUED)



## Appendix B (continued)

## Episode #220 "Guns and Roses", Scene 19-20 (continued)

NUMB3RS #220/33 "Guns and Roses" Cherry REV 3-22-06 29.  
 19 CONTINUED: (2) 19

LARRY

As we fire test shots, our program measures muzzle blast and echo pattern. It's absolutely essential to the understanding of acoustical matching procedure that impulses are not moved or eliminated.

David walks back to the bed...

CHARLIE

Ready?

David puts his finger on the trigger and BOOM!

On the plasma screen -- a new acoustic fingerprint -- that doesn't match.

CHARLIE (cont'd)

Not even close.

DAVID

Maybe it wasn't a gunshot?

CHARLIE

No, it's a gunshot, but--

LARRY

The recorded waveform was bouncing around more. Something's missing.

DAVID

Missing?

CHARLIE

Is it possible some evidence was removed from the bedroom?

DAVID

Shell casing, maybe.

LARRY

With these variations, it would have to have been something much larger.

DAVID

Her body? But that's why I'm in the room shooting the gun. Right?

But Charlie's mind is now focused on the room...

## Appendix B (continued)

## Episode #220 "Guns and Roses", Scene 19-20 (continued)

NUMB3RS #220/33 "Guns and Roses" Cherry REV 3-22-06

30.

A20

**CHARLIE VISION**

A20

Begin  
Scene  
20**QUICK FLASH of STYLED SUICIDE -- The slide of the gun, gunshot,**

CHARLIE

I need to talk to Don.

20

**INT. FBI - BULLPEN - NIGHT**

20

Megan enters. Finds Don at his desk, working.

DON

According to her husband she had cancer. She was dying.

MEGAN

Even if it's true you had every right to pursue the line of investigation you did.

DON

I was just hoping that the job didn't make her that unhappy.

MEGAN

You know, there's a reason law enforcement officers are seven times more likely to kill ourselves than civilians.

DON

If you're trying to cheer me up, it's not working.

MEGAN

It's our personalities, Don. Most of us go into this job because we're trying to test ourselves, prove ourselves... We're afraid that if we ask for help, people are gonna think we're weak.

Charlie and David walk in.

DAVID

Think Charlie's got something.

DON

What do you mean?

(CONTINUED)

## Appendix B (continued)

## Episode #220 "Guns and Roses", Scene 19-20 (continued)

NUMB3RS #220/33 "Guns and Roses" Cherry REV 3-22-06  
20 CONTINUED:

31.  
20

CHARLIE

Sound waves. A gunshot produces a sound wave that travels. If the wave hits a reflective substance like rock, the air-pressure energy of the sound wave moves back in the opposite direction. Towards you.

Begin word picture

DON

An echo.

CHARLIE

Exactly. But those returning sound waves do a lot more than just let us hear our own voice. They tell us what we cannot see. Take a bat for example...

AUDIENCE VISION --

Begin visual demonstration

A bat hangs. Sound waves spread out and hit a frog.

CHARLIE (V.O.) (cont'd)

A bat emits a sound wave and listens carefully to the echoes that it causes.

The sound waves bounce back off the frog.

CHARLIE (V.O.) (cont'd)

By hearing how long it takes an echo to return, the bat's brain automatically knows how far away the animal is.

The frog hops... the bat zeroes in on it.

CHARLIE (V.O.) (cont'd)

The bigger the animal, the louder the echo.

Small sound waves bounce off of a bug.

CHARLIE (V.O.) (cont'd)

Most importantly, if the animal is moving towards or away from the bat, the pitch of the echo will be raised or lowered accordingly. It's called the Doppler Effect.

Concept

The bug hops away...

(CONTINUED)

## Appendix B (continued)

## Episode #220 "Guns and Roses", Scene 19-20 (continued)

NUMB3RS #220/33 "Guns and Roses" Cherry REV 3-22-06 32.  
 20 CONTINUED: (2) 20

**RESUME CHARLIE AND GROUP --**

End visual demonstration

DON  
 Charlie, what does it mean?

CHARLIE  
 We recreated the acoustics of  
 Nikki's room with the comm system  
 the agents used. What we found was  
 that something was missing...

Explanation

MEGAN  
 Missing?

CHARLIE  
 Actually, someone. -- Don, someone  
 else was in the room when Nikki died.

End scene

21 **OMITTED**

21

END OF ACT TWO

## Appendix B (continued)

## Episode #220 "Guns and Roses" (Port, 2006a), Scene 29

NUMB3RS #220/33 "Guns and Roses" Cherry REV 3-22-06  
28 CONTINUED:

42.  
28

MEGAN

The guns this robbery crew uses are military quality.

DON

Which Davis has access to.

DAVID

Right. He recovered those military assault rifles in that bust last year.

MEGAN

He's under financial pressure from his wife's illness. Selling guns would have been a way to help her.

DAVID

Nikki finds out. Calls you when she has no other place to turn.

MEGAN

And gets killed before she has a chance to do it again.

Don's running it over in his head. Turns to plasma.

DON

I want 24/7 surveillance on everyone in this photo.  
(points)  
This guy Mitchell pops out of his hole, I wanna know about it.

Off our group -- and on MITCHELL.

29

**INT. CHARLIE'S OFFICE - DAY**

29

Begin  
Scene  
29

Amita knocks. Finds Larry and Charlie.

AMITA

Am I interrupting something?

CHARLIE

Another Fleinhardt doomsday prophecy.

LARRY

You make me sound like Chicken Little. I was merely advising Charles as to the dangers of unleashing a cosmic force.

(CONTINUED)

## Appendix B (continued)

## Episode #220 "Guns and Roses", Scene 29 (continued)

NUMB3RS #220/33 "Guns and Roses" Cherry REV 3-22-06  
 29 CONTINUED:

43.  
 29

CHARLIE  
 Larry isn't thrilled with  
 cataloguing DNA.

AMITA  
 Do you have something to hide,  
 Larry?

LARRY  
 My DNA's as pure as the driven  
 snow... But human history lives in  
 our genes... it contains the  
 footprints of our ancestors...  
 tells us where we came from.

AMITA  
 I'm not sure I'd mind knowing that.

LARRY  
Individually. But what about how  
 it can be used? What are the  
 safeguards? Experience tells us  
 that once something's out of the  
 bottle, it's out of the bottle for  
 all time.

CHARLIE  
 Again with the bottle...

LARRY  
 It's a metaphor, Charles.

AMITA  
 Well, one could certainly  
 understand the hazards in not being  
 too careful.

LARRY  
 Which is exactly why I find it  
 judicious to move slowly and  
 decisively.

Amita looks at Charlie, who continues to work.

AMITA  
 This from a man who sold his house,  
 with nowhere to live.

She and Larry exchange a small, smile.

(CONTINUED)

## Appendix B (continued)

## Episode #220 "Guns and Roses", Scene 29 (continued)

NUMB3RS #220/33 "Guns and Roses" Cherry REV 3-22-06  
29 CONTINUED: (2)

44.

29

Concept

CHARLIE  
Okay. I've identified several groups of genetic markers called **haplotypes**. Now I need a set of algorithms to compare them against the Bio department's photo base.

Begin word picture

LARRY  
And this could identify the people who left traces of their DNA in this Agent's house?

CHARLIE  
Imagine a blueprint for a home...

ENTER AUDIENCE VISION

Close on a **blueprint**...

Begin visual demonstration

CHARLIE (V.O.) (cont'd)  
It tells you what kind of home you're going to build, a Colonial for example.

We see the blueprint morph into frame of a Colonial.

CHARLIE (V.O.) (cont'd)  
But there are variables, hundreds of variables, color, size, roof type. The prints don't tell us this.

Our framed house changes, color and roof type, as Charlie talks.

CHARLIE (V.O.) (cont'd)  
By looking at thousands of Colonial homes from across the country, we know certain things. Colonials aren't purple, they're not made of brick, they don't have flat roofs...

Rows of Colonial Homes slide by, frame by frame, one after the other.

CHARLIE (V.O.) (cont'd)  
By applying a **statistical index**, we can sort out the common characteristics among Colonial Homes and build our own.

(CONTINUED)

## Appendix B (continued)

## Episode #220 "Guns and Roses", Scene 29 (continued)

NUMB3RS #220/33 "Guns and Roses" Cherry REV 3-22-06 45.  
 29 CONTINUED: (3) 29

**Our Colonial, a mixture of different pieces is built.**

**RESUME SCENE --**

End visual demonstration

CHARLIE (cont'd)  
 With a little luck, I should be  
 able to put a statistical face on  
 all of Don's samples.

LARRY  
 Like some DNA Bizarro World.

On Charlie, Anita,

End scene

30 **INT. EPPES HOUSE - NIGHT** 30

Don sits on the couch. Alan nearby.

DON  
 When you join the FBI they talk  
 about pride, what it means to wear  
 the badges... Even let you hold  
 Dillinger's gun...

ALAN  
 But they never tell you about these  
 kinds of cases, do they.

DON  
 The weird thing is knowing that  
 Nikki was murdered, it doesn't  
 change the fact that she was  
 unhappy and in a bad relationship.

ALAN  
 Sounds like you're projecting.

DON  
 Truth is I don't know anyone on the  
 job who has a great relationship.

ALAN  
 C'mon. That can't be true.

DON  
 It is... I mean, I've involved you  
 and Charlie in some of my stuff,  
 but really, you guys don't know the  
 half of it.

(CONTINUED)



## Appendix B (continued)

## Episode #305 "The Mole" (Port, 2006b), Scene 14

NUMB3RS #305/42 "The Mole" 2nd WHITE Rev 9-07-06 16.  
 13 CONTINUED: 13

CHEN  
 I'll speak with the Ambassador, see  
 what I can do...

14

**INT. FBI - WAR ROOM -- NIGHT**

14

Begin Scene 14
----------------------

Don, Megan enter, find David.

DAVID  
 What'd the Consulate General say?

MEGAN  
 That he didn't know her very well.

DAVID  
 (joking)  
 Well, he's either telling the truth  
 or the Chinese have a pretty  
 liberal hiring policy...

DON  
 What's up?

DAVID  
 Credit card had a bunch of charges  
 to night clubs, lingerie shops and  
 the occasional "adult" store.

MEGAN  
 Not exactly the image her neighbors  
 painted...

DON  
 Run her with LAPD Vice. Narco too.  
 See what else she was hiding.

MEGAN  
 We still don't know if this girl  
 was even murdered.

Charlie enters --

CHARLIE  
 Actually, we do. As promised, I  
 have your answer about whether this  
 was an accident.

DON  
 Charlie, what'd you skip classes?

(CONTINUED)

## Appendix B (continued)

## Episode #305 "The Mole", Scene 14 (continued)

NUMB3RS #305/42 "The Mole" 2nd WHITE Rev 9-07-06 17.  
 14 CONTINUED: 14

CHARLIE  
 Lunch... and dinner... Do you guys  
 have a sandwich or something?

DON  
 We'll send out. What do you got?

Charlie starts to hook up his laptop.

CHARLIE  
 Well, at first I was using a steady  
 motion algorithm to try to  
 determine the victim's movement at  
 impact. But my results were  
 inconclusive.

DAVID  
 But you persevered.

Charlie walks and imitates the motion he describes.

CHARLIE  
 I imagined walking... the motion of  
 her feet... Then it became obvious,  
 curtate cycloid.

Begin word  
 picture

Concept

MEGAN  
 Curtate cycloid, of course.

CHARLIE  
 Think of someone's stride like the  
 moon orbiting around the Earth...

AUDIENCE VISION --

Begin visual demonstration

We see an animated moon...

CHARLIE (V.O.) (CONT'D)  
 As the moon moves around the Earth  
 and the Earth moves around the sun,  
 the moon traces out a curtate  
 cycloid curve in space.

The moon spins and circles the Earth...

CHARLIE (V.O.) (CONT'D)  
 When you walk it's really a series  
 of little circles rotating inside a  
 larger circle.

An animated heel swings on an arc past the knee....

(CONTINUED)

## Appendix B (continued)

## Episode #305 "The Mole", Scene 14 (continued)

NUMB3RS #305/42 "The Mole" 2nd WHITE Rev 9-07-06 18.  
 14 CONTINUED: 14

**CHARLIE (V.O.) (CONT'D)**  
**The heel orbiting backward, then forward past the knee is a small circle within the larger circle of walking...**

**RESUME SCENE**

End visual demonstration

**CHARLIE (CONT'D)**  
 From there, I could probabilistically determine the leg motion of your victim at the point of impact.

**MEGAN**  
 And this helps us how?

Explanation

**CHARLIE**  
 The marks on her legs that the vehicle's lights made, they're high.

**DON**  
 High?

**CHARLIE**  
 The bumper of the vehicle was rising on impact.

**DON**  
 So, the car was accelerating.

**MEGAN**  
 Which means this was no accident.

End scene

END OF ACT ONE

## Appendix B (continued)

## Episode #305 "The Mole" (Port, 2006b), Scene 16

15 NUMB3RS #305/42 "The Mole" 2nd WHITE Rev 9-07-06 20.  
CONTINUED: 15

DAVID  
Don. You're gonna wanna check this  
out. Tech's just found something  
on Kim's laptop.

16

**INT. TECH ROOM - MOMENTS LATER**

16

Begin Scene 16
----------------------

Don and David enter, where TECH works.

DON  
What do we got?

TECH  
Web sites. Mostly porn.

Charlie enters....

DAVID  
Explains why she's buying five  
hundred dollar lingerie on Rodeo  
Drive.

CHARLIE  
Megan said you guys found  
something?

DAVID  
Michelle Kim's laptop, she had a  
thing for porn sites.

CHARLIE  
(but then--)  
Did she save any images from these  
websites?

TECH  
She downloaded quite a few images.

We see several windows open on the computer, each a JPEG  
image of a body part of a naked woman.

DON  
What are you thinking?

CHARLIE  
Just that the NSA's discovered that  
groups like al-Qaeda and Hezbollah  
encrypt messages in photographs.

(then)  
With some simple software you could  
hide numbers, photos... any image  
you wanted.

(CONTINUED)

## Appendix B (continued)

## Episode #305 "The Mole", Scene 16 (continued)

NUMB3RS #305/42 "The Mole" 2nd WHITE Rev 9-07-06 20A.  
16 CONTINUED: 16

DON

Yeah, but these groups have no  
connection to China, right?

CHARLIE

True... but there are more Chinese  
operatives in the U.S. today than  
during the cold war.

DAVID

Doing what?

(CONTINUED)

## Appendix B (continued)

## Episode #305 "The Mole", Scene 16 (continued)

NUMB3RS #305/42 "The Mole" 2nd WHITE Rev 9-07-06 21.  
 16 CONTINUED: 16

CHARLIE

Mostly pirating technology. They're after our combat, intelligence and weapons systems.

DON

And you think this is how they could be communicating...

CHARLIE

You remember the image of the little girl we found hidden in a photograph?

DAVID

That child porn case...

CHARLIE

This is similar, only more sophisticated. You see this photo,

JPEG photograph of a naked Asian woman.

CHARLIE (CONT'D)

It's really made up of thousands of pixels which are reproduced as squares.

(to tech)

Could you push in on the upper right quadrant please?

Problem

The Tech obeys. We see a squared off image, enlarged and pixilated/squared.

CHARLIE (CONT'D)

Remove some of the squares, you can still see the photo. A coded message can easily be hidden inside the missing information.

DON

Then how do you see it?

CHARLIE

It's possible for me to develop an algorithm to look for coded messages in the image Kim downloaded.

(off Don)

Think of the tests they give people for color blindness...

Begin word picture

(CONTINUED)

## Appendix B (continued)

## Episode #305 "The Mole", Scene 16 (continued)

NUMB3RS #305/42 "The Mole" 2nd WHITE Rev 9-07-06 21A.  
 16 CONTINUED: 16

**AUDIENCE VISION** --

Begin visual demonstration

A Green Circle made up of mini green circles aka color blind chart.

CHARLIE (V.O.) (CONT'D)  
 To a person who's color blind all they see is a bunch of green dots.

Same image, now a red 2 8 appears inside the circle.

CHARLIE (V.O.) (CONT'D)  
 But, to someone whose eyesight is perfect, the same exact image reveals a hidden picture.

RESUME SCENE --

End visual demonstration

DON  
 You think you can crack this?

CHARLIE  
 If there's a message, I should be able to find it.

ON PORN IMAGE.

End scene

17 OMITTED

17

## Appendix B (continued)

## Episode #305 "The Mole" (Port, 2006b), Scene 26

NUMB3RS #305/42 "The Mole" 2nd WHITE Rev 9-07-06 32-33.

26

**INT. FBI - WAR ROOM - DAY**

26

Begin  
Scene  
26

Colby walks in, sees David.

DAVID

Any luck on the security videos  
from Kim's apartment building?

(CONTINUED)



## Appendix B (continued)

## Episode #305 "The Mole", Scene 26 (continued)

26 NUMB3RS #305/42 "The Mole" 2nd WHITE Rev 9-07-06 34.  
CONTINUED: 26

COLBY  
No. Only cameras were in the  
lobby. No way to tell which  
apartment the guests are going to.  
So far Kim's always alone.

Charlie appears.

CHARLIE  
You know, that might not be true.

COLBY  
Charlie, what are you doing here?

CHARLIE  
Working on something for Larry...  
(then)  
You said the footage for these  
cameras is archived, right?

COLBY  
Right.

CHARLIE  
Well, if the apartment was a  
meeting place, chances are your  
mole's been there more than once.

COLBY  
Yeah, but there's months of  
footage... hundreds of guests.

CHARLIE  
Still we know when Kim was there,  
right?

DAVID  
So?

CHARLIE  
So, I can run a series of  
Eigenfaces.

Concept

COLBY  
Eigenfaces?

CHARLIE  
Advanced facial recognition  
techniques. I've been working on a  
program that matches human  
asymmetry points...  
(MORE)

(CONTINUED)

## Appendix B (continued)

## Episode #305 "The Mole", Scene 26 (continued)

NUMB3RS #305/42 "The Mole" 2nd WHITE Rev 9-07-06 35.  
 26 CONTINUED: 26

CHARLIE (CONT'D)  
 I can create an algorithm that  
 matches all visitors during the  
 times we know Kim was in the  
 apartment.

DAVID  
 Asymmetry points? C'mom Charlie  
 help me out here.

CHARLIE  
 No face is perfectly symmetrical...  
 Charlie picks the Rubik's Cube off the desk.

Begin word  
 picture

**CHARLIE VISION**

We see a Rubik's Cube all mixed up...

Begin visual demonstration

CHARLIE (V.O.) (CONT'D)  
 -- each little square represents a  
 piece of a symmetry point, nose,  
 ear or eye.

Each square has a small piece of nose, ear or eye.

CHARLIE (V.O.) (CONT'D)  
 When the right combination is  
 found... an individual symmetry  
 point or body part is matched.

The blue side is complete... a whole eye.

**RESUME SCENE**

End visual demonstration

Explanation

DAVID  
 If playing with Rubik's Cubes help  
 us solve this case, then let's buy  
 a couple. Wait. Lemme guess. You  
 already got a whole bunch, right?

Charlie smiles. Megan walks in.

MEGAN  
 Just heard from LAPD. Chop Shop in  
 Van Nuys has an SUV, matches the  
 description of the one that hit our  
 victim.

Colby and David move...

End scene

## Appendix B (continued)

## Episode #305 "The Mole" (Port, 2006b), Scene 43

NUMB3RS #305/42 "The Mole" 2nd WHITE Rev 9-07-06 51.  
 42 CONTINUED: 42

DON  
 Carter wouldn't leave classified documents in his house. He'd come here, get the papers and head out.

MEGAN  
 Right under our noses.

DON  
 We have the locations for the meets?

MEGAN  
 Yeah, but they're scattered all over the city.

DON  
 E-mail the info to Charlie, see what he can come up with...

43

**INT. CALSCI - CHARLIE'S OFFICE - DAY**

43

Begin  
 Scene  
 43

Charlie inputs addresses on a computer/LCD screen as he and Amita talk with Megan.

MEGAN  
 Don's afraid Carter's going to try to sell whatever information he's got, before he leaves the country.

Charlie pops a series of addresses on the screen.

CHARLIE  
 And these appointments from Carter's PDA are meetings between him and the Chinese?

MEGAN  
 That's what we think.

Charlie hits a button, the addresses overlay on a map of LA County. The points are grouped in an area around downtown.

Problem

CHARLIE  
 All these addresses are within a couple of miles of the FBI. I've learned from the NSA that operatives will often arrange meeting places months in advance. They're given a list. Never used twice.

(CONTINUED)

## Appendix B (continued)

## Episode #305 "The Mole", Scene 43 (continued)

NUMB3RS #305/42 "The Mole" 2nd WHITE Rev 9-07-06 52.  
 43 CONTINUED: 43

MEGAN  
 So this pre-arranged place would  
 logically be somewhere inside this  
 circle.

Concept

AMITA  
 Then this is a classic  
 combinatorial optimization problem.

Begin word  
 picture

CHARLIE  
 And nobody's better at  
 combinatorics than you.

MEGAN  
 (smiles)  
 Sounds interesting...

AMITA  
 It's really a simple question of  
 branching and bounding.

MEGAN  
 Branching and bounding?

CHARLIE  
 Imagine you're trying to predict  
 how a tree is going to branch...

Begin visual demonstration

**ENTER AUDIENCE VISION**

We see a tree superimposed over a map of Los Angeles.

CHARLIE (CONT'D)  
 We know where six of the meeting  
 places or "branches" already are...

The oak sprouts three limbs, two branches off each...

CHARLIE (CONT'D)  
 But the question is, where would  
 the seventh branch or Carter's next  
 meeting place be?

Several more limbs grow with branches.

**RESUME SCENE**

End visual demonstration

Explanation

CHARLIE (CONT'D)  
 Certain factors can eliminate  
 potential branches. For example,  
 Carter needs to make a fast and  
 clean get away.

(CONTINUED)

## Appendix B (continued)

## Episode #305 "The Mole", Scene 43 (continued)

NUMB3RS #305/42 "The Mole" 2nd WHITE Rev 9-07-06 53.  
 43 CONTINUED: 43

MEGAN  
 Something near the freeway...

CHARLIE  
 Which all of these places are.

**BACK TO AUDIENCE VISION** -- Begin visual demonstration

Two of the new branches disappear...

CHARLIE (CONT'D)  
 These meetings have taken place in  
 areas zoned for business with an  
 open courtyard, promenade, multiple  
 entrances and exits...

Two more branches disappear...

**RESUME SCENE** End visual demonstration

CHARLIE (CONT'D)  
 One was Pershing Square, one  
 Staples Center...

MEGAN  
 They're all places Carter could  
 easily escape from.

CHARLIE  
 By running an algorithm that  
 analyzes the features of the  
 existing meeting places to find key  
 variables then applying a branching  
 and bounding algorithm, I can  
 hopefully give you a location for  
 Carter's next probable destination.

Off image of Disney Hall that takes us to -- End scene

44 **EXT. LOS ANGELES - LATE NIGHT** 44

Disney Hall looms across the street. It's quiet and empty.  
 PAN OVER to find Don's vantage point.

DAVID (V.O.)  
 Sinclair for Eppes...

DON  
 Eppes...

Establish David in front of Disney Hall. Intercut --

(CONTINUED)

## Appendix B (continued)

## Episode #318 "Democracy" (Heuton &amp; Falacci, 2007), Scene 16

15 NUMB3RS 318/55 "Democracy" BUFF Rev 2/21/07 18. CONTINUED: 15

The Man takes the papers, walks away.

TUTTLE (CONT'D)  
I'll get back to you on that.

DAVID  
Do you know a Rachel Lawton?

TUTTLE  
Doesn't sound familiar.

COLBY  
What kind of business do you do?

Tuttle stretches his back.

TUTTLE  
I retired last year.  
(off Colby's look)  
I still manage a hedge fund, serve on corporate boards. I'm trying to put more time into public service.

COLBY  
Why do you employ statisticians and computer scientists?

TUTTLE  
To test stock market systems. I dream about finding that magic formula for striking it rich.

DAVID  
Some might say you found it.

COLBY  
Quite a lot of it, in fact.

Tuttle eyes them oddly.

TUTTLE  
Take it from a guy with more than enough. It's never enough.

16 **EXT. CALSCI -- DAY** 16 Begin Scene 16

Charlie walks with Millie.

MILLIE  
Sounds like this Oswald kid bit pretty hard on the FBI hock-

(CONTINUED)

## Appendix B (continued)

## Episode #318 "Democracy", Scene 16 (continued)

16 NUMB3RS 318/55 "Democracy" BUFF Rev 2/21/07 19.  
CONTINUED: 16

CHARLIE

But he still won't apply to CalSci.  
He doesn't grasp what he could  
accomplish here. I don't know how  
to get that across to him.

MILLIE

Your whole life has been math and  
science, same for your students.  
You were raised in the church and  
you preach to the converted. But  
now it's time to convert a heathen.

CHARLIE

He's one resistant kid.

MILLIE

You work with the FBI. I gotta  
think that no-neck cops are a  
tougher audience than a bright  
skateboarder.

CHARLIE

Hey, my brother's one of those no-  
neck cops, and he's got a neck.

MILLIE

Of course he does -- I'm  
exaggerating to make a point. You  
can reach a non-math audience.  
What's Oswald's main objection?

CHARLIE

He thinks he's not good enough,  
that all he can do here is fail.

MILLIE

So find a way to show him his  
potential.

Oswald comes up behind them --

OSWALD

Hey Charlie -?

MILLIE

And if I'm not mistaken --

Oswald joins them --

OSWALD

Charlie, hey, there's something off  
about Rachel's numbers.

(CONTINUED)

## Appendix B (continued)

## Episode #318 "Democracy", Scene 16 (continued)

16 NUMB3RS 318/55 "Democracy" BUFF Rev 2/21/07 20.  
CONTINUED: 16

He hands Charlie a printout -- smiles at Millie --

OSWALD (CONT'D)  
Hey, how ya doing.

MILLIE  
I'm good. Please, go ahead.

OSWALD  
(to Charlie)  
I did what you said -- printed them out without the headings to look for patterns. Didn't find any -- but her numbers -- there's still something funny about them, I can't quite put my finger on it.

Charlie's staring at the numbers --

CHARLIE  
You're right -- there's too many 7s. And -- 3s.

OSWALD  
Too many? Too many for what?

CHARLIE  
For this list to be random.

OSWALD  
You can tell that just by looking?

CHARLIE  
I know what to look for, from financial fraud and tax cases.

MILLIE  
For some reason, when most people make up numerical reports, they use too many 3s and 7s. And they don't use enough 1s and 2s.

OSWALD  
Really? Me, I'd use too many 4's.

MILLIE  
Even if you don't know what the numbers describe, you can know somebody's lying about it. And on that note, I have to run.

CHARLIE  
Bye, Millie. And thanks.

(CONTINUED)



## Appendix B (continued)

## Episode #318 "Democracy", Scene 16 (continued)

16 NUMB3RS 318/55 "Democracy" BUFF Rev 2/21/07 21. 16  
CONTINUED:

Millie smiles and heads off --

OSWALD  
Who's that? She seems nice.

CHARLIE  
Dr. Finch, chair of the math,  
physics and astronomy division.

OSWALD  
Really. But she was, you know --

CHARLIE  
-- easy to talk to?

OSWALD  
Okay, maybe. But anyway--  
(off the data)  
How do we find what this is?

CHARLIE  
We've got math applications that  
help analyze unlabeled sets of  
numbers. Items tend to come in  
groups. In a grocery store, a  
dozen might mean a dozen eggs, a  
half dozen would be bagels --

OSWALD  
--24 would be a case of beer --

CHARLIE  
It's called metadata -- information  
about data. For instance, the  
numbers 1-2-3-4-5 are data.

Begin word  
picture

Concept

Begin visual demonstration

**ENTER AUDIENCE VISION:**

Handwritten numerals 1, 2, 3, 4 and 5 appear individually and  
come together against a non-descript background.

CHARLIE (V.O.) (CONT'D)  
They could refer to anything. But  
if you find out they're a zip code--

**PULL BACK** to reveal it's on a **STAMPED ENVELOPE** -- in the area  
one would find a zip code -- with no sending address.

CHARLIE (V.O.) (CONT'D)  
They mean something specific. In  
this case, Schenectady, New York.

**ON THE ENVELOPE**, a Schenectady, NY address burns in.

(CONTINUED)

## Appendix B (continued)

## Episode #318 "Democracy", Scene 16 (continued)

16 NUMB3RS 318/55 "Democracy" BUFF Rev 2/21/07 22. 16  
CONTINUED:

**BACK TO SCENE:**

End visual demonstration

OSWALD  
So we use that to figure out what  
Rachel's numbers are talking about--

CHARLIE  
And maybe we'll know why she died.

End scene

17 **INT. FBI TECH ROOM -- DAY** 17

Colby and David walk up to Megan, working computer databases.  
(Stacked windows of political web sites.)

DAVID  
If you want a spooky guy to  
mastermind a conspiracy -- J.  
Everett Tuttle's your first pick.

MEGAN  
What makes you say that?

COLBY  
We told him three former employees  
died within two weeks -- he didn't  
care, didn't ask how they died.

MEGAN  
Did he express concern for them or  
their families?

DAVID  
Not at all.

COLBY  
The only time he expressed the  
slightest interest was when --

MEGAN  
-- don't tell me. When you asked  
him about himself.

DAVID  
You got that right.

MEGAN  
Could be a self-absorbed Type-A  
personality. Or -- a sociopath.

DAVID  
You got anything new?

(CONTINUED)

## Appendix B (continued)

## Episode #318 "Democracy" (Heuton &amp; Falacci, 2007), Scene 38

37 NUMB3RS 318/55 "Democracy" BUFF Rev 2/21/07 42. 37  
CONTINUED:

STACY  
No, not that I've heard. And  
that's what's really scaring me --  
she's never gone this long without  
calling Mom and Dad.

Megan looks down at Pico -- who's watching her.

38 INT. EPPES GARAGE - NIGHT 38

Don scans boards of organization theory. Charlie watches.  
Oswald plays air hockey with Alan.

DON  
Can't be that many possibilities.

CHARLIE  
In general, no. There's  
power/control and power/wealth.

OSWALD  
Comes down to money. People want  
money to get power and people want  
power to get money.

ALAN  
There are fanatical idealists.

Oswald scores on Alan.

OSWALD  
Mercy rule?

ALAN  
Must be a Canadian hockey table.

Alan quits in disgust.

DON  
If they can rig a county election,  
why not a larger one?

CHARLIE  
Bigger election, bigger conspiracy.  
Too big, it can't sustain secrecy.  
Like Watergate. Or Iran-Contra.

Concept OSWALD  
Unless there's a self-perpetuating  
element -- like nano technology.

Don and Alan turn to Oswald -- what is he talking about?

(CONTINUED)

Begin  
Scene  
38

## Appendix B (continued)

## Episode #318 "Democracy", Scene 38 (continued)

38 NUMB3RS 318/55 "Democracy" BUFF Rev 2/21/07 43. 38  
CONTINUED:

OSWALD (CONT'D)  
Wait, this is better. You know how they stack champagne glasses and fill them with champagne?

Begin word picture

**ENTER AUDIENCE VISION:**

Begin visual demonstration

The classic pyramid of champagne glasses.

OSWALD (V.O.) (CONT'D)  
You only pour the champagne into the top glass but it overflows into all the other glasses.

The champagne pours over the top and into the glasses below.

**BACK TO SCENE**

End visual demonstration

OSWALD (CONT'D)  
Requires resources applied in only one location, but it spreads.

ALAN  
(sotto voice)  
Good God, another one.

CHARLIE  
You mean the conspiracy starts from a single source but can spread.

Alan goes to the board with Jason Brasher's name.

Explanation

ALAN  
That's right, because the Supervisors oversee the county budget. They approve everything. Including voting equipment the county buys.

DON  
Brasher could make sure the county keeps buying rigged machines.

CHARLIE  
And with LA County's huge population, rigged machines here could make the difference in a statewide election.

The four look at each other, realizing the implications.

DON  
He's not just after a Supervisor's seat--

(CONTINUED)

## Appendix B (continued)

## Episode #318 "Democracy", Scene 38 (continued)

NUMB3RS 318/55 "Democracy" BUFF Rev 2/21/07 44.  
 38 CONTINUED: 38

ALAN  
 They say, as California goes, so  
 goes the country. This Tuttle --  
 he wants to be a kingmaker.

End scene

39 INT. FBI ELEVATOR -- NIGHT 39

Don exits the elevator, David meets him, fills him in on the walk to the bullpen.

DAVID  
 Megan just got a report back on Tru-Poll Systems, the company that made the electronic voting machines.

DON  
 Yeah, what do we got?

David hands him a printout.

DAVID  
 Tru-Poll recently upgraded the motherboards in all machines in California. Those motherboards are manufactured in Taiwan by a company based here in the states. A company called SDKG Electronics.

They arrive at Megan's desk.

MEGAN  
 The interesting part of this -- SDKG was founded by an entrepreneur named Paul Prescott. Two years ago, Tuttle tried to buy out the company. Prescott said no.

DAVID  
 Then, Prescott died in a rock climbing accident.

DON  
 Really. An accident.

DAVID  
 People who get in Tuttle's way tend to have them.

DON  
 Who owns the electronics firm now?

(CONTINUED)

## Appendix B (continued)

## Episode #318 "Democracy" (Heuton &amp; Falacci, 2007), Scene 45

43 NUMB3RS 318/55 "Democracy" BUFF Rev 2/21/07 48. 43  
 CONTINUED:  
 CHARLIE (CONT'D)  
 She told the FBI "they picked the  
 wrong computer geek to mess with."  
 OSWALD  
 Not the -- most threatening  
 statement I've ever heard.  
 CHARLIE  
 Her code could be hidden in the  
 machine's legitimate coding,  
 probably in the operating system.  
 Oswald goes up to the printout on the board --  
 OSWALD  
 So you look for the computer code  
 that -- looks like Jane's.  
 (looks at the code)  
 This all looks exactly alike.  
 CHARLIE  
 I'll write an algorithm to isolate  
 her code from the rest. You find  
 Dr. Finch, tell her we need a  
 priority run on the supercomputer.  
 And be convincing --  
 OSWALD  
 Yeah, well, I'll tell her -- the  
 fate of democracy is at stake.  
 44 OMITTED 44  
 45 INT. FBI WAR ROOM -- DAY 45 Begin  
Scene  
45  
 Charlie with Don, David, Colby. He shows them a motherboard.  
 CHARLIE  
 Jane's code is embedded in the  
 operating system on the motherboard  
 of the Tru-Poll machines-  
 DAVID  
 And you can prove that?  
 CHARLIE  
 Mathematically incontrovertible.  
 COLBY  
Problem How could rigged machines pass all  
 the testing they went through?

(CONTINUED)

## Appendix B (continued)

## Episode #318 "Democracy", Scene 45 (continued)

45 NUMB3RS 318/55 "Democracy" BUFF Rev 2/21/07 49. 45  
CONTINUED:

CHARLIE  
Think of these voting machines, or  
any computer for that matter, like  
a man reading instructions to  
assemble a model car.

Begin word  
picture

Charlie picks up a piece of paper.

CHARLIE (CONT'D)  
Say these are the instructions --  
if you wanted the man to build  
something that was different than a  
car, the easiest way is to simply  
rewrite the directions. But--

Charlie slaps the paper down on the table --

CHARLIE (CONT'D)  
--these changed instructions are  
evidence of tampering. However--

**ENTER AUDIENCE VISION:**

Begin visual demonstration

Instructions to a classic car model. Pieces of plastic, glue.

EYES read the instructions.

CHARLIE (V.O.) (CONT'D)  
--if you can alter the operating  
system -- that is -- *if you can*  
*alter how the man thinks* -- how he  
interprets the instructions--

EYES read original, correct instructions. But the materials  
are assembled strangely. It does not look like a car.

CHARLIE (V.O.) (CONT'D)  
Left can become right, red is  
green, up is down--

**BACK TO SCENE:**

End visual demonstration

Explanation

CHARLIE (CONT'D)  
The voting machine makes illegal  
alterations, but since it happened  
in the operating system, not the  
software, there's no evidence.

DAVID  
Mess with the operating system, you  
can make the machine do anything?

(CONTINUED)

## Appendix B (continued)

## Episode #318 "Democracy", Scene 45 (continued)

NUMB3RS 318/55 "Democracy" BUFF Rev 2/21/07 50.  
 45 CONTINUED: 45

CHARLIE

In this case, it was designed so  
 the machines only execute the bad  
 program on election day. After  
 that, it erases itself.

COLBY

Jane Aliano can testify to this --  
 long as Tuttle doesn't get to her.

DON

We need to move her somewhere safe.

End scene

46 **EXT. CONSTRUCTION SITE -- DAY** 46

Jane in her hooded sweatshirt, with David and Colby, walking  
 quickly toward a car. Jane holding her head down.

They pass THREE MAINTENANCE MEN in work cloths, one working a  
 JACKHAMMER. Another glances up as they pass.

With David, Colby and Jane as they walk --

A POV COMING UP ON THEM FROM BEHIND

The "Maintenance Men" following, closing the distance --

Suddenly, DARK FIGURES rush from all sides --

Colby and David turn, weapons up --

DAVID

Get on the ground, now!

COLBY

Do it!

FBI SWAT -- assault rifles trained on the "Maintenance Men."  
 Each now seen holding a SILENCED GUN.

David and Colby looking to "Jane." Not Jane. It's Megan.

47 **INT. FBI INTERROGATION ROOM -- DAY** 47

Cliff Dawkins across from Don and Meeks. His confidence  
 gone. He's pale, distracted.

MEEKS

Mr. Dawkins, we just arrested three  
 men trying to assassinate Jane  
 Aliano. They're Tru-Poll Security.  
 On your company payroll.

(CONTINUED)



## Appendix B (continued)

## Episode #414 "Checkmate" (Port, 2008a), Scene 15

NUMB3RS: 414/75: "Checkmate" - FINAL Shooting Script - 3/28/08 12.

15

EXT. FBI TRAINING CENTER - DRIVING TRACK - DAY

15

Begin  
Scene  
15

Megan and Charlie walk and talk. Cars race around the course behind them.

CHARLIE

How many people had access to the witnesses information?

She hands him a list.

MEGAN

About fifty. Multiply their correspondence, e-mails, makes it more like thousands.

Problem

CHARLIE

Remember it's quality not quantity that counts. In this case, Temporal Link Analysis will prove that.  
(off her look)  
Imagine an uncut diamond...

Concept

Begin word  
picture

MEGAN

Not a problem --

**ENTER AUDIENCE VISION**

Begin visual demonstration

Of a large, uncut diamond.

CHARLIE (V.O.)

When a diamond is discovered, it is a large uncut stone...

ZOOM into the diamond.

CHARLIE (V.O.) (cont'd)

Under a microscope, the rock's flaws and inclusions become visible.

We see the imperfections.

CHARLIE (V.O.) (cont'd)

To maximize your profit... they must be removed by cutting the diamond...

The diamond is cut, falls into four smaller...

CHARLIE (V.O.) (cont'd)

So the valuable and brilliant facets are revealed...

(CONTINUED)

## Appendix B (continued)

## Episode #414 "Checkmate", Scene 15 (continued)

NUMB3RS: 414/75: "Checkmate" - **FINAL Shooting Script** - 3/28/08 13.

15 CONTINUED: 15

... and more brilliant pieces.

RESUME SCENE

End visual demonstration

Explanation

CHARLIE (cont'd)

Similarly, Temporal Link Analysis searches the e-mails sent by users with access to the sensitive information, removing the bad ones or "flaws" and revealing those that are of value.

MEGAN

Something outside their job parameters.

CHARLIE

Exactly.

In the background the Instructor yells for Charlie --

INSTRUCTOR (B.G.)

Eppes, you're up --

CHARLIE

I'll call Larry and Amita. They should be able to help out.

He starts to leave...

MEGAN

Charlie -- brake into the turn, accelerate on the way out.

CHARLIE

Thanks --

End scene

16 INT. FBI - INTERROGATION ROOM - DAY 16

HEAVY sits... across from Don. ND Agent stands in the background.

HEAVY

Watch like that... must make you the man in charge.

DON

I got two dead witnesses who were supposed to testify against your boss.

HEAVY

Bitch and snitch, you wind up in a ditch.

(CONTINUED)

## Appendix B (continued)

## Episode #414 "Checkmate" (Port, 2008a), Scene 24

NUMB3RS: 414/75: "Checkmate" - **FINAL Shooting Script** - 3/28/08 **23.**

23 CONTINUED: 23

DAVID (cont'd)  
Two gallons a day... keeps the  
pipes clean.

ALAN  
Oh no, this isn't for me -- it's  
for the toilet.  
(off his look)  
I'm recycling rain water. The new  
system can hold up to 1200 liters.  
(then)  
If you're looking for Don --

DAVID  
Actually I need --

ALAN  
Charlie. Nope, can't help you there  
either.

DAVID  
You.

ALAN  
Me?

DAVID  
How long does it take to learn to  
play chess?

ALAN  
Years to get competitive...

DAVID  
I have this afternoon.

ALAN  
(puts water down)  
Then we're talking about speed  
chess. Better get going.

**24** INT. FBI - GYM - DAY

**24** Begin  
Scene  
24

An FBI Agent, LEX, 20s and buff, flips another AGENT during a  
gun take away. Ten FBI AGENTS including Charlie, watch -- all  
dressed in sweats. Instructor PAUL teaches the class. Behind  
them are several strike dummies.

PAUL  
Alright Eppes, you're up. Prisoner escort...

Charlie, pure fear in his eyes, steps up and grabs Lex by the  
arm.

(CONTINUED)

## Appendix B (continued)

## Episode #414 "Checkmate", Scene 24 (continued)

NUMB3RS: 414/75: "Checkmate" - **FINAL Shooting Script** - 3/28/08 24.

24 CONTINUED: 24

PAUL (cont'd)  
Go --

Charlie barely has time to blink before LEX is on him -- and flips Charlie to the mat hard. The class lets out a collective groan. Lex smiles and struts away.

ON CHARLIE - as he looks up through the blurry light and sees Don extending his hand.

DON  
C'mon bro, walk it off.

Don helps Charlie up... the class continues behind them as they walk to the side. Charlie tries his best to suck it up.

CHARLIE  
This is good. Things are going really well.

DON  
I can see that.

Don hands Charlie the partial photo of the mountain range.

DON (cont'd)  
Think you can dial us into the location?

CHARLIE  
(rubs his head)  
Supervised Multiclass Labeling.  
(then)  
Imagine a cadaver dog searching for a body...

Concept

Begin word picture

**ENTER AUDIENCE VISION**

Begin visual demonstration

Bloodhound tracks through the woods.

CHARLIE (V.O.) (cont'd)  
If you show the dog a photo of the subject, it's useless.

Dog stares at the photo of the missing person (man), tries to eat the picture.

CHARLIE (V.O.) (cont'd)  
Give him a piece of clothing, though, and the dog keys off the scent.

(CONTINUED)

## Appendix B (continued)

## Episode #414 "Checkmate", Scene 24 (continued)

NUMB3RS: 414/75: "Checkmate" - **FINAL Shooting Script** - 3/28/08 25.

24 CONTINUED: (2) 24

Hound sniffs a shirt and takes off like a bat out of hell...

CHARLIE (V.O.) (cont'd)  
The SML algorithm looks for its own  
information or scent...

Our photo appears, above it are a series of numbers... Dog  
next to it.

CHARLIE (cont'd)  
-- by scanning millions of images  
on the internet to look for a  
match...

Above that a second row of numbers cycle through... when it  
finds a match, the dog starts barking.

RESUME SCENE End visual demonstration

DON  
So...

CHARLIE  
I'll call Amita and Larry... again.

They walk back... Lex waits for Charlie --

CHARLIE (cont'd)  
Could use some brotherly advice  
here --

DON  
Go to shake his hand -- then, kick  
him in the nuts.

Charlie smiles --

CHARLIE  
That's the same advice you gave me  
in elementary school.

DON  
Don't fix what's not broken -- End scene

25 INT. EPPES HOUSE - DINING ROOM - DAY 25

Alan and David sit and play chess. David takes notes.

ALAN  
This tactic is called a "pin."  
(then)  
Who's your adversary anyway?

(CONTINUED)

## Appendix B (continued)

## Episode #414 "Checkmate" (Port, 2008a), Scene 40

NUMB3RS: 414/75: "Checkmate" - **FINAL Shooting Script** - 3/28/08 **40.**

39 CONTINUED: 39

The target moves back... Charlie pulls it off -- hands it to Stephen who takes it and stares at the target incredulously.

He counts the rounds... then, recounts it.

STEPHEN (cont'd)  
I can't believe it...  
(looks up)  
290, high score.

Charlie tries to control his pleasure --

STEPHEN (cont'd)  
How'd you do it... some kind of  
crazy math formula or something?

CHARLIE  
(recites)  
"Fast is fine but accuracy is  
final. You need to learn to be slow  
in a hurry."  
(beat)  
Wyatt Earp...

Charlie slides and locks his gun, presents it to Stephen --

40

**INT. CALSCI - CHARLIE'S OFFICE - NIGHT**

40

Begin  
Scene  
40

-- where Megan finds Larry and Amita working on their Higgs Boson project.

MEGAN  
Glad you guys are here... are you  
busy?

LARRY  
Just trying to find the existence  
of a massive scalar elementary  
particle predicted to exist by the  
standard model of particle physics.

MEGAN  
Cool, once you're done I was hoping  
you could take a look at this --

She hands Larry a file... Amita and Larry read.

AMITA  
A list of murder victims...

LARRY  
Who's J-Light?

(CONTINUED)

## Appendix B (continued)

## Episode #414 "Checkmate", Scene 40 (continued)

NUMB3RS: 414/75: "Checkmate" - **FINAL Shooting Script** - 3/28/08 41.

40 CONTINUED: 40

MEGAN

The man who made the list and ordered the hits from jail.

LARRY

He must have been monitored.

Megan hands Amita a DVD -- she places it in her laptop.

MEGAN

He is, which means he's using some kind of code.

LAPTOP - shows surveillance footage from jail. J-Light and Bishop playing chess.

MEGAN (cont'd)

David thinks J-Light's passing messages through this kid while he teaches him chess lessons.

AMITA

The beautiful thing about chess is that both opponents know everything. Nothing is hidden.

Problem

LARRY

So within the lessons, perhaps lies the coded message.

MEGAN

If it's true, can you crack it?

LARRY

Normally we'd need the cipher but --

AMITA

In this case we have the victims' names or the results. So by using backward induction we might be able to work backwards and crack it.

Concept

(off Megan's look)

It's like the Rosetta Stone...

Begin word picture

Amita draws three horizontal lines on the chalk board.

AMITA (cont'd)

... the exact same text is written in three different languages.

And writes the phrase, "Everything Is Numbers," in English, French and Hindu.

(CONTINUED)

## Appendix B (continued)

## Episode #414 "Checkmate", Scene 40 (continued)

NUMB3RS: 414/75: "Checkmate" - **FINAL Shooting Script** - 3/28/08 **42.**

40 CONTINUED: (2) 40

AMITA (cont'd)  
If you can understand just one...

She circles the French word *Nombres*...

AMITA (cont'd)  
You'll be able to read the other  
two.

-- and the Hindi word for Numbers (note: Matt will write).

AMITA (cont'd)  
My algorithm will be looking for  
overlaps between the sets of data  
-- the victims and the chess  
lessons.  
(beat)  
Then, translate the unknown code by  
comparing it to the known murders  
and their gang affiliations.

**41 INT. RITZ CARLTON - SUITE - LIVING ROOM - NIGHT 41**

-- Don (new clothes) finishes putting the touches on a  
beautiful candlelight dinner he has laid out.

DON  
Dinner's ready...

Robin is in the other room.

ROBIN (O.S.)  
Coming...

She walks in... clearly surprised to see what Don has  
arranged.

Don gets up, pulls out her chair --

DON  
Like you said... we talked about  
spending a weekend in a place like  
this...

-- crosses over and sits down.

ROBIN  
Have to get the number of your  
shrink... and thank him.

He pulls out a little present, bow tied around it.

(CONTINUED)

End scene



## Appendix B (continued)

## Episode 509 "Conspiracy Theory" (Port, 2008b), Scene 29

NUMB3RS:509/88: "Conspiracy Theory" -FINAL Shooting Scr.- 10/28/08 32.

28 CONTINUED:

28

COLBY

Except the break-in of David's car doesn't fit.

LIZ

Where were you guys prior to that?

COLBY

We arrested McGill.

LIZ

You took him in?

COLBY

No, we called a unit -- didn't want to waste time processing the guy. Don wanted us to toss his house.

LIZ

So any evidence that you collected from McGill's documentary would have been in David's car...

COLBY

There wasn't anything new there. Just old footage of Hanson...

LIZ

A burglar wouldn't have known that...

COLBY

They're after the video tape --

OFF Colby --

29

INT. FBI - WAR ROOM - DAY

29

Begin  
Scene  
29

Liz, Colby and Robin. ON SCREENS -- footage of the California Pacific Club bombing..

ROBIN

For a guy in charge, Hanson hasn't gotten us very far with the GEO guest list...

(hands file)

On the other hand, McGill may not be so crazy -- okay he is crazy, but it doesn't mean he's wrong. I've managed to ID nineteen members off anti-GEO websites.

(CONTINUED)

## Appendix B (continued)

## Episode 509 "Conspiracy Theory", Scene 29 (continued)

NUMB3RS:509/88: "Conspiracy Theory" -**FINAL Shooting Scr.**- 10/28/08 33.

29 CONTINUED:

29

LIZ

Look at the company profiles...  
Between their factories they're  
exploiting half the children in  
China.

Charlie walks in...

COLBY

Charlie -- where did you keep your  
work on McGill?

Pulls laptop out of his knapsack --

CHARLIE

My laptop of course... the  
processing speed for the algorithm  
was relatively low and --

COLBY

You had it with you last night?

CHARLIE

You think that's what the burglar  
was after? The video...

ON SCREEN -- McGill's 1st video plays (digital squares)...

LIZ

Must have watched it ten times  
before it was destroyed... just the  
backs of a bunch of guys' heads and  
Hanson talking about falling Yen.

COLBY

Let's say the same guy who set the  
bombs orchestrated the break-ins...  
he finds out we have the tape,  
wants to make sure we can't ID him.

CHARLIE

Suggesting the burglar and the  
bomber are one and the same...

LIZ

Except... David said the bombs were  
purely amateur hour -- and these  
break-ins were all high-end jobs...

CHARLIE

Suggesting the burglar and the  
bomber aren't one and the same...

(CONTINUED)

## Appendix B (continued)

## Episode 509 "Conspiracy Theory", Scene 29 (continued)

NUMB3RS:509/88: "Conspiracy Theory" -FINAL Shooting Scr.- 10/28/08 34.

29 CONTINUED: (2)

29

COLBY  
-- which does mean someone in the  
GEO wants to make sure his identity  
remains a secret.

CHARLIE  
Who's got the most to lose?

ROBIN  
We don't know yet...

CHARLIE  
Or you might -- think of Simpson's  
paradox...

Concept

COLBY  
I love that show...

Begin word  
picture

Takes a marker... writes STATS on a piece paper.

CHARLIE  
Not Homer... Edward. David Justice  
had a better batting average in  
both of these years than Derek  
Jeter... but combine them and Jeter  
beats him by forty points.

ROBIN  
Still doesn't mean Jeter's the  
better hitter for either year.

CHARLIE  
Exactly... go with what you know --  
not what you don't.

LIZ  
The guy we can identify... Hanson.

COLBY  
He's the front man for the group.  
These people were in his house.

LIZ  
Some pretty powerful dudes on this list...

ROBIN  
And who knows what they'd do to  
Hanson if that tape gets out --

OFF image of Hanson --

End scene

## Appendix B (continued)

## Episode 509 "Conspiracy Theory" (Port, 2008b), Scene 41

NUMB3RS:509/88: "Conspiracy Theory" -FINAL Shooting Scr.- 10/28/08 44.

**ACT FOUR**

**40 INT. FBI - HALLWAY - DAY 40**

David, holds file, and Charlie head toward the war room...

DAVID

-- I'm just saying it's not that big of a deal...

CHARLIE

I guess...

DAVID

Look at your brother -- man dated an ATF Agent, FBI Agent and an A.D.A. Three women, all strapping guns... sleep with that.

As they walk into --

**41 INT. FBI - WAR ROOM - DAY 41**

Colby looks at crime scene photos of Jonze. Next to it are DOT PHOTOS of his fleeing KILLER (SHADOW). David and Charlie enter.

COLBY

A shadow... that's all we have -- It's like looking at a comic book.

DAVID

Lab results are back... bomb residue all over Jonze apartment, and under his fingernails.

Colby clicks on screen... CASHIERS CHECK.

COLBY

ERT found this in his apartment. Fifty grand...

DAVID

Guess his reasons for bombing were financial, not political. And Jonze's background gave him the perfect cover.

COLBY

Don't say it...

Begin  
Scene  
41

(CONTINUED)

## Appendix B (continued)

## Episode 509 "Conspiracy Theory", Scene 41 (continued)

NUMB3RS:509/88: "Conspiracy Theory" -FINAL Shooting Scr.- 10/28/08 45.

41 CONTINUED:

41

DAVID  
He was a patsy.  
(then)  
Any prints?

ON SCREEN -- blown up image of the check... w/ two prints.  
Check is made out to Jeff Jonze. Bank name is Golden Bear  
Mutual.

COLBY  
Pulled two sets, both latent. One  
is Jonze... other no go.

CHARLIE  
You know fingerprints can reveal  
more than just an individuals  
identity. They can show what he  
touched -- anyone have matches?

Begin word  
picture

David tosses him a box from his pocket -- Charlie catches --

Concept

CHARLIE (cont'd)  
Description electrospray ionization...  
(strikes the match)  
Any substance, heated enough, will  
emit unique spectral lines in a  
specific color...

CLOSE ON -- burning match... as it EXPLODES INTO A BURST OF  
WHITE... ZOOM IN as it ERUPTS --

AUDIENCE VISION

Begin visual demonstration

-- into a fireworks display...

CHARLIE (cont'd)  
-- For instance, a fireworks display...

A FLASH of fireworks... Charlie stands in front of the Statue  
of Liberty...

CHARLIE (cont'd)  
Where every explosive has a signature  
display and color pattern...

More fireworks go off... WIPE TO: Charlie standing in front  
of the Washington Monument --

CHARLIE (cont'd)  
The Crossette contains several  
large silver and gold stars...

(CONTINUED)

## Appendix B (continued)

## Episode 509 "Conspiracy Theory", Scene 41 (continued)

NUMB3RS:509/88: "Conspiracy Theory" -FINAL Shooting Scr.- 10/28/08 46.

41 CONTINUED: (2) 41

OFF the burst of the Crossette... WIPE TO: Charlie in front of the St. Louis Arch...

CHARLIE (cont'd)  
The Kamuro is a dense burst that leaves a heavy red glitter trail...

Charlie holds up his index finger... ZOOM INTO --

CHARLIE (cont'd)  
Each substance that is present on a human fingerprint also burns at a specific color temperature...

Bursts of fireworks erupt from EXTREME CU of a FINGERTIP.

CHARLIE (cont'd)  
Revealing its chemical property -- i.e. acetate, mercury, water...

OFF glitter trail REVEAL --

RESUME SCENE

CHARLIE (cont'd)  
I can run the print through CalSci's mass spectrometer and compare the results to EPA reports... look for chemical matches based on geography.

End visual demonstration

DAVID  
Narrow down where this guy lives.

COLBY  
How come we don't have one of these machines?

CHARLIE  
You do... but you need a mathematician to do the work.

42 INT. FBI - TECH ROOM - NIGHT 42

Liz sits with a TECH who composites (Identi-Kit) Jonze's killer i.e. "The Shadow" on the computer.

LIZ  
-- higher cheek bones.

McGill walks in with Colby --

End scene

(CONTINUED)

## Appendix B (continued)

## Episode 608 "Ultimatum" (Port, 2009), Scene 44

NUMB3RS-608/110: "Ultimatum" - Rev. Green - 10/14/09 30.

ACT THREE

44

INT. FBI - TECH ROOM - NIGHT

44

Begin  
Scene  
44

Don, Nikki and Charlie look at Garcia's file on screen.

CHARLIE

Edgerton seems pretty confident  
that Garcia's still in the system.

DON

Let me see the report on his  
escape.

Nikki clicks on an evidence photo of Garcia's cut wristband.

NIKKI

Marshals found this on the exercise  
yard. Did a cell check ten minutes  
later, Garcia was gone.

DON

Any proof he actually left?

Nikki clicks on video showing civilians exiting the prison.

NIKKI

This video shows visitors exiting  
the jail before it was locked down.

Three people turn their faces away from the camera.

NIKKI (cont'd)

Two have been cleared. Marshals  
think this --  
(clicks on one)  
Is Garcia. His pants are too short.  
They figure he got clothes from his  
lawyer but the size was off.

DON

(notices something)  
Pause it. Garcia's listed as right  
handed. This guy's reaching for the  
door with his left.

NIKKI

(turns to Charlie)  
Okay Charlie, you're looking at six  
thousand prisoners.

(CONTINUED)

## Appendix B (continued)

## Episode 608 "Ultimatum", Scene 44 (continued)

NUMB3RS-608/110: "Ultimatum" - Rev. Green - 10/14/09 31.

44 CONTINUED: 44

CHARLIE

Maybe not. Garcia lived in a specific cell, which means he was only exposed to a portion of the jail population each day.

DON

You're still talking about a thousand people. We don't have time to interview them all.

CHARLIE

With **Longitudinal Socializing Process**, we might not have to. Detention facilities are a breeding ground for criminal enterprises.

Concept

Begin word picture

NIKKI

And that's going to help us --

CHARLIE

Think of the TV show "Survivor."

**AUDIENCE VISION**

Begin visual demonstration

We see footage of contestants on **Survivor**.

CHARLIE (V.O.) (cont'd)

Every contestant is assigned to a tribe. During the course of the game, players compete in contests called challenges.

We see players competing in an obstacle course.

CHARLIE (V.O.) (cont'd)

Players must use their individual skills in order for their team to succeed. If they do, the tribe succeeds.

Footage of a tribal counsel.

CHARLIE (V.O.) (cont'd)

And when they go to the tribal counsel, if contestants have built their alliances correctly, they'll "Survive."

Inside jail prisoners walk down a hallway.

(CONTINUED)



## Appendix B (continued)

## Episode 608 "Ultimatum", Scene 44 (continued)

NUMB3RS-608/110: "Ultimatum" - Rev. Green - 10/14/09 32.

44 CONTINUED: (2) 44

CHARLIE (V.O.) (cont'd)  
**Jails aren't that much different.  
The networks that are established  
in prisons offer significant  
financial and logistical resources  
to criminals.**

Prisoners start pairing off.

CHARLIE (V.O.) (cont'd)  
**The petty thief blends his skills  
with the gun runner. The accountant  
who embezzled millions allies with  
the drug kingpin who can launder  
his money.**

RESUME SCENE End visual demonstration

CHARLIE (cont'd)  
Longitudinal Socializing Process  
looks for the most beneficial  
patterns and relationships.

Explanation

NIKKI  
Who Garcia would've had to build  
alliances with in order to  
"Survive" being whacked by Salazar.

CHARLIE  
I can run the data and narrow down  
possible matches but Don, I'll need  
your help analyzing the final  
candidates. End scene

45 INT. L.A. FEDERAL PENITENTIARY - D9-33 - NIGHT 45

Edgerton kicks a vending machine. A candy bar falls down.

EDGERTON  
(takes a bite)  
Stale.

COLBY  
I know how you can get a hot pizza.

EDGERTON  
Sorry, you're worth a little more  
to me than that.  
(then)  
I could've gone for Eppes. But you  
know what it's like.

(CONTINUED)

## VITA

Michelle Louise Simms received her Bachelor of Science degree in geography from Texas A&M University in 1991 followed by a Master of Agriculture in natural resources development in 1995. Returning to Texas A&M, she obtained a Master of Science in geography specializing in geographic education in May 2007 and a Ph.D. in May 2011. Her research interests include informal and non-formal education, especially Entertainment-Education, and geography education. She plans to pursue the development of entertainment products that educate through film, television, and new media as a writer/producer.

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