ASSOCIATIONS BETWEEN PRIMETIME TELEVISION SHOWS AND VIEWERS' MATHEMATICS KNOWLEDGE, SCIENCE KNOWLEDGE AND CONFIDENCE

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ABSTRACT

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In recent years, a rise in science and mathematics content has been observed in adult television programs. The programs *CSI* and *Numb3rs,* for example, frequently contain specific references to various science and mathematics problems. It is possible that a viewer's academic self-efficacy, defined as one's belief in the capabilities to organize and execute actions in the effort of goal attainment, may be influenced by such content; as such, television programs have the potential to positively engage adults in academics while simultaneously providing entertainment. To investigate this possibility, avid viewers of programs involving science and math were instructed to complete a questionnaire rating their chemistry and mathematics self-efficacy. In addition, the questionnaire examined viewers' understanding of specific science and mathematics topics before and after reading provided texts. Results showed a significant relationship between chemistry, but not mathematics self-efficacy and program preference. Gains in content knowledge were not observed in relation to program preference. Overall findings, however, indicate that adults may indeed engage with academic content in television programs. Such findings suggest that further research into academic self-efficacy and television content is warranted.

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OVERVIEW OF THE DISSERTATION

This dissertation is organized into five chapters. Chapter I introduces the concepts and research questions pertaining to the dissertation. Chapter II examines an extensive body of research on television with a specific focus on its role as a media artifact by referencing material within cognitive psychology, media studies and self-efficacy. Chapter III describes the main study. The write-up includes a description of the methods used for the collection and analysis of the data. Chapter IV describes the study results. Chapter V provides a discussion with comments and interpretations of the results, and highlights the limitations of the study and implications for future research.

CHAPTER I: INTRODUCTION

Television is a universal tool helping people acquire information, be it for entertainment or for current events. With its especially powerful entertainment and informational appeal, it often attracts viewers for several hours at a time. Often, these excessive hours of television watching are viewed in a negative context as a wasteful indulgence (Winn, 1985; Lillard & Peterson, 2011). Some consider it leads to attention defects, obesity and an overall apathetic lifestyle. However, the content of some programs has vastly changed in unique ways compared to prior decades. In recent years, viewers have witnessed a rise in science and mathematics content. Production companies now spend money to include specific content designed to depict true-to-life occupations of their main characters. Such television programs have the potential to positively engage adults in academics while simultaneously providing entertainment.

Appropriate medical jargon, forensic laboratory analyses and law enforcement protocols are just a few of the areas in which experts have helped programmers to include authentic content into weekly television program episodes. Over time, a television program in itself can evolve into a multifaceted system, one that requires retrieval of prior plot elements in order to make salient connections to new situations. For example, the American Broadcasting Corporation's (ABC) *Lost* had many open-ended plotlines that required viewers to understand current interactions while linking these to appropriate previous episodes (Abrams, 2004 to 2010). Likewise, Fox's *House*, incorporated numerous instances of medical terms and scientific jargon, referred to as "specialized

content" (Shore, 2004 to 2011; Woznicki, 2005). "Specialized content" for our study was defined as specific academic material integral to a plot's progression (i.e., mathematics and science).

A popular book, *Everything Bad is Good for You* by Steven Johnson (2005) claims that today's shows are multifaceted and that all this added specialized content helps viewers to be "smarter" and manage systems more effectively. This notion is derived from the work of David Marc and Robert Thompson (*Prime Time Prime Movers*, 1995) who compared shows from prior decades to those of today. Moreover, they suggest that programming has evolved from single linear plot lines (like *Starsky & Hutch*, as mentioned by Johnson, 2005; Blinn, 1975 to 1979) to more multifaceted, complicated webs. However, Johnson's notions are based on little empirical evidence.

The goal of the present study was to confirm the presence of an association through a popular culture artifact as a means to study adult knowledge and confidence towards academics. The results of this study may inform our understanding of television's potential influence on everyday learning and motivation in the fields of mathematics and science. Since specialized content is now more prevalent in television, it may positively influence a viewer's mindset on these topics once he or she sees how characters utilize "expert know-how" in a constructive manner. Potentially, this body of research could also be used by media researchers as a way to understand fandom or "the state or attitude of being a fan," (Merriam-Webster, 2011) with fan defined as "an ardent devotee; an enthusiast," (The American Heritage College Dictionary, 2004) and how this concept relates to academia. Analyzing this relationship may help in understanding television viewing as it relates to cognitive processing in general. As media consumption

and popular culture continue to evolve, this information can be shared with educators and media researchers to increase motivation to learn among adults.

Time Spent Watching Television. Most avid fans of programs such as *Lost, House,* and *Numb3rs* spend many hours watching the screen. While the plotlines of television programs are often a primary source of motivation and entertainment, it is important to remember that the path to "who-done-it" or catching a criminal often includes a series of steps, problem-solving examples or higher level vocabulary. It may be the case that a relationship exists between the embedded academic material and how that material requires viewers to think more abstractly about an episode's given situation, situations in similar programs, or even real-world situations. For example, in a typical *Numb3rs* (*CBS*) episode, the main character uses mathematics to solve crimes.

Overall, the objective of solving any crime is usually very clear and often familiar: find clues, interview witnesses, draw conclusions and arrest the perpetrator(s). In *Numb3rs,* for example, mathematics is utilized as a crime-solving tool, thus the steps involved in this television program have been altered from that of a typical criminal investigation. Avid television fans often utilize information from past episodes to process events and even to make predictions. Since avid fans have a grasp on the program as a system, to some degree, any embedded specialized content must also be processed. As a result of processing this specialized content, avid fans may then feel more confident in their abilities to process related academic content.

The Present Study. In the present study, we examined a related body of research from educational, popular culture, and cognitive perspectives. The included research is an application of television's current theoretical model to the cognitive notions of *self-*

efficacy, cognitive load, system processing and *convergence. Self-efficacy* is defined as the belief that one is capable of performing in a certain manner to attain a certain set of goals (Bandura, 1994, 1997, 2001, 2002). C*ognitive load theory* provides "guidelines intended to assist in the presentation of information in a manner that encourages learner activities that optimize intellectual performance," (Sweller 1988; 2011; Sweller, Van Merriënboer, & Paas, 1998). S*ystem processing* is the manner in which separate entities relate to function as a whole (Hmelo-Silver & Pfeffer, 2004; Hmelo-Silver, Marathe, & Liu, 2007). *Convergence* is defined as the depth and breadth of avid fan exposure (including online and DVR viewing; blogs; highly developed network-supported websites and fan forums) and the relationship of these elements to confidence in understanding a topic (Jenkins, 2006).

Based on this previous research, we investigated the following research questions: do fans of different programs extract information from text differently? Does program preference affect one's mathematics and chemistry self-efficacy? In turn, does mathematics and chemistry self-efficacy show a relationship in the prediction of program preference?

In order to study differences between avid fan groups, the following specific television fan groups were studied: all *CSIs,* all *Law & Orders, Heroes,* and *Numb3rs*.[1] *Avid fan(s)* television viewers are those who self-indicated they were moderate or extreme television fans and loyal to their chosen television program. An additional group consisting of avid fans of "Any Other Program" was used as a comparison group.

[1] During the pilot, *Medium* fans were used. However, when the actual dissertation study was conducted, there was a very small participation rate of these fans. Consequently, the few fans attracted were moved to the avid fan of "Any Other Program" group. Thus, *Medium* appears in the survey instrument (Caron, 2005 to 2011).

All *CSIs* (Crime Science Investigation and all spin-off programs) and *Numb3rs* programs were selected because they included technical or specific terminology related to plot resolution and follow an ordered set of crime-solving steps. Both *Numb3rs* and *CSIs* include forensic information, related skill demonstrations, and related to the focus of this study, an inclusion of mathematics and science content. To establish comparative differences, *Heroes* was also selected because it simply mentioned technical jargon unrelated to plot resolution and did not follow an ordered set of crime solving steps. *Numb3rs* and *CSIs* constituted the primary programs of focus, because more cognitive gains and elevated levels self-efficacy were predicted to be present among the avid fans of each of these shows due to the addition of specialized content. *Numb3rs* was selected for its mathematical content as a novel method of crime solving. All *CSIs* were selected for their forensic science content that often includes areas of study such as chemistry. All *Law & Order* programs were selected because legal jargon is often presented within the plot resolution and this approach is different from the jargon used in *Numb3rs* (mathematics) and *CSI* (various sciences). All *Law & Orders* (a group inclusive of all spin-off programs), for the most part contain non-scientific content and crime solving-themes and are devoid of the forensic science techniques often displayed in programs such as *CSI*.

All *CSIs*, all *Law & Orders*, and *Numb3rs* programs are considered similar because they follow a similar sequence of events in each episode. *Heroes* was selected for its periodic (not presented in every episode) science content and complicated plotlines. This program does not use periodic science content to solve crimes or resolve actions on a weekly basis; rather, it mentions scientific terminology from time to time,

but in a lesser degree from that of *Numb3rs* and all *CSI* programs. *Heroes* is considered unlike the other four programs due to its increased number of characters and plot threads that stretches over multiple seasons and episodes that begin with the program's first episode. All *CSIs* episodes are shown in primetime on the CBS Network. *Numb3rs* was shown in primetime on the CBS Network (airing ceased in 2010). *Heroes* was shown in primetime on the NBC network (airing ceased in 2010). All episodes of *Law & Orders* can be seen on the NBC network and are syndicated on multiple cable channels. Descriptions of programs used for purposes of this study are summarized in Table 1.

Table 1

Television Program Descriptions and References

Program	*Description*
All CSIs	Crime dramas about forensic investigators who use high-tech science to follow the evidence and solve crimes in various locales.
Numb3rs	A drama about an FBI agent who recruits his mathematical-genius brother to help the Bureau solve a wide range of challenging crimes in Los Angeles. Inspired by actual events, the series depicts how the confluence of police work and mathematics provides unexpected revelations and answers to the most perplexing criminal questions.
Heroes	A total eclipse casts its shadow across the globe, seemingly calling forth a multitude of everyday men and women with special powers.
All Law & Orders	In the criminal justice system, the people are represented by two separate yet equally important groups: the police who investigate crime and the district attorneys who prosecute the offenders.
Any Other Program	Those viewers who did not indicate one of the above programs was their favorite were categorized as belonging to this group.

Note. From "CSI: Crime Scene Investigation," [Television Broadcast], by A. Zuiker (Creator), 2000 to 2011, by the *Columbia Broadcasting System;* "CSI: Miami," [Television Broadcast], by A. Donahue, C. Mendelsohn & A. Zuiker (Creators), 2002 to 2011, by the *Columbia Broadcasting System;* "CSI: NY," [Television Broadcast], A. Zuiker, C. Mendelsohn & A. Donahue, (Creators), 2004 to 2011, by the *Columbia Broadcasting System;* "Numb3rs," [Television Broadcast], N. Falacci & C. Heuton (Creators), 2005 to 2010, by the *Columbia Broadcasting System;* "*Law & Order*," [Television Broadcast], D. Wolf (Creator), 1990 to 2011, by *National Broadcasting Company; "Law & Order: Special Victims Unit*," [Television Broadcast], D. Wolf (Creator), 1999 to 2011, by *National Broadcasting Company;* "Heroes," [Television Broadcast], T. Kring (Creator), 2006 to 2010, by the *Columbia Broadcasting System.*

The present investigation employed a data collection measure that contained two short readings (one involving mathematics and one involving science), two self-efficacy

inventories, and open-ended questions asking how program content related to academic text subjects were asked to read during the study. All data were assessed using quantitative analyses. Results were derived from surveying 2010 New York Comic Con Festival attendees and all *CSIs,* all *Law & Orders*, *Heroes*; and *Numb3rs*[2] online fan forums and Facebook page members. The results of the study, while modest, lay the ground-work for future investigations into these factors in an effort to inform media researchers as well as educators who look to harness television's potential to teach content.

[2] *Heroes* and *Numb3rs* were ending their tenures on their respective networks at the time of this data collection. Online and NY Comic Con resources were used in an effort to reach more potential subjects.

CHAPTER II: LITERATURE REVIEW

Television

From Black and White to Convergence

Television has been an integral part of American culture since it became commercially available in the 1930s. At first, families gathered around in the evening, viewing a single small black and white square box. Programs ranged from variety shows to cowboy westerns (Comstock & Scharrer, 1999). For most, watching television was a group event, sharing a window into a new world. Viewers were entertained by programming that was often shown in weekly or daily installments. Since most programs were shown only once, if viewers missed their favorite shows, they would need to wait until the next week. The only way to catch up and be ready for the next week's installment was to hear what happened from a friend, neighbor or work colleague.

As time passed, in-home entertainment came to be part of daily life as a way to relax and gather information about the surrounding world. Early programming was often housed on studio lots with limited budgets and technical effects. Today's programming is markedly different, with high-cost special effects and skilled writers crafting complex and riveting dramas. These programs often contain many plotlines and characters; this multi-character, multi-threaded television format has changed from the earlier style of programming in which dramatic sequences followed a single line and often reached their resolution within the span of a single episode. Today, there is more included in television programming, which has changed the ways that viewers process television. With more

information and plot directions to follow, it is no wonder the small screen has moved to the online universe. Television has become multi-platformed, as most programs now branch out into social networks and television network-supported websites. Some fans share information, recap episodes and discuss their feelings about particular episodes.

Television as a Cognitive Workout

Television as a media artifact has provided entertainment and information to the masses for many years in the form of newscasts, documentaries and educational programming. Entertainment is provided in the form of dramatic series, sitcoms, reality programs and game shows – to name but a few examples. Each possesses components that provide a degree of cognitive knowledge depending on the topic at hand.

To understand how television viewing has changed as a result of increasing program complexity, we may first look to Sweller's (1988, 2011) cognitive load theory. His research suggests that a small load on working memory yields a greater transfer to long-term memory. Specifically, if the information is less complicated in the manner it is presented, one will be more likely to remember it and extract it for later use. This area of cognitive research is often aimed at instructors (in any capacity: formal education or otherwise) teaching problem solving, thinking and reasoning. It is also believed that people are able to learn more effectively if they can build upon what they have already experienced (Chi & Ohlsson, 2005; Sweller, 1998). Given this, there may be a relationship between the increased "weight" placed upon today's television programs (as consumption may be defined as a weekly "workout" providing viewers an experience in multi-thread following and specialized content "lessons") and their cognitive processes as

they relate to knowledge and confidence. In addition, a viewer's attempt at following and understanding multi-level themes and information may adjust their outlook on their own comfort in overall cognitive processing. While Sweller's (1998, 2011) theory predicts less transfer to long term memory if the cognitive load is increased, there is something to be said for the influx of information often present in today's television (or the increase in cognitive load) and the ability for avid fans to recall specific events for use in processing newly presented information within subsequent seasons. Domain knowledge is an area that distinguishes experts from novices and perhaps the same relationships exist to some degree for avid fans versus casual viewers (Sweller, 1998).

Experts utilize schemas on an everyday basis. As problem solvers, they recognize a problem state as belonging to a particular category and can thereby identify the steps they need to utilize in solving the said problem. Steps are derived from past experiences and acquired information or schemas. The same can be said to be true to some degree for television viewers. Television programs are one good example that provide schema representations, especially those programs with criminal investigation themes. These series of steps often include a crime being committed, evidence being gathered, witnesses being questioned and often, a twist in the plot by the close of the program. Prior information is utilized by viewers to make predictions and assist in processing of newly presented information. This transfer includes both factual and procedural knowledge. Both types of knowledge are present in the programs examined in this study, as they not only contain examples of problem solving steps, but often true to life material utilized by experts in the field. From Sweller's (1998, 2011) research and novice-expert research in

general, it appears that schemas are a major factor in distinguishing experts from novices in problem-solving skills. Overall, problem solvers must consider the following:

- the current problem;
- the goal state;
- the relation between the current problem state and the goal state;
- the relation between the problem solver and operators;
- the use of sub-goals (Sweller, 1998).

This breakdown of steps provides an ordered set of events that is commonly utilized by successful problem-solvers. It may be argued that the majority of today's criminal investigation television program follows this sequence of events. If a viewer is continually exposed to this set of events, is it not possible for them to feel a sense of confidence in their own problem-solving? The added cognitive load in current television programming provides exercise in this skill, which may transfer and result in a viewer's increased confidence in following the problem solving protocol and processing of specialized information of a similar nature contained within the program.

Shows of the past did not involve a large cognitive load and most of the dramatic connections were resolved within a single episode. There were fewer opportunities to watch missed episodes and viewers were required to understand the latest sequences at the time of airing. Currently, the number of character changes and multi-episodes arcs has increased. Today's programming requires one to know and remember storylines and characters that stretch across many episodes, if not subsequent seasons. Thus, more work is required from a viewer's working memory and long-term memory to process this information.

As a multimedia artifact, television includes visual, auditory and sometimes textual components that vary in their combinations and abundance (Mayer, 2001). This

multimodality nature of information presentation may lead to an increase in effective working memory capacity, according to Baddeley (1999). Working memory includes an auditory loop for processing speech and a visual-spatial sketch-pad for processing visual information. According to Baddeley's theory, both are independent and limited in capacity. By using them together and presenting information within multiple modalities, working memory capacity should increase (Baddeley, 1999; Penney, 1989 as cited in Sweller, 2011). Many studies have shown that auditory and visual information presented together ease processing and lead to better learning than a unimodal format (Ginns, 2005). However, while the mode of presentation of information is optimal, the intrinsic nature of today's television programming (the actual concepts and multithreaded plotlines) has the potential, in theory, to affect one's cognitive load in a negative way.

Johnson (2005) argues that all media are more demanding today and learning takes place indirectly from media at large. We can see an example of the plot complications Johnson refers to with a map of character connections from the television series, *24*, and the more limited complexity displayed by *Dallas* a show created decades prior (Figure 1). As narratives require processing effort, one can argue the cognitive work demanded by viewers of today's programs is increased due to the use of multiple threads and the organization of many characters and their relationships to one another. While television today utilizes more modalities than in the past, the increased complexity of programs may offset any processing and learning benefits offered by such multi-modal presentations.

Dallas 24

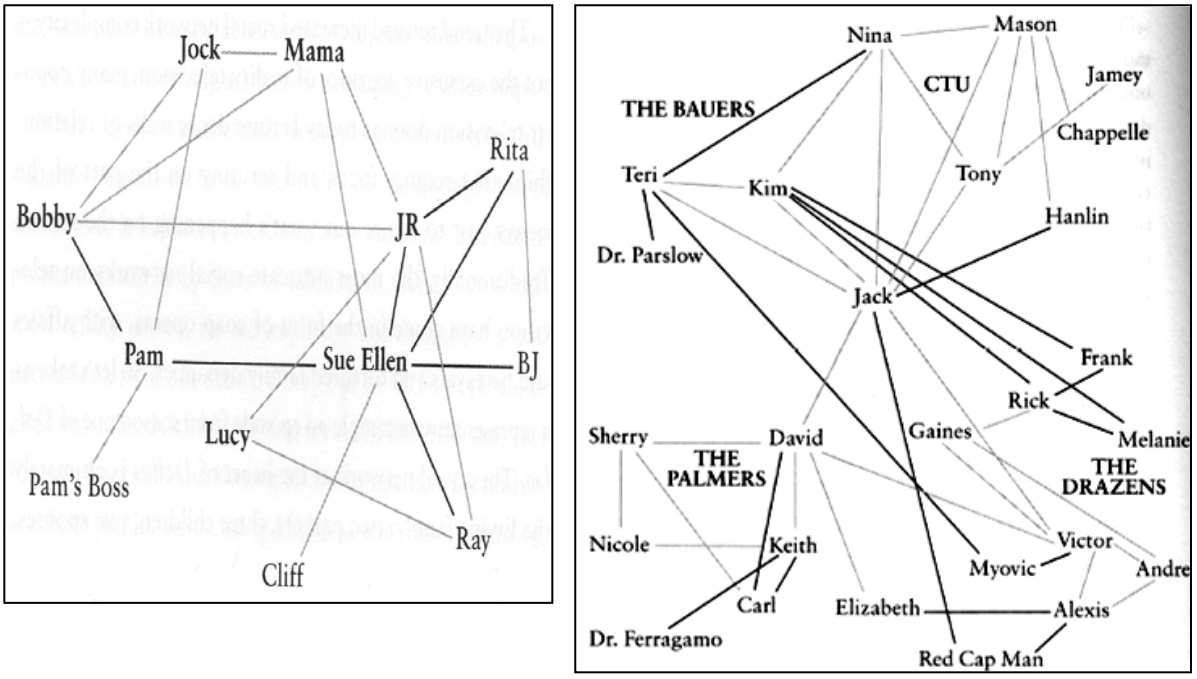

Figure 1. Character Plot Connections within Fox's *24's* First Season & *Dallas'* First Season. From "Everything Bad is Good for You: How Today's Popular Culture is Actually Making us Smarter," by S. Johnson, 2005, pp. 110 & 112, New York: Riverhead Books. Copyright 2005 by Author. "*24*," [Television Broadcast], R. Cochran & J. Surnow (Creators); "*Dallas*," [Television Broadcast]. D. Jacobs (Creator).

A study by Bradley and Shapiro (2004) for instance, found that the complex syntax from television scenarios influences cognitive processing and the parsing of reality. Much has been published in relation to cultivation theory, according to which high levels of television viewing may lead a viewer to cultivate perceptions of the world that align with a program's portrayal of reality (Gerbner, Gross, Morgan, & Signorielli, 1982 as cited in Mattera, 2007). This group surmised that a cognitive burden (i.e., many threads of information) results in unlikely events being viewed as valid. From their research, they differentiated between simple and complex syntax:

Simple syntax: The mother sternly tells the son that that divorce is his fault.

The man boldly taunts the gunman.

Complex syntax: The boy is told by the mother sternly that the divorce is his fault.

The gunman is taunted by the man boldly.[3]

They surmised that, complication in language use has an effect on one's thinking, yet more research is required on how language affects one's overall thinking skills and what is used to assist in this processing.

In analyzing Bradley and Shapiro's (2004) research, it is important to note a major limitation was the manner in which television was tested. That is, these researchers used the written text of television scenarios, rather than presenting the live action sequences that were viewed by real audiences. While it may be more effective for data gathering purposes to represent subjects with text, it removes other features of the program (such as sound and animated action sequences) that may affect processing of the actual image. Text, as in scripts or lines, are the foundation of television studies, but a concern for those in television research is the use of techniques such as those derived from literary studies (Hartley, 1997). This is because television is watched, not read, by an audience. In addition, text by itself can be interpreted by an audience in many ways, and thus is all the more open to interpretation than if surrounded by lighting, characters delivering lines, or music. Cinematic additives limit interpretation. Thus, it may be more realistic to understand viewers' thoughts and gauge or determine behavioral responses such as cognition and self-efficacy in an effort to determine if any overall changes in

[3] Bradley, S., & Shapiro, M., (2004). "Parsing Reality: The Interactive Effects of Complex Syntax and Time Pressure on Cognitive Processing of Television Scenarios." *Media Psychology, 6(*4): 330.

thinking have occurred during viewing versus reading. Conceivably, researchers could observe different results by altering the artifact's presentation.

Intricacy Influx and Outside the Box

Some view excessive amounts of television in a negative way, because it does not require much input from the viewer. It has been viewed as a stimulating and attractive artifact eliciting little participation (Comstock & Scharrer, 1999; Livingstone, 1998). Winn (1985) describes a trancelike state many children fall into with its short sequencing of overloaded stimuli. Adults often react in a similar manner causing negative consequences such as a sedentary lifestyle and even depression (Teychenne, Ball & Salmon, 2010). Excessive television viewing in children is believed to have a negative relationship with language development and academic achievement. With so much research pointing to the hazards of television, it is hard to fathom that television could ever serve to boost academic confidence or offer cognitive benefits. However, even Winn (1985) admits, generations of children have reached adulthood without showing signs of any negative trend in overall intelligence (as cited in Johnson, 2005). She also references the effects of technology usage (i.e. computers) – today, this is an often daily occurrence.

Other research demonstrates that television may contribute to an increase in processing due to its supportive online platforms and often true-to-life technical elements (Flynn, 1984, 1987, 1994; Johnson, 2005; Neisser, 1998). However, caution must be exercised in making claims about any related increase in intelligence. Steady increases in intelligence may be the results of an increased emphasis on writing and reading in conjunction with today's availability of popular technology (Flynn, 1994).

An avid fans' media consumption is no longer defined as an inactive experience with little effect on cognitive function. Just as we learn letters and process language to read books, we interpret images and plots to watch television (Herrmann, 2000), potentially leading some to blog and join online discussion groups, thus for some making television a steady conversation rather than a previously perceived idle ritual. Avid fans also frequently refer to their own knowledge and experience both in the world they inhabit while comparing this to the "reality" television creates (i.e. social interactions or occupation likenesses). Even if the television worlds are imaginary, most hold references comparable to their current environment, providing additional scaffolds for learning and processing (Black, 2007; Herrmann, 2000), thus easing the cognitive burden for additional information (i.e. science and mathematics). As a result and by cognitive definition, these adults are active in their television engagements (Bradley & Shapiro, 2004, Johnson, 2005; McLuhan, 1964). Primetime television shows today contain fascinating formats and characters that utilize avid fans' cognitive skills to manage presented situations. While watching, viewers are required to process new information, follow character developments, absorb technical jargon and make connections to the past.

Digital Changes. Overall, society has shown a vast increase in the use of electronic media and a drastic decrease in the use of print media (Johnson, 2005). Viewers can see this evidence on most major network's websites, fan pages and social forums. This influx of electronic media provides a change in processing for all viewers. Marshall McLuhan (1964) was one of the first researchers to call attention to media and cognition. He argued that media consumed and defined one's mind. He stated, the "effects of technology do not occur at the level of opinions or concepts, but alter sense

ratios and patterns of perception steadily and without resistance" (p. 18). He was one of the first to highlight the force of technology on our perception and thinking. According to his theory, everyone learns a new language when a new medium is introduced. One learns from print media events that are in a linear, repetitive and logical manner. Television, as defined by McLuhan, is a non-linear, multi-thread visual artifact that changes the way viewers process information. In order to make sense of everything, we use schemas to categorize given elements beyond the information provided. In other words, television viewers attach meaning to what is observed and engage in a learning process to some degree (Herrmann, 2000).

One could argue, television production companies make programs more intricate in an effort to steer viewers into seeking other media forms to process their programs (e.g., blogs, online fan forums, network based websites, etc.) and keep up with the ever changing narratives. The freedom to comment is available and abundant and also serves as a form of entertainment. This form of contributing and participating adds to the collection of shared information. This type of multiple medium information presentation or *convergence*, coined by Henry Jenkins (2006) is seen in the trend of combining formerly separate media. For example, when someone watches a television show today, it is not necessarily an isolated experience. Fans can view the show's website (or unofficial fan-produced websites), participate in online forums or catch up on missed episodes. Thus, an interesting effect takes place. Avid fans are likely to participate in these and additional media outlets, which then adds to a more informative experience affecting both knowledge and confidence in presented material.

Gathering and sharing information has become more sophisticated as programs utilize the Internet. For instance, according to Jenkins (2006), avid *Matrix* fans created elaborate guides to help them track information about the fictional Zion, a resistance movement featured in the movie's trilogy (Silver, 1999). Fans of *Survivor* (CBS) (Parsons, 2000 to 2010) have used the Internet to find information about the show's contestants before they are made public. Fans have also used accessible satellite imaging (such as those from platforms like Google Earth) to identify the set locations in spite of "no fly zone" agreements with local governments. With available knowledge easily accessible to avid fans, more is processed and gained. This shift in media consumption and usage appears to promote indirect learning (navigation of Internet searches) and direct content learning (programming facts and content knowledge).

Despite the suggested cognitive gains within Johnson's (2005) work, empirical evidence does not back his notion. The definition of "smarter" is based on the societal influx of advanced technology and media, where his claims might require viewers to engage in more effortful mental processing. While, Johnson's argument appears plausible, a formal theory of causation in this field of television and cognition has not yet been found. For now, it is only seen as a correlation based on the author's cognitive self-discovery through a journalistic lens whereby he analyzes society. The difficulty lies in testing this idea empirically, because numerous environmental factors, such as consumption hours, Internet use and education may affect an avid viewers' processing making it difficult to determine if television is the single causal factor in their "educations." This inability to control for the many confounding factors may explain the

limited research that exists in the context of examining adult avid viewers. Perhaps, looking for associations between variables is a more reachable goal.

Some studies have focused on behavior and genre such as a) the semiotic moment of meaning making, exploring how audiences read and make sense of presented information b) an ethnographic focus on how people behave when they are in an audience, coupled with their technology perception and c) how members focus on a self-definition in relation to specific genres or media text (i.e., crime drama fans or those who follow *Star Trek*) (Casey, Casey, Calvert, French, & Lewis, 2008; Costello & Moore, 2007; Dickinson, Harindranath, & Linne, 1998; Lewis, 1991; Morley, 1992). Some studies have focused on media use and its impact on crime perception as this often produces a skewed view of criminal actualities (Pfeiffer, Windzio, & Kleimann, 2005). A few studies have investigated educational television programs and some have shown learning effects from viewing specific programs. Others have focused on adult viewers but not to the extent of the techniques and abundance associated with children's television (Linebarger, Kosanic, Greenwood, & Doku, 2004; Star, Johnson, & Petty, 2008).

The combination of television and network supported websites has been a regular part of the American Culture since the 1990s. A regular analysis by the Neilsen Company (2009) noted a recent rise in consumption, according to its Anywhere Anytime Media Measurement Initiative (A2/M2), which captures data not only from television, but also from Internet and mobile sources. It was estimated that more than half (57%) of Americans with internet access at home use television and the Internet together at least once a month. Often, these excessive hours of television and Internet usage are viewed in

a negative context as a wasteful indulgence. However, there may be something acquired from this *convergence,* as a viewer engages in these activities simultaneously (Jenkins, 2001; 2006). This type of viewer is more likely to locate relevant program information, read show synopses, view online episodes or participate in online forums all of their own volition and interest. The above involve active engagement and exercising of cognitive functions.

Impact of Television on Adults. Various negative sentiments regarding television have arisen over the years. Some of these include decreased attention spans, promotion of apathy, and increase in sexual aggressions. Mostly, research has focused around the amount of violence contained in most television programs. Initially, most violent acts were suggestive (i.e. the viewer would hear a sound effect and witness a victim fall to their death) but today they are only limited by a creator's imagination. Regardless of these negative aspects, adults still spend a considerable about of time in front of the television. However, it appears they may do this for reasons other than the highly published and research reasons listed above.

It is reported that many adults and older adults today watch significant amounts of television (Mares & Woodward, 2006). Often those who retire watch more television than others because they have more time to devote to this activity (Mares & Woodward, 2006; Robinson, Skill, & Turner, 2004 as cited in Mares, 2007). What is more intriguing is that older adults confirm they have a more active use for television as a source of discussion among other fans, acquiring novel information and/or as a leisurely means to pass the time (Ostman & Jeffers, 1983; Rubin, 1984 as cited in Mares, 2007). In order to rise to avid fan status, there is a degree of time investment needed for processing the

given information. Exposure to new information, talking with others, and encoding newly presented information are some of the ways people optimize learning through elaboration (Anderson, 2005; Anderson & Bower, 1973). While they may not be aware of it, the television shows avid viewers consume provide a venue for gathering information, some of which may be influenced by a viewer's background.

According to Mares (2007), fans have varying degrees of background information for the programs they view. This information may vary from domain specific knowledge (e.g. the experience of being a former linebacker may help process information from a televised game), to prior experiences related to the content (viewing past episodes in a series), to high levels of expertise (professional chefs remembering much more from a Food Network program than amateur cooks) (Mares, 2007). Having background information increases the likelihood of comprehension and increases the speed of processing (Harris, Durso, Mergler, & Jones, 1990). Additionally, prior knowledge influences memory strategy efficiency (Anderson, 1973; Chi, 1978). It would be interesting to study those with limited background knowledge of an academic subject for an effect of the program's academic content on one's academic self-efficacy. One difficulty that arises is finding these avid fans in a single setting; this is often the Achilles' heel in media research.

Currently, research studies concerning prior content knowledge or expertise within adult processing are conflicting; the reason for this discrepancy is unclear. It may be due to the difficulty in testing any hypothesis as there are many variables to control when studying television fans. For example, age differences have been shown to be based on current familiarity. In Mares' (2006, 2007) research, there are studies that

reduced or eliminated age differences as shown in Hultsch and Dixon (1983). Younger adults remembered current entertainment text better than older adults, but no age differences existed when reading about celebrities from prior decades. There are also studies which show no age differences when it comes to prior knowledge.

Working memory is another important variable to consider when examining prior knowledge. Hambrick and Engle (2002) looked at the working memory capacity of adults with regards to prior baseball knowledge. They found that knowledge of baseball was the single strongest predictor of what each subject remembered from a short broadcast. Given previous studies focused on expert information can an avid fan also be considered an expert? Are they not, to some degree, interchangeable? Experts have a certain way of processing information based on their familiarity with the topic. This can also be applied to novel situations. Every individual has a method and a manner in which they break down and process information. Perhaps with some television programs that include terminology true-to-life of their main character's careers, we can be begin to look at the content as a cognitive modifier or even confidence builder. Limited research is available to answer the question of the relationship between television fandom (as a form of expertise) and cognition (Casey et al., 2008).

Avid Fan: Defined

Drama treads have been around for centuries in cave paintings, folklore, fables, Shakespeare plays and more recently, soap operas. To successfully enthrall the self is no idle task. In most cases, it comes to them as an automatic response; for example, the ability to recite how last week's character is caught up in another crisis by referencing

relevant information that unveiled itself in prior seasons. This cognitive processing only become amplified and enhanced with the addition of academic material. Thus, reviewing the activities of avid fans and fan groups, rather than a general audience may provide insight into processing differences (Fiske, 2010).

Since television's inception, researchers have studied the relationship between viewing and behavior, as well as how to categorize and define what it means to be a fan or an audience member. Media studies often define audiences as "a category rather than a being," (Casey et al., 2008). On the whole, audiences are difficult to define and more difficult to keep stable with a steady set of spectators (Ang, 1991 as cited in Mares & Woodard, 2006). An audience member enters a venue of viewing for a short time and exits when the credits roll (sometimes earlier if not satisfied). It describes an extension of the viewer, but does not "capture or define" how one thinks (Casey et al., 2008). Casey et al. (2008) extends the definition by formulating the idea that viewers understand the world based on their own experiences. Viewers process information by viewing according to their culture – watching alone or with others, avidly or passively.

Fans, by definition, are more involved than the average viewer. Some fans may be negatively referred to in our society as "obsessive types" who join fan clubs or become emotionally distressed if a program ends (Casey et al., 2008). Some high profile communities (such as "Trekkies" who immerse themselves in the world of *Star Trek*) have huge followings. Jensen (1992) suggests that academia has contributed to the often negative fan connotation. He notes that the label of "fan" conjured an image of a deranged individual engaging in irrational behavior and becoming deluded by the whimsy of popular culture (Jensen, 1992 as cited in Casey et al, 2008). Despite all these

negative perceptions of fandom, there may be some positive aspects for the heightened involvement of fans, as these viewers may absorb copious amounts of information related to their chosen programs.

This idea is hard to verify, however, because aspects taken from Jensen (1992) and those similar were often derived from anecdotal evidence and not scientific analyses (Casey et al., 2008). Few studies have actually examined the condition of being a fan and making the self-declaration. Jensen often pointed to an "us vs. them" scenario where those who were "fans" and their activities were perceived as unorthodox or even strange by the average viewer. Jenkins (1992, 2006) who coined the term *convergence,* explored fan culture as both an academic and a self-declared fan. His research supports the notion of active, rather than passive participation, as a means for a program's fan members to organize meaning to assist them in their construction of an alternative reality where their program "lives." Jenkins likewise talks of "poaching" or the process of reinventing on the part of a fan. Fans may rewrite the narratives in their minds or in actuality in an effort to relate the information to aspects of their true selves – in other words, they make the show a part of their existence. For instance, fans may imagine themselves in the narrative interacting with the characters; it is interesting to note that this practice frequently occurs in educational settings, with the goal of improving learning encouraging students to relate information to their own lives (Anderson, 2005).

Sharing information is also a common quality among those who define themselves as fans (Jenkins, 1992, 2006). Whether in the form of text, forums, blogs or websites, fans are often critics of the program they hold in the highest regard. As a result, they frequently interpret, predict, and categorize what they like, and what they do not

like. Fans differ from ordinary audience members, yet often, that line is not very clear. When does a person turn into a fan, and are there clear attributes that define fandom?

Television viewers who voice program opinions may be regarded as fans. Mediated interactivity, more participatory than decades past, moves today's viewer from being the idle watcher to a participant who is actually heard and active. In fact, television is similar to watching a play. Andrejevic (2008) surmised online fan sites are now an integral part of productions. Unlike movies, television is a serial entity where changes are made during the season and online resonance could have an effect on production. In a play the audience listens to banter (laughs, jeers, etc.); the Internet functions in a similar manner. Fan forums, online critiques and Facebook pages provide production companies with laughs and jeers. Active fan participation requires a degree of hierarchical content knowledge and organization. This is contrary to the *displacement effect*, in which television is thought to displace other learning activities. Beentjes and Van der Voort (1988) determined, for children, that time spent watching television took the place of reading and homework, activities that may foster overall cognitive development and academic achievement. However, with the viewer making the choice to participate as fans, some cognitive gains may result from their actions.

For producers, fan sites can serve as a makeshift focus group, providing feedback regarding new plots and characters. They can also serve as a forum for criticism (Andrejevic, 2008). Being a fan, no longer involves a lighthearted discussion over coffee. Now, it is about tweeting, blogging and active participation. The primary consumer is believed to be idle, yet the after-viewing activity of an avid fan may be one where they fire up the keyboard and move their mouse to either look for more or make

additions to the daily banter. They may even seek the counsel of other fans. Part of the worth of these sites is they shatter the boundaries of the television box and let viewers "talk" to their program (Couldry, 2000).

Online forums and fan pages drastically changed the interactivity of television programs; a decade prior, this type of interactivity was nonexistent. Some websites even go beyond the boundaries or traditional forums. The "mockumentary," *The Office* (Gervais & Merchant, 2005 to 2011), serves as one illustration of this new turn in the evolution of television interactivity. While programs have weekly episodes, networks have also extended the presence of their characters beyond the television screen. Through the program's web presence, viewers feel encouraged to feel as though they are interacting with the main characters. For instance, viewers can read emails that characters on the show sent to their former boss. Fans may even comment on blogs written through a characters' perspectives. For example, Jim and Pam Halpert are a couple on the program with a baby girl. Within *The Office* webpage, these characters "maintain" a blog on which people can post responses (Gervais & Merchant, 2005 to 2011). Not only does this blog draw avid fans in, but it appears to offer a greater sense of reality. All this further reinforces the view that cognitive elements assist in processing. This sort of interactive medium encourages viewers to further process each program. The avid fans who participate with this interactive media are much different from those who tune in once a week. They are more dedicated in their viewing and make extra efforts to participate in the "culture" of their program. This convergence of information may heighten the cognitive processing of show elements by avid fans (Jenkins, 2006). They have a wealth of information they have sought to understand. Avid fans thus do more

than passively watch programs, they relate to events or change their perception of dramatic events within the shows as if they were occurring in the real world. Fans treat these characters as if they exist outside the confines of a television set.

The Self and Cognition

Social Cognitive Theory and Self-Efficacy

Bandura's (1986, 1994, 2002) social cognitive theory emphasizes the role of media in shaping the way we think. He indicated that an individual's behavior is formulated indirectly by viewing models of behavior. Viewers can learn by observing others, such that vicarious experiences are the typical way human beings interact with their surrounding environment. Bandura (1994) describes modeling as the processes of response acquisition that may have as much impact as direct experience. The ability to use this information or symbols sets humans apart from the limited stimulus-response world of animals. Humans interpret stimuli, as opposed to just responding to them. We use symbols in order to understand the world. We are able to regulate and reflect on not only our own actions, but in a vicarious sense on the actions of others. Since the availability of media has increased over the years, we are likely to shape our thoughts around what we see through our television sets.

Bandura (1997, 2001) also developed the idea of perceived self-efficacy, defined as our belief in our ability to succeed in specific situations. In this socio-cognitive approach, behavior, cognition, and environmental influences are viewed as commingling constructs of each other (Banudra, 1977, 1986). More specifically, self-efficacy involves the belief that one's capabilities will successfully prevail over circumstances in order to

achieve a goal. This approach concerns one's own perceived capability rather than the intention of performing the task. Bandura's theory thus implies that individuals can exert a semblance of control over their behaviors rather than passively accepting a given situation. Self-efficacy beliefs affect an individual's behavior and development through their choice of actions in responding to the changing stimuli in an environment.

Increases in self-efficacy are more likely to occur as a result of learning, whereas a decrease may be the result of an unreachable goal (Pajares, 1997). For example, Pajares (1997) determined that in high school, students with a high self-efficacy choose more challenging projects, increase their effort, and are less likely to give up, all of which may explain why students of comparable ability may have different academic performances. Researchers have confirmed a relationship between self-efficacy and student achievement (Hampton & Mason, 2003; Multon, Brown, & Lent, 1991; Pajares & Miller, 1994; Shell, Colvin, & Bruning, 1995). While mastery is often seen as a necessary component of self-efficacy, might successful examples provide the same positive feelings of goal attainment and confidence? Bandura's theories provide an interesting framework to examine the intermingling of knowledge processing confidence and avid fan television consumption if academic information is presented within programs. Individuals who have increased levels of self-efficacy, on the whole, tend to exert more effort and meet challenging situations head-on while persisting longer than others who have decreased levels of efficacy.

Chemistry and Mathematics Self-Efficacy

Mathematics and chemistry are two subjects that many people struggle to understand. After high school and college, adults may find little need to revisit these

areas. However, they are still areas that may cause a certain amount of anxiety when these subjects are brought up in everyday life (Hachey, 2009; Kurbanoglu & Akim, 2010). As an example, for some, witnessing a documentary or news broadcast layered with content-specific terminology may induce a viewer to simply change the channel. Self-efficacy may be an especially important characteristic to consider when examining adult motivation in math and the sciences.

Feelings of self-efficacy are often correlated with the possession of actual abilities (Bandura, 1997), which is an important determinant of one's confidence when facing any task. If one knows they have done something well in the past, this will produce high self-efficacy ratings. These feelings go beyond real ability. Self-efficacy has "effects on thought, affect, action, and motivation" (Bandura, 1997, p. 46). Thus, someone with higher self-efficacy ratings may have more positive goal attainment than someone who has lower self-efficacy ratings, even when both may have the same ability level (Paunonen & Hong, 2010). Those with high global self-efficacy across several areas have shown higher levels of achievement overall in outcomes related to academic success (Multon et al., 1991 as cited in Paunonen & Hong, 2010).

In contrast, pessimistic feelings towards mathematics have been mostly explained by negative attitudes and experiences related to mathematics (Betz & Hackett, 1983). Mathematics self-efficacy is different from other measures because of its situational or problem specific nature reflecting a person's confidence in their ability of success (Hackett & Betz, 1989). Studies conducted by Betz and Hackett (1983, 1985) support the role of self-efficacy expectations in choosing a mathematics-related career. They found a correlation between attitudes towards mathematics and the extent to which one selects a

mathematics related college major. Perhaps a television program focused on mathematics can be an attitude changer. The argument for avid fans is if enough examples within their show are displayed, this will change their perception of an academic subject. While a television show cannot be a substitute for instruction, the ease in use of mathematics by a character may potentially alter previously negative connotations toward it.

An interesting exploratory study by Yoshida (2002) hypothesized that adults had an inverted U-shaped relationship between self-efficacy and mental effort during mathematical problem solving which transfers to the processing of an overall mathematical system. While mathematics performance was significantly correlated with self-efficacy scores, scores for medium and high-efficacy subjects were similar even when high efficacy subjects invested less mental effort than medium-efficacy subjects. In other words, high-efficacy adults put less effort toward knowledge acquisition and problem solving because of more automated skill levels (Yoshida, 2002). Because these adults were familiar with the subject area, they exercised less effort due to their low levels of self-efficacy. This suggests that by increasing self-efficacy, an individual may reduce their amount of mental effort in related tasks. In a time where mental activities and exercises are used as a way to promote cognitive functioning in adulthood, perhaps incorporating this specific type of programming could help.

Another study by Star et al. (2008) investigated the effects of a magazine style broadcast program on adults learning mathematics. This program included video segments developed with National Science Foundation funding, rather than the standard network-type shows with large production budgets and producers. The study sought to

determine if adults re-learning basic mathematics could benefit from television as both a motivator and skill builder. Those who viewed the video showed a significant improvement in perceived difficulty as well as conceptual knowledge, procedural execution and fact recognition (Star et al., 2008).

In chemistry and other sciences, self-efficacy was also found to be an academic performance predictor. Andrew (1998) reported that college students' self-efficacy beliefs predicted 24% of academic performance in physical science and 18.5% in bioscience. Significant positive correlations between self-efficacy beliefs and science achievement have also been found at the high school level (Kupermintz, 2002; Lau & Roeser, 2002). Among high school students, those with high self-efficacy tend to choose more challenging projects, increase their effort and are less likely than others to give up on tasks related to the sciences (Pajares, 1997).

How do these positive feelings of self-efficacy arise? For many they are generated during achievements in formal schooling; for example, scoring an excellent grade on a test, knowing the answer when called upon, or witnessing a classmate's successful equation solving. Observing these examples are helpful for overall learning and self-efficacy. Observational learning and modeling are two forms of knowledge acquisition. These two methods are continually utilized, when avid fans tune into their programs that possess similar academic information. Most of this presented information also depends on understanding how the "system" of their program operates.

Star et al.'s (2008) research opened the door to television's potential. There was a significant difference in mathematics self-efficacy of those belonging to the television viewing group. However, multiple viewings over time with network programming could

provide a different perspective. Since determining the amount of processing from television remains elusive, it seems desirable based on cognitive, developmental and media theories to understand what can be gained from it and the affects it has on avid fans of differing programs. Overall, there is limited research with adults and television systems with a specialized content. In fact, more research is needed.

Knowledge Systems

Understanding is about mastering a body of related facts, relationships and then having the ability to explain and predict events (Hachey, 2005; Kayser et al., 1999). Moreover, it requires one to use acquired knowledge, as this applies to various circumstances. Understanding is one of the more important aspects of cognition for a person and is vital to the successful navigation of their environment (Halford, 1992). The world is full of systems, from the intricate processes of the central nervous system to the nuances of a Shakespearian play. Individuals differ in their means of comprehension. Processing requires an ability to understand component processes, integrate information from several sources, generate inferences, connect novel information with past information, produce explanations, coordinate perspectives, and abandon or reject prior concepts that are no longer helpful (Chi & Ohlsson, 2005). The manner in which one processes one type of information may affect the processing of similar information.

There are two types of knowledge: declarative, which encompasses information about the world, and procedural knowledge, which consists of the methods used to attain goals, a topic long studied in education (Hiebert, 1986; Ohlsson, 1994; Winograd, 1975). Declarative knowledge includes information about specific events (e.g., a girl is wearing a red hat); facts (the 2010 Winter Olympics were held in Vancouver); and

empirical generalizations (lack of exercise and an unhealthy diet increase the likelihood of obesity). This type of knowledge involves the description of an event rather than instruction. When expressed in statements, the units of declarative knowledge are propositional, as they can be true or false to describe an environment. Since declarative knowledge is independent of a goal or situation, it can be applied to any context where it may seem useful.

In contrast, procedural knowledge includes methods, instructions, customs, and schedules, to name a few (e.g. baking a cake, filing income taxes, or planning a wedding). Procedural knowledge is instructive rather than explanatory. This type of knowledge may be referred to as rules that take this form: "Goal, Situation → Action," (Ohlsson, 1994). If one seeks to accomplish a goal in a certain context (situation), then any action towards the goal is likely to be related, fitting or practical. If you want to bake a cake (Goal), and the oven is off (Situation), then you must turn it on (Action). Rules for goal attainment are not true or false, because they do not describe a situation but provide instruction. Declarative and procedural knowledge can be thought of as a capability or expertise.

An individual gains procedural knowledge from models and examples (Craik, 1943). A particular action in any context is one where the student possesses a goal and is then facing a situation that requires problem solving. Mastery of any subject requires knowing the facts (declarative knowledge) and the heuristics for understanding how to solve a problem (Ohlsson, 1994). Additionally, mastery of a subject requires the capability to transfer knowledge from one form to another (Aebli, 1980). This is an important factor when considering how viewers interact with television. As primetime

television programs present information that not only references declarative knowledge, but also combines this with procedural knowledge as characters engage in problem-solving situations, avid viewers are bearing witness to the Situation, Goal → Action model.

Along with the cognitive load theory, another related theory is the mental model theory, which is focused on the representation of any number of people, processes and things that underlie thinking with propositional content (Johnson-Laird, 2005). Mental models represent the manner in which people understand multifaceted systems (Craik, 1943; Gentner & Gentner, 1983; Johnson-Laird, 2005; Schwartz & Black, 1996). For example, a viewer creates a model of a particular television show to assist with future processing with models of characters and plotlines. When a novel plotline and specialized content formation are presented, the model aids in the understanding of new relationships and familiarity of related vocabulary (Schaeken, De Voght, Vandierendonck, & Ydewalle, 1996). A viewer can apply reasoning, predict resolutions, and become familiar with specialized vocabulary; these are some of the key benefits of mental model processing. Given this, television as an indirect learning stimulus may provide insight into mental model development, cognitive load theory, and academic self-validation that can further transfer into other areas of cognitive and everyday skills.

In addition to gathering facts, dates, and other specifics, what does it mean to understand each piece of information as it relates and interacts with the whole? What does it mean to process a system? How do people acquire any body of knowledge? Systems processing and learning takes time and often requires complicated associated processes to understand word parings and associations (Chi & Ohlsson, 2005; Hmelo-

Silver & Pfeffer, 2004; Hmelo-Silver, Marathe, & Liu, 2007). The traditional methods of education supporting learning in the form of texts, illustrations, practice problems and instructor feedback, are presented in classrooms or elsewhere. Some systems are often difficult to process and require extensive time to be spent acquiring the knowledge. Primetime television shows are probably not the first place one would look for purposes of measuring cognitive processing.

Systems processing is a particular area of interest because it is a cognitive task that can be difficult for beginners and specialists alike (Hmelo-Silver & Pfeffer, 2004; Hmelo-Silver, Marathe, & Liu, 2007). Many systems are difficult to understand, so there is a limited body of knowledge in this context (Chi & Ohlsson, 2005). Understanding systems takes attention, cognitive skills, and the ability to link past information with current material. It is suspected that current media have altered the way one processes information; this may have ramifications for understanding television, which was once viewed as an artifact solely created for the purposes of entertainment.

Some systems can be particularly difficult to comprehend, as they consist of multiple levels that often rely on specific interrelationships (Ferrari & Chi, 1998; Wilensky & Resnick, 1999). Understanding a system requires a person to construct concept networks about a particular domain and its associations, which are often inherently dynamic. Interpreting these is a multifaceted undertaking as this calls for one to reflect abstractly while testing models under similar circumstances. Furthermore, any system increases demands on working memory. Several systems in science and mathematics have a “complex causality,” meaning the intermediate steps that occur between the cause and effect may not be continuous (Grotzer & Perkins, 2000).

In television, people vary in the ways they view systems. For example, an avid viewer who watches every episode, talks with others about show occurrences and participates in online fan groups may have a different method of processing any system than someone who just tunes in once a week. Avid viewers may enhance their processing of information with these additional activities. In other words, they may ease their cognitive load (Johnson, 2005; Sweller, 1998).

Collins and Ferguson's (1993) Structure–Behavior–Function (SBF) Analysis utilized within the work of Hmelo-Silver, Marathe and Liu (2007) and Hmelo-Silver and Pfeffer Green (2004) is a useful design for helping to process systems because it highlights the differences between novice and expert processing. This model showed promise in analyzing principles of systems due to its focus on causality and the relationships of entities. Since this has proven applicable to areas such as science and history, perhaps it has potential for helping us to understand the processing of television. This model raises the question of whether avid fans can transfer the system processing used in the program to mathematics and science. In reconnecting with self-efficacy, having any entity to process is one matter, yet the inclusion of specific academic content may affect avid fans' perception about related tasks such that they feel they can accomplish these.

Summary

After reviewing the literature in areas related to television, cognition, and self-efficacy, it appears that there has been little research into the relationship between these factors, particularly among adults. Additionally, there has been no prior research with

avid primetime television program fans to investigate these factors as they relate to the processing of mathematical and science systems.

Overall, systems are difficult to process (Chi & Ohlsson, 2005; Hmelo-Silver & Pfeffer, 2004; Hmelo-Silver et al., 2007), especially in regards to mathematics (Yoshida, 2002) and science as related to chemistry (Hampton & Mason 2003; Multon et al., 1991; Pajares & Miller, 1994; Shell et al., 1995). Not only is there a degree of difficulty in processing this information, there is a degree of difficulty that varies depending on whether you are a beginner or an expert. The same can be said for some television programs. Based on the literature, it seems possible that primetime television programs with a specific specialized content might aid in an adult's processing of systems that deal specifically with mathematics and science and may prove to be important tools for building mental models (Thalheimer, Wilder, deSoto, & Black, 1992) as well as for promoting positive self-efficacy (Bandura, 1986, 1997). Few have examined these factors among viewers who are faithful to particular programs' among these avid fans; television may play an especially important role. Research about this population is thus warranted.

CHAPTER III: EVIDENCE OF ASSOCIATIONS BETWEEN AN AVID FAN'S COGNITION AND THEIR SELF-EFFICACY

Goals

Based on the research literature, the expected outcome of the study was that television programs that included specialized content integral to an episode's resolution would affect one's cognition and self-efficacy. Avid viewers often speak to others about a program's plotlines during, before and after viewing (online and/or in person) and may be affected by the presentation of specialized content. The behaviors of avid fans might all be considered a means of enhancing system processing. However, it is important to consider that there are differences between individuals and their prior knowledge. In television testing, while subject selection is an issue, in order to target specific fans, a specific means of sampling was utilized.

There were three main goals of this study. The first goal was to determine if avid fans of specific programs find similarities between themselves and their television show characters. The second goal was to determine if there are any associations between mathematics self-efficacy and chemistry self-efficacy and one's primetime television program preference. The third goal was to determine if all *CSIs* and *Numb3rs* avid viewers process academic information differently from viewers of *Heroes*, all *Law & Orders* and Any Other Program viewers. The data from these results were used to identify possible self-efficacy differences and establish any relationship between that construct and program preference.

Research Questions

This study investigated the following research questions and hypotheses as they pertain to avid fan program preferences:

1. **Self-Concept**: Do avid viewers identify with show characters?
    a. H_1: *Numb3rs* and all *CSIs* avid fans will believe that more episode and character references affect their self-concept to a greater degree than avid fans of all *Law & Orders, Heroes* and Any Other Program fans.
2. **Academic Self-Efficacy**: Does program preference affect feelings towards academic subjects? Can mathematics and chemistry self-efficacy relate to the prediction of program preference?
    a. H_2: Ratings of chemistry self-efficacy by subsection (cognitive skills, psychomotor skills, and everyday skills) among *Numb3rs* and all *CSIs* avid fans will be more positive than among *Law & Orders, Heroes* and any program avid fans.
    b. H_3: The mathematics and chemistry self-efficacy total scores of *Numb3rs* and all *CSIs* avid fans will be more positive than among all *Law & Orders, Heroes* and any program avid fans. Additionally, mathematics and chemistry self-efficacy will show a relationship in the prediction of program preference.
3. **System Processing**: Do fans of certain programs extract information from text differently, and do they find specific elements of their programs helpful in this process?

a. H_4: *Numb3rs* and all *CSIs* avid fans (as compared to Any Other Program avid fans) will have higher pre-test scores based on provided information on ballistics and the second law of thermodynamics, and likewise will be able to extract more information from the text within each of the subject areas.

b. H_5: More *Numb3rs* and all *CSIs* avid fans will indicate that program references are helpful in processing academic material than avid fans of all *Law & Orders, Heroes* and Any Other Program avid fans.

Method

While it is feasible to look to theories and models from general mathematics, science, self-efficacy, and system research, these may not be sufficient for describing the effect a television program has on a viewer who stays faithfully attentive. There may be a special role of the media artifact that remains unknown. There appears to be a call for additional studies in this area as little has been published on the use of television as it relates to knowledge acquisition and self-efficacy.

A study was conducted to test for differences in processing among viewers. To highlight included academic material, we look to an example from the CBS series *Numb3rs*. In past years, programs did not include the level of academic accuracy they often do today. During season 1 episode 4, a student apparently commits suicide by jumping off a bridge and a lead character, Charlie[4], investigates and suspects foul play. He believes the parabolic path followed by the student terminates farther from the bridge

[4] David Krumholtz plays Charlie Epps, a brilliant mathematician and college professor who believes numbers hold the key to everything (Terrance, 2007, p. 121).

than it should for a jumper. Charlie was ultimately wrong in his assumption of foul play. However, he was correct that the body would follow a parabolic path in its descent (Falacci & Heuton, 2005). Seemingly, the creators and writers provide a unique method of crime solving for the purposes of entertainment. However, it is believed the use of mathematics in this episode (and every episode) can be argued to be an important indirect learning tool.

This study also used the *CSI* series and its subsequent spin off and related programs set in various cities. Programs dealing with forensic science and crime scene reconstruction became more popular after the premiere of *CSI: Crime Scene Investigation* in 2000. Prior programs related to crime scene investigations talked of this science but refrained from detailed explanations or reenactments. The show solved gruesome murders as part of a metropolitan police department within the Las Vegas Police Department. The use of computer graphics to reenact criminalistics and studio simulation of victim injuries added to the show's dramatic plot twists (Terrance, 2007). These added components may be especially important for fostering many other types of thinking that can affect one's outlook on mathematics and science (Johnson, 2005; McLuhan, 1964; Sweller, 1998).

To summarize, there was an interest in learning how the presented information and content affects those avid fans who view a television show repeatedly and if these adults are able to transfer this information to specific academic areas or elevate their feelings of confidence towards these academic areas. Since learning from television is difficult to study with the use of an experimental control, a survey method was used to interview avid fans of all *CSI* programs and *Numb3rs* and the results were compared to

programs such as *Heroes*, all *Law & Orders* and Any Other Program fans that served as a "control group."

Participants

All participants were asked to complete an informed consent form. Data were collected from two arenas. First, avid adult fans were recruited during a New York Comic Con Festival on October 8, 9 and 10, 2010. Comic-Con attendees were chosen for their devotion to all things related to the comic world and/or related comic genre. The venue is appropriate for data collection, since in recent years there has been an increase in the presence of television program representatives and networks at comic related festivals. Since the conventions celebrating primetime television programs are less populous, a higher likelihood of attracting avid fans through this strategy was anticipated. Second, avid fans were recruited during the summer and autumn of 2010 using advertisements through *Facebook* fan pages for all *CSIs*, *Heroes*, all *Law & Orders* and *Numb3rs* and fan forums programs housed within television network websites. Each platform allows viewers to share opinions, comment on the latest episode, and access program information. During recruitment, the participants' viewing habits were assessed with the survey instrument. We sought to collect data from avid fans of a single program. If a participant self-indicated they were an avid fan of multiple programs (i.e., if a participant was an avid fan of all *CSI* programs and subsequently indicated they were also a fan of any *Law & Order* program) they were eliminated from the pool of data. All participants completed a questionnaire to indicate biographical information (such as age,

gender, and education), television-viewing habits, and fan loyalty status. Additionally, participants answered open-ended questions to elicit overall program knowledge.

Five-hundred and eighty-seven (587) fans were recruited during data collection both online and at New York Comic Con. Data from participants were not considered if participants were less than 18 years of age, did not self-indicate loyalty to their program of choice, and were of minor fan level status. Data was also not considered if participants did not complete at least 90% of the three sections of interest to this study: chemistry self-efficacy, mathematics self-efficacy and academic text reading sections. The resulting sample was comprised of 403 avid adult fans (227 females, 175 males and 1 unidentified, age range = 18-67). All participants were fluent in English. Participants received contact information if they had any questions about the survey. The demographic section also included a consent form. Demographics for the study's participants are presented in Tables 2.1-2.7.

Table 2.1

Television Avid Fan Sample Demographics

Characteristic	N	% of Sample
Sex		
Male	175	43.4
Female	227	56.3
N/A	1	.2
Total	403	
Highest education		
Some High School & High School	34	8.4
Some College & Bachelors	254	63.0
Some Graduate School, Masters Degree, & Doctorate	115	28.5
Television program		
All Varieties of CSI	47	11.6
All Varieties of Law & Order	51	12.6
Numb3rs	101	25.0
Heroes	41	10.1
Any Program	163	40.4
Chemistry, mathematics and/or science occupation		
0 Descriptors	219	54.3
1 Descriptor	109	27
2 Descriptors	48	11.9
3 Descriptors	27	6.7
Collection Venue		
Online	154	38.2
NY Comic Con	249	61.8

Note. "Avid Fan" = those who self-indicated that were of moderate or extreme fan level and loyal to their chosen program. For the sample, M = 31.07 years (SD = 11.303) and age range was 18 to 67 years. When sample totals are less than 403, data are missing. Data were then uploaded into SPSS (Chicago, IL: Version 19). Descriptive analyses with means and standard deviations were grouped by television program.

Table 2.2

Television Avid Fan Sample Demographics – Age by Group

Age Category (By Years)	N	% of Total N
18-25	175	43.4
26-29	61	15.1
30-39	76	18.9
40-49	50	12.4
50-59	36	8.9
60+	5	1.2
Total	403	100%

Table 2.3

Television Avid Fan Sample Demographics – Age Frequencies by Television Program

	Television Program				
Age Category (By Years)	Any CSI Show	Any Law & Order Show	Heroes	Numb3rs	Any Other Program
18-25	16	24	18	51	66
26-29	7	6	7	9	32
30-39	4	12	10	19	31
40-49	9	7	4	12	18
50-59	8	2	2	9	15
60+	3	0	0	1	1
Total	47	51	41	101	163

Table 2.4

Television Avid Fan Sample by Collection Locale

Television Program	NY Comic Con	Online	Television Program Totals
All CSIs	28	19	47
All Law & Orders	43	8	51
Numb3rs	5	96	101
Heroes	38	3	41
Any Program	135	28	163
Collection Locale Totals	249	154	403

Table 2.5

Television Avid Fan Sample by Collection Locale Demographics Breakdown: Education

	Level of Education							
	NY Comic Con				Online			
Television Program	Some High School & High School	Some College & Bachelors	Some Graduate School, Masters, & Doctorate	Totals	Some High School & High School	Some College & Bachelors	Some Graduate School, Masters, & Doctorate	Totals
All CSIs	1	22	5	28	3	12	4	19
All Law & Orders	6	28	9	43	1	2	5	8
Numb3rs	0	3	2	5	5	60	31	96
Heroes	3	21	14	38	2	0	1	3
Any Program	11	90	34	135	2	16	10	28
Totals	21	164	64	249	13	90	51	154

Table 2.6

Television Avid Fan Sample by Collection Locale Demographics Breakdown: Gender

	Gender					
	NY Comic Con			Online		
Television Program	Males	Females	Total	Males	Females	Total
All CSIs	13	15	28	3	16	19
All Law & Orders	21	21	43*	0	8	8
Numb3rs	3	2	5	30	66	96
Heroes	23	15	38	0	3	3
Any Program	76	59	135	6	22	28
Totals	136	112	249	39	115	154

Note. * One avid fan of Law & Order did not indicate gender. An additional participant was added to the final total.

Table 2.7

Television Avid Fan Sample by Collection Locale Demographics Breakdown: Occupation Descriptors

	Chemistry, Mathematics and/or Science Occupation Descriptors							
	NY Comic Con				Online			
Television Program	Math	Chemistry	Science	None	Math	Chemistry	Science	None
All CSIs	10	1	6	15	7	3	7	10
All Law & Orders	9	2	6	26	2	1	3	5
Numb3rs	3	1	2	1	43	18	39	38
Heroes	18	2	10	18	2	1	2	1
Any Program	30	7	29	83	6	0	6	18

Note. Participants were allowed to select more than one of the three descriptors: Mathematics, Science & Chemistry. Those who selected "None" did not indicate mathematics, science or chemistry as part of their current occupation.

Procedure

The design was modeled on a study of learning effects amongst expert video game players entitled, *Learning and Video Games: A Process for Future Learning Approach* (Hammer et al., 2007). In the Hammer, et al. study, specific video games served as a grouping factor among avid players. Cognitive processing differences were determined among avid players of *Sim City* and *Civilization*, based on participant responses to questions about academic texts. The study focused on the relationship between game formats and academic material (specifically urban planning).

Along the same vein, we surmised in the present study that avid fans of television programs with specialized content may also show differences in processing and self-efficacy. In the present study, avid fans are defined as those who self-indicate loyalty to their program of choice and are of moderate to extreme fan level status. Participants did not watch television during the survey and were recruited based on their self-

identification as a fan. This study employed a factorial design, with avid viewer-ship of a particular program serving as a between-subjects grouping factor. A research survey was developed specifically for this study through a pilot study process.

New York Comic Con. During the New York Comic Con data collection, participants read and signed a statement giving their consent to participate. For the data collection, participants read and agreed to a statement giving their consent to participate with an online data collection platform. No personal identifying information was attached to any participant surveys.

Among the New York Comic Con attendees, data were collected from a booth located in the center of the entrance lobby area at the convention center. The booth was comprised of a two large tables, multiple chairs, stools, clip boards, and survey instruments. Comic convention attendees typically wear costumes related to their favorite characters. In an effort to attract more participants and fit in with the New York Comic Con culture, data collectors dressed in costumes related to some of the programs of focus (i.e. law enforcement officials, criminal investigators, and the character "Claire Bennet" from *Heroes*). Signs were also created with the television program names and catch phrases to attract the attention of New York Comic Con attendees. For example, a sign with the phrase "Save the Cheerleader, Save Her Dissertation," was created in order to attract attendees, who may have been familiar with a similar line from the program, *Heroes* (i.e. Save the cheerleader, save the world"). The signs and costumes served as icebreakers and frequently encouraged attendees to participate in the study.

Data collection took place at the booth and each participant was guided by the researcher. When potential participants inquired about the project, the researcher would

provide a short introduction wherein the researcher introduced herself, asked potential participants their television viewing backgrounds, and then asked them to complete the survey of questions about their favorite television program. After they agreed to participate, participants were provided a paper survey booklet, a clipboard for writing, a place to sit, and writing materials. Participants were told the survey would take about 20 minutes were given an opportunity to ask questions about the study. During the survey, participants were asked to provide information about their television habits, how they felt their television program related to themselves as a person, and their feelings of self-efficacy for both mathematics and science. In addition, participants were asked to complete two short readings and answer questions related to the text.

At the completion of the New York Comic Con data collection, the researcher collected all survey paperwork. Participants were given a gift card for a digital song download as compensation and thanked for their time. Follow-up information was provided to all participants if they had any additional questions. Data were stored in a large plastic crate with a lock to protect identities and data. Consent forms and completed surveys were not stored together.

Online. For the online data collection, data were collected using *Survey Monkey* (http//:www.surveymokey.com), a survey platform for conducting online research. After they agreed to participate, viewers were brought to the main page of the survey. Participants were told the survey would take approximately 20 minutes. Participants with questions were given the opportunity to contact the researcher via email. As in the NY Comic Con data collection, participants were asked to provide information about their television habits, how they felt their television program related to themselves as a person,

and their feelings of self-efficacy for both mathematics and science. In addition, participants were asked to complete two short readings and answer questions related to the text.

Due to funding and the logistics of online compensation, online data collection participants received no compensation but were thanked for their participation but were not given compensation. Follow-up information was available to all participants if they had any additional questions. Data were housed on a secure server only accessible to the principle investigator.

Materials

Study Sections. During the present study, participants completed the following sections of either paper/pencil survey (New York Comic Con attendees) or an online survey (see Appendix A and B).

- Self-Concept & Television Assistance: Participants were asked open-ended questions in order to elicit how they believed their program related to themselves at the beginning of the survey. At the end of the survey, they were asked how their favorite television program assisted them in extracting information from the provided texts related to ballistics and the second law of thermodynamics;
- Self-Efficacy Scales: This section included a three-part self-efficacy Likert-type scale questionnaire comprised of mathematics statements and chemistry questions;

- Academic Text Reading Section: This section included two mathematics and forensic statements followed by open-ended questions to elicit understanding and assess system processing with an academic subject.

Measures

Self-concept. Self-concept areas were based upon a scheme developed from a previous pilot study. Participants were asked open-ended questions in order to elicit how they believed their program related to themselves and their desires. These included questions related to how avid fans felt their television program affected their ideas of what they would like to be or in other words, what they aspired or wanted to be. The measure also included a question asking participants to include a character from their television program they would like to be like and why they selected this character (see Appendix A: questions #8 and #9). Points were assigned if there was a presence of the indicated elements (1 = yes, 0 = no).

A point for "Career Similarities" was assigned when the participant stated how a television character or episode reference from their favorite program had a similar career or similar career activities. For example,

> *Television Program Affecting Career*
> "I got into the show after I started my job and since the character does the same thing, I learned a little."
>
> *Specific Character Affecting Career*
> "I am already quite like Chuck [a main character]. WE have similar jobs. The pilot episode was kind of scary actually."

A point for "Similar to Self" was assigned when the participant stated how a television character or episode reference from their favorite program had similar qualities. For example,

> *Television Program Affecting Self*
> "The show demonstrates certain qualities in real-world situations that I have used in the past."
>
> *Specific Character Affecting Self*
> "The empathy of Peter Petrelli on Heroes seems like an admirable trait."

A point for "Role Model/Aspiration" was assigned when the participant stated how a television character from their favorite program had served as a role model or had character traits they aspired to emulate. For example,

> *Television Program Affecting Aspirations/Role Model*
> "It definitely makes me want to be more knowledgeable about sciences, especially physics."
>
> "I want to be a forensic scientist. It looks so interesting… problem-solving with science!"
>
> *Specific Character Affecting Aspirations/Role Model*
> "Numb3rs, Don Epps, he's a leader who cares for his team and gets the job done. I want to be that guy."

Mathematics & chemistry self-efficacy. Academic readings were selected based upon a scheme developed from a pilot study. Subsequent academic readings were provided by the suggestion of science and mathematics educators currently employed in the field. The Likert-type scales specific to mathematics and chemistry were coded separately. Mathematics and chemistry self-efficacy inventories were utilized in their original format. Currently, these inventories are used specifically for college students to determine their likelihood of success with a given subject area. While they are typically used within a higher education setting, it is the opinion of this researcher that they can be used with adults of any age.

Chemistry self-efficacy. To measure chemistry self-efficacy the Chemistry Self-Efficacy Scale for College Students (Uzuntiryaki & Aydin, 2008) was used. This

instrument measured participants' self-efficacy for chemistry by asking respondents to rate their confidence in their ability to perform tasks based on 21 questions (see Appendix A: Science Section). The questions ask about the purposes of science education and their experiences with chemistry educators. Three areas of focus were included: self-efficacy of cognitive skills, psychomotor skills, and everyday skills. The range of possible scores was from 1 to 9, with 1 indicating *very poorly* and 9 indicating *very well*. The total score was the sum of all items. The mean scores of each question indicated a confidence level. Three areas of focus were also analyzed. For an area of focus, the total score for each item was summed. Differences in means were compared using t-tests with television program as a grouping factor.

Table 3

Chemistry Areas of Focus Item Identification for Dissertation Study

Self-Efficacy Question Type	*Item Number*
Self-efficacy for cognitive skills	Items 1, 2, 3, 4, 6, 7, 9, 10, 14, 17, 18, & 19
Self-efficacy for psychomotor skills	Items 5, 11, 13, 15, & 20
Self-efficacy for everyday skills	Items 8, 12, 16, & 21

Note. From "Chemistry Self-Efficacy, Scale for College Students," by E. Uzuntiryaki and Y.C. Aydin, 2008, *Research in Science Education, 39(4)*, pp. 539-551. Copyright Springer Science + Business Media B.V. 2008. Adapted and used for this study with permission of the authors.

This instrument has been shown to have high internal consistency, with Cronbach's alpha coefficients ranging from 0.82 to 0.92. The Chemistry Self-Efficacy Scale also has high face and content validity. The items were developed through consultation with experts in chemistry, chemistry education, educational psychology, and educational measurement (Uzuntiryaki & Aydin, 2008). Researchers scored the scale by

determining an overall score. For this study, the instrument showed high internal consistency, with a Cronbach's alpha of 0.91.

Mathematics self-efficacy. To measure mathematics and problem-solving self-efficacy the Self-Description Questionnaire (SDQIII) was used (Marsh, 1992). This instrument measures participants' self-efficacy for mathematics by asking respondents to rate their confidence in skills and ability in mathematics. The scale is comprised of 10 questions (see Appendix A: Mathematics Section). The range of possible scores is from 1 to 7, with 1 indicating *definitely false* and 7 indicating *definitely true.* The total score for each scale is the sum of ten items. This instrument showed high internal reliability, with Cronbach's alpha of .94 for mathematics self-efficacy measure. The SDQIII was designed to measure multiple dimensions of self-concept (Marsh & O'Neill, 1984; Marsh, 1992; Marsh, 1990). It is a validated self-concept measure using the same research strategy as that related to the other SDQ scales and has undergone rigorous and extensive testing to establish its psychometric soundness as a measure of self-concept. While the SDQIII instrument was originally designed for late adolescents and young adults, Marsh and O'Neill (1984) noted it may be used with adults older than 25. However, a limitation of the scale is that it may not tap into many important elements of adult lives.

Academic text reading section. The academic article section was based upon a scheme developed from a previous pilot study. Mathematics and science readings were selected with the consultation of science and mathematics professors at Teachers, College Columbia University. These readings were selected from mathematics and science books. Online encyclopedias were also consulted for related information (*Second Law of*

Thermodynamics, n.d*; Ballistics*, n.d.). Each is similar in length and contains charts or formulas. Readings were chosen for readability, abstractness, and system composition. The science reading focused on defining ballistics. The mathematics reading focused on the second law of thermodynamics. Immediately after each text, participants completed a series of open-ended questions on their understanding of given material (see Appendix A: Prior Knowledge Section). Questions were based on the Hmelo-Silver, Marathe and Liu (2007) Structure-Behavior-Function (SBF) model yet renamed "Elements," "Purposes," and "Mechanisms" for this study (see Table 4). The readings were an attempt to determine participants' ability to extract information from provided texts. Open-ended questions were scored on a weighted scale. The frequency of each type was totaled. The two articles were of equal length and format. Participant responses were compared based on program of interest.

Table 4

Article Questions Description Scoring

Question Type	*Description*	*Point Value*
Elements	A simple listing of article system contents and structures.	*1*
Purpose	This intends to elicit participants' understanding of items contained in the system and as well as element behaviors.	*2*
Mechanisms	An attempt at understanding of actions and activities related to the text. This intends to evoke understanding of purpose functions.	*4*

Note. Adapted from "Fish Swim, Rocks Sit, and Lungs Breathe: Expert-Novice Understanding of Complex Systems," by C.E. Hmelo-Silver, S. Marathe, & L. Liu, 2007, *The Journal of Learning Sciences, 16(3)*, 307-331. Copyright 2007 by Lawrence Erlbaum Associates, Inc. and "'Comparing expert and novice understanding of a complex system from the perspective of structures, behaviors, and functions," by C. E. Hmelo-Silver & M. Pfeffer Green, 2004, *Cognitive Science: A Multidisciplinary Journal, 28(1)*, 127-138.

Questions following each reading involved asking participants what they knew before and after concerning a specific academic area. Open-ended responses were coded based on type of processing they elicited. The "Element," "Purpose," and "Mechanism"

questions for each participant were summed to determine a final score applied before reading and after reading. A target list of "Elements," "Purposes" and "Mechanisms" for the ballistics and second law of thermodynamics systems was identified through a process of analysis and informal reliability testing on a subset of participant responses. These lists can be found in Table 1 and Table 2 in Appendix B. For each participant's response to the free recall questions in the pretest and posttest, we determined which of the "Elements," "Purpose" and "Mechanisms" from the respective target list were present and recorded the number of "Elements," "Purpose and "Mechanisms" for each participant's response.

A point for an "Element" was assigned when the "Element" was stated literally or by a synonym used in a context consistent with the contents of the article presented in the study. For example, *energy* was acceptable for the "Element" *work* if used in the context of converting heat into mechanical energy and "bullet" was acceptable for the "Element" *projectile* if used in the context of items that travel in a flight path. A point for an "Element" was assigned if the "Element" was not stated literally, but was obviously implied. For example, *trajectory* is implied when referring to projectiles traveling in a curved path affected by specific forces (wind, air resistance, gravity and composition) and *temperature* is implied when referring to a system getting warmer or colder.

To receive a point for "Purpose," both the "Element" and the "Purpose" had to be stated or implied. A point for both "Purpose" and "Mechanism" could be assigned for the same "Element." For example, a point could be assigned to the "Purpose" of *equilibrium* and the "Mechanism" for *equilibrium* if both were stated. A point for "Mechanism" was only awarded if the participant correctly conveyed a level of detail or

explanation beyond the "Purpose" indicating an interaction between "Elements" of the system. Blanks for any response containing, "not much," "I don't know," "not sure," or anything similar were scored as a zero. A final total score was calculated for the answers before and after each of the two readings.

Reliability of elements, purpose and mechanism coding. An inter-rater reliability analysis using the Kappa statistic was performed to determine consistency among raters (Landis & Koch, 1977) for the "Element" "Purposes" and "Mechanisms" coding for the ballistics and second law of thermodynamics after reading questions. To measure inter-rater reliability, the primary researcher conducted the majority of the coding and a second independent researcher coded 15% of the open-ended questions. Thus, 61/403 participants were qualitatively reassessed by an independent coder and Cohen's Kappa scores were calculated. An inter-rater agreement of .88 was obtained for pre-reading of second law of thermodynamics knowledge; .78 was obtained for pre-reading of ballistic information; .79 for after reading ballistics text; and .84 for after reading second law of thermodynamics text.

Television assistance in processing text. Open-ended, free response questions were asked after each participant read two articles on both ballistics and the second law of thermodynamics to determine how they felt their television programs assisted them in answering questions about the provided text. Points were assigned if there were any of the elements listed below (1 = yes, 0 = no). Blanks, "Not much," "I don't know," "Not sure," or anything similar was scored as a zero.

A point for “Specific Character Actions in a Specific Episode” was assigned when the participant stated how a specific television character in a specific episode from their favorite program helped them answer the question. For example,

> “In downtown Miami, a sniper was killing people. After the shooting the ‘CSI’ group found a Man kills inside a bus. Thanks to the Ballistics they find out killing bullet in that man's brain. It wasn't from the sniper, someone on the street got scared with all the shooting and he pulled out a gun to defend himself but he was nervous and he pulled the trigger.”

A point for “Specific Episodes” was assigned when the participant stated how a specific episode from their favorite program helped them answer the question. For example,

> “’CSI’ most definitely. One of my favorite episodes (forgot which one) dealt with 3 guns and they had to match and mix to find out which was the gun.”

A point for “General Program Themes” was assigned when the participant stated how general program themes from their program helped them answer the question. This could be, for instance, a method of crime solving that was similar in every episode. For example,

> “’Fringe.’ the FBI frequently study bullets I can't think of a specific segment.”

> “’Criminal Minds’ always deals with this and cop shows always deal with this.”

A point for “General Character Themes/Actions” was assigned when the participant stated how general character actions/themes from their program helped them answer the question. A problem solving method was similar in every episode. For example,

> “For every thing there is always a reaction. You have to have consequences for every action. Jack Baurer gets arrested by the gov't.”

> “Yes, while Dexter himself looks at blood splatter to figure out what happening during a crime, ballistics are often talked about when killers use guns. Dexter never uses a gun on his victims. He uses a sedative to knock them out then wakes them up and stabs them in a sealed room to minimize any splatter.”

A chart including hypotheses and questions of focus are presented in Table 5.

Table 5

Primetime Television Shows Affect Viewers' Mathematics and Science Knowledge and Confidence Hypothesis Table

Hypothesis	***Survey Section***
Self-Concept	
H_1. *Numb3rs* and all *CSIs* avid fans will believe that more episode and character references affect their self-concept to a greater degree than avid fans of all *Law & Orders, Heroes* and Any Other Program fans.	Free response questions #8 &10. Coding for: Overall Program Career Similarities Overall Program Self Similarities Overall Program Role Model/Aspirations Specific Character Career Similarities Specific Character Self Similarities Specific Character Role Model/Aspirations
Mathematics & Chemistry Self-Efficacy	
H_2. Ratings of chemistry self-efficacy by subsection (cognitive skills, psychomotor skills, and everyday skills) among *Numb3rs* and all *CSIs* avid fans will be more positive than among *Law & Orders, Heroes* and any program avid fans.	Sum of all chemistry self-efficacy scale questions by subsections.
H_3. The mathematics and chemistry self-efficacy total scores of *Numb3rs* and all *CSIs* avid fans will be more positive than among all *Law & Orders, Heroes* and any program avid fans. Additionally, mathematics and chemistry self-efficacy will show a relationship in the prediction of program preference.	Sum of all mathematics & chemistry self-efficacy scale questions.
Cognitive Processing of Academic Text Readings: Ballistics & Second Law of Thermodynamics	
H_4. *Numb3rs* and all *CSIs* avid fans (as compared to Any Other Program avid fans) will have higher pre-test scores based on provided information on ballistics and the second law of thermodynamics, and likewise will be able to extract more information from the text within each of the subject areas.	Free response questions #3 immediately following both readings scored by an "Element," "Purpose" and "Mechanism" rating system.
H_5. More *Numb3rs* and all *CSIs* avid fans will indicate that program references are helpful in processing academic material than avid fans of all *Law & Orders, Heroes* and Any Other Program avid fans.	Free response question #4 immediately following readings. Coding For: Specific Characters Specific Episode General Themes General Character Actions

Note. For complete survey see Appendix A: Dissertation Instrument.

CHAPTER IV: RESULTS

Self-Concept

Hypothesis 1. Individuals were classified by "Television Program" (5 categories; all *CSIs*, all *Law & Orders*, *Numb3rs*, *Heroes* and Any Other Program) and by six concepts related to their self-concept (Overall Program Career Similarities, Overall Program Self Similarities, Overall Program Role Model/Aspirations, Specific Character Career Similarities, Specific Character Self Similarities, and Specific Character Role Model/Aspirations). The first table displays findings for the entire sample and subsequent tables display findings based on collection locales (New York Comic Con attendees and online participants, respectively).

In this study, the highest frequencies were derived from specific characters viewed as role models. Scores were analyzed based on the collection locale and television program. Frequencies and percentages are presented in Table 6a-c. Role model feelings were robust for the entire sample. *Numb3rs* and *Heroes* displayed the highest frequencies based on group size (72 out of 101 and 30 out of 41 respectively). Likewise, *Numb3rs* and *Heroes* displayed the highest percentage of overall role model feelings (71.28% and 73.17% respectively). The other five self-concepts were non-significant. Overall Program Self Similarities did approach a marginal level of significance; however, some of the expected cell counts were less than five (see Tables 2a-3c. in Appendix C). All non-significant frequencies can be found in Appendix C.

Table 6a

Avid Television Fan Group and Overall Role Model or Aspirations Appear to Be Similar for Specific Character(s)

Seen as a Role Model	All *CSI*s	All *Law & Orders*	*Numb3rs*	*Heroes*	Any Other Program	Total
Yes	27	26	72	30	91	246
No	20	25	29	11	72	157
						403
% "Yes" Per Program	57.45	50.98	71.28	73.17	55.83	
% "Yes" Total Sample	6.70	6.45	17.87	7.44	22.58	61.04

Note. Yes/No lines indicate frequencies.

Table 6b

Avid Television Fan Group and Role Model or Aspirations Appear to Be Similar for Specific Character(s) (New York Comic Con Sample)

Seen as a Role Model	All *CSIs*	All *Law & Orders*	*Numb3rs*	*Heroes*	Any Other Program	Total
Yes	14	22	2	27	77	142
No	14	21	3	11	58	107
						249
% "Yes" Per Program	50.00	51.16	40.00	71.05	57.03	
% "Yes" Total Sample	5.62	8.83	0.80	10.84	30.92	57.01

Note. Yes/No lines indicate frequencies.

Table 6c

Avid Television Fan Group and Role Model or Aspirations Appear to Be Similar for Specific Character(s) (Online Sample)

Seen as a Role Model	All *CSIs*	All *Law & Orders*	*Numb3rs*	*Heroes*	Any Other Program	Total
Yes	13	4	70	3	14	104
No	6	4	26	0	14	50
						154
% "Yes" Per Program	68.42	50.00	72.92	100.00	50.00	
% "Yes" Total Sample	8.44	2.60	45.45	1.95	9.09	67.53

Note. Yes/No lines indicate frequencies.

Additionally, individuals were classified by "Television Program" (5 categories; all *CSIs*, all *Law & Orders*, *Numb3rs*, *Heroes* and Any Other Program) and by "Character Viewed as a Role Model" (Yes/No) in a 5x2 contingency table (Table 7), and a chi-square test for independence was conducted. The chi-square test for independence indicated a significant association between television program group and character(s) viewed as a role model, χ^2 (4, n = 403) = 11.28, p = .024, V = .167. According to Gravetter and Wallnau (2004, p. 605) this is a medium effect size for a 5x2 contingency table.

Table 7

Contingency Table of Avid Television Fan Group and Character Viewed as a Role Model

Character Viewed as a Role Model	All *CSIs*	All *Law & Orders*	*Numb3rs*	*Heroes*	Any Other Program	Total	χ^2	df	*P*
Yes	27	26	72	30	91	246	11.284	4	.024
No	20	25	29	11	72	157			

For further analyses, to follow-up on television group comparisons, a post-hoc analysis was conducted. A chi-square tests of independence was conducted on the 10 possible 2x2 contingency tables (i.e., to compare all *CSIs* vs. all *Law & Orders*; all *CSIs* vs. *Heroes*; all *CSIs* vs. *Numb3rs*; all *CSIs* vs. Any Other Program; all *Law & Orders* vs. *Heroes*; all *Law & Orders* vs. *Numb3rs*; all *Law & Orders* vs. Any Other Program; *Heroes* vs. *Numb3rs*; *Heroes* vs. Any Other Program; and finally *Numb3rs* vs. Any Other Program). To adjust for testing 10 2x2 tables simultaneously, the Bonferroni correction was used; $\alpha = 0.05/10=.005$ was used as the level of significance for each of the 10 tests. However, after conducting theses test, no significant differences were found.

Mathematics and Chemistry Self-Efficacy

Chemistry Self-Efficacy Subsections

Hypothesis 2. A multivariate test (MANOVA) was conducted as directed by Stevens (2009) with dependent variables (a) self-efficacy for cognitive skills (b) psychomotor skills and (c) everyday skills, with the independent variable (factor) being group (television program). The means and standard deviations for all three chemistry self-efficacy subsection scores for avid fans are presented in Table 8.1. *Numb3rs* fans produced the highest mean scores for chemistry self-efficacy for cognitive skills, psychomotor skills and everyday skills (M = 56.47, s.d. = 28.828; M = 23.24, s.d. = 12.828 and M = 19.36, s.d. = 9.239 respectively). *Heroes* avid fans produced the lowest mean scores for chemistry self-efficacy pertaining to cognitive skills and everyday skills (M = 46.05, s.d. = 25.835; M = 15.90, s.d. = 8.093) while All *Law & Orders* avid fans

produced the lowest chemistry self-efficacy scores for psychomotor skills (M = 18.08, s.d. = 10.565).

Table 8.1

Descriptive Statistics for Chemistry Self-Efficacy for Cognitive Skills, Psychomotor Skills and Everyday Skills by Avid Television Fan Group

	Cognitive Skills			Psychomotor Skills			Everyday Skills		
Television Program	*n*	*M*	*SD*	*N*	*M*	*SD*	*n*	*M*	*SD*
All *CSIs*	47	**56.21**	27.64	47	**22.43**	11.57	47	**19.11**	8.38
All *Law & Orders*	51	46.08	25.27	51	18.08	10.57	51	16.14	8.00
Numb3rs	101	**56.47**	28.83	101	**23.24**	12.83	101	**19.36**	9.24
Heroes	41	46.05	25.84	41	18.34	11.26	41	15.90	8.09
Any Other Program	163	47.34	23.79	163	19.02	10.77	163	16.28	7.29
Overall	403	50.37	26.26	403	20.29	11.57	403	17.33	8.20

Note. Bold indicates the two highest means. The highest possible score for each subject section is 108 for cognitive skills (12 questions), 45 for psychomotor skills (5 questions) and 36 for everyday skills (4 questions).

The MANOVA indicated no significant differences among groups in the linear combination of chemistry self-efficacy cognitive skills, psychomotor skills and everyday skills scores (Wilks' Lambda= .961, $F(4, 398) = 1.312$, $p = .205$). Since the MANOVA results were non-significant, three one-way between groups analysis of variances (ANOVAs) were conducted to explore the impact of television avid fan group on responses recorded for the three chemistry self-efficacy subsections (cognitive skills, psychomotor skills and everyday skills). All participants' answers were coded for each item and a final score was calculated within each subsection. Participants were grouped according to their television program preference.

There was a statistically significant difference in chemistry self-efficacy cognitive skills scores for the five television groups: F (4, 398) = 3.171, p = .014. Post-hoc differences using Tukey HSD show a significant difference in chemistry self-efficacy cognitive skills scores for *Numb3rs* versus Any Other Program Fans (M = 56.47, s.d. = 28.83 and M = 47.34, s.d. = 23.79, respectively).

There was a statistically significant difference in chemistry self-efficacy psychomotor skills scores for the five television groups: F (4, 398) = 3.360, p = .010. Post-hoc differences using Tukey HSD showed a significant difference in chemistry self-efficacy cognitive skills scores for *Numb3rs* versus Any Other Program Fans (M = 23.24, s.d. = 12.83 and M = 19.02, s.d. = 10.77, respectively).

There was a statistically significant difference in chemistry self-efficacy everyday skills scores for the five television groups: F (4, 398) = 3.413, p = .009. Post-hoc differences using Tukey HSD showed a significant difference in chemistry self-efficacy cognitive skills scores for *Numb3rs* versus Any Other Program Fans (M = 19.36, s.d. = 9.24 and M = 16.28, s.d. = 7.29, respectively).

Additionally, scores were analyzed based on collection locale and television program. Fans were grouped into two categories: (a) *Numb3rs* and all *CSIs* (a) All other programs including all *Law & Orders* and *Heroes*. Subsequent tables report chemistry self-efficacy subsection scores by collection locale (New York Comic Con versus online). To determine if group differences existed, t-tests were conducted. Results are indicated in Tables 8.2-8.5.

Table 8.2

Descriptive Statistics for Chemistry Self-Efficacy for Cognitive Skills, Psychomotor Skills and Everyday Skills Comic Con Sample – All CSIs & Numb3rs Fan versus Everyone Else

	Cognitive Skills			Psychomotor Skills			Everyday Skills		
Television Group	*n*	*M*	*SD*	*N*	*M*	*SD*	*n*	*M*	*SD*
All *CSIs* & *Numb3rs*	33	**54.18**	29.22	33	**22.33**	11.75	33	**19.06**	8.84
All Other Programs	216	45.29	23.11	216	18.11	10.26	216	15.58	7.13

Note. Bold indicates the highest means scores for each chemistry self-efficacy subsection. The highest possible score for each subject section is 108 for cognitive skills (12 questions), 45 for psychomotor skills (5 questions) and 36 for everyday skills (4 questions).

Table 8.3

Descriptive Statistics for Chemistry Self-Efficacy for Cognitive Skills, Psychomotor Skills and Everyday Skills by Avid Television Fan Group (New York Comic Con)

	Cognitive Skills			Psychomotor Skills			Everyday Skills		
Television Program	*n*	*M*	*SD*	*N*	*M*	*SD*	*n*	*M*	*SD*
All *CSI*	28	53.57	29.65	28	21.71	18.32	28	18.32	8.95
All *Law & Orders*	43	45.58	24.43	43	17.95	10.17	43	16.05	7.63
Numb3rs	5	**57.60**	29.59	5	**25.80**	13.35	5	**23.20**	7.66
Heroes	38	46.00	26.20	38	18.13	11.31	38	15.63	8.21
Any Other Program	135	45.00	21.91	135	18.16	10.05	135	15.41	6.68
Overall	249	46.47	24.13	249	18.67	10.54	249	16.04	7.45

Note. Bold indicate highest means scores for each chemistry self-efficacy subsection. The highest possible score for each subject section is 108 for cognitive skills (12 questions), 45 for psychomotor skills (5 questions) and 36 for everyday skills (4 questions).

For those participants at New York Comic Con, there was a significant effect for the chemistry self-efficacy cognitive skills scores, $t(247) = 1.983$, $p = .049$, with *CSI* & *Numb3rs* (M = 54.18, s.d. = 29.21) receiving higher scores than the any other program group (M = 45.29, s.d. = 23.11). Also, there was a significant effect for chemistry for the

self-efficacy psychomotor skills scores, $t(247) = 2.159$, $p = .032$, with all *CSIs* & *Numb3rs* (M = 22.33, s.d. = 11.749) receiving higher scores than the other television groups (M = 18.11, s.d. = 10.26). Finally, there was a significant effect for the chemistry self-efficacy everyday skills scores, $t(247) = 2.527$, $p = .012$, with all *CSIs* & *Numb3rs* (M = 19.06, s.d. = 8.84) receiving higher scores than the other television groups (M = 15.58, s.d. = 7.13).

Table 8.4

Descriptive Statistics for Chemistry Self-Efficacy for Cognitive Skills, Psychomotor Skills and Everyday Skills Online Sample – CSI & Numb3rs Fan versus Everyone Else

	Cognitive Skills			Psychomotor Skills			Everyday Skills		
Television Group	*n*	*M*	*SD*	*N*	*n*	*SD*	*n*	*M*	*SD*
All *CSIs* & *Numb3rs*	115	57.02	28.21	115	23.17	12.64	115	19.34	9.02
All Other Programs	39	55.02	29.03	39	22.13	12.90	39	19.59	8.83

Note. The highest possible score for each subject section is 108 for cognitive skills (12 questions), 45 for psychomotor skills (5 questions) and 36 for everyday skills (4 questions).

Table 8.5

Descriptive Statistics for Chemistry Efficacy for Cognitive Skills, Psychomotor Skills and Everyday Skills by Avid Television Fan Group (Online)

	Cognitive Skills			Psychomotor Skills			Everyday Skills		
Television Program	*n*	*M*	*SD*	*N*	*M*	*SD*	*n*	*M*	*SD*
All *CSIs*	19	**60.11**	24.64	19	**23.47**	11.76	19	20.26	7.54
All *Law & Orders*	8	48.75	31.15	8	18.75	13.26	8	16.63	10.36
Numb3rs	96	56.51	28.95	96	23.10	12.86	96	19.16	9.30
Heroes	3	46.67	25.42	3	21.00	12.49	3	19.33	6.66
Any Other Program	28	58.61	29.23	28	23.21	13.13	28	**20.46**	8.67
Overall	154	56.68	28.33	154	22.90	12.67	154	19.40	8.94

Note. Bold indicate highest means scores for each chemistry self-efficacy subsection. The highest possible score for each subject section is 108 for cognitive skills (12 questions), 45 for psychomotor skills (5 questions) and 36 for everyday skills (4 questions).

For participants participating online, there was no significant effect for the chemistry self-efficacy cognitive skills scores (with equal variances not assumed), $t(64) = .253$, $p = .801$. Also, there was no significant effect for the chemistry self-efficacy psychomotor skills scores (with equal variances not assumed), $t(64) = .436$, $p = .664$. Finally, there was no significant effect for the chemistry self-efficacy everyday skills scores (with equal variances not assumed), $t(67) = .879$, $p = .879$.

Chemistry & Mathematics Self-Efficacy Measures

Hypothesis 3. All *CSIs* and *Numb3rs* fans reported higher overall self-efficacy towards chemistry (M = 98.26, s.d. = 46.75 and M = 99.40, s.d. = 49.94, respectively) than all *Law & Orders*, *Heroes* and fans of Any Other Program (M = 80.90, s.d. = 42.83; M = 80.71, s.d. = 80.71 and M = 88.42, s.d. = 40.68, respectively). All *Law & Orders* and *Numb3rs* fans reported higher self-efficacy towards mathematics (M = 48.80, s.d. = 15.10 and M = 47.10, s.d. = 16.24, respectively) than all *CSIs*, *Heroes* and fans of Any Other Program (M = 45.02, s.d. = 14.65; M = 43.34, s.d. = 16.30 and M = 46.66, s.d. = 14.54, respectively). *Heroes* produced the lowest chemistry and mathematics self-efficacy scores (chemistry M = 80.71, s.d. = 43.53 and mathematics M = 43.34, s.d. = 16.30). Chemistry and mathematics self-efficacy scores by avid television fan group are shown in Table 9.1.

Table 9.1

Chemistry Self-Efficacy and Mathematics Self-Efficacy by Avid Television Fan Group

	Chemistry Self-Efficacy			Mathematics Self-Efficacy		
Television Program	*n*	*M*	*SD*	*n*	*M*	*SD*
All *CSIs*	47	98.26	46.75	47	45.02	14.65
All *Law & Orders*	51	80.90	42.83	51	**48.80**	15.10
Numb3rs	101	**99.40**	49.94	101	47.10	16.24
Heroes	41	80.71	43.53	41	43.34	16.30
Any Other Program	163	88.42	40.68	163	46.66	14.54
Overall	403	88.42	44.95	403	46.51	15.23

Note. Bold indicates the highest means. The highest possible score for chemistry self-efficacy is 189 and the highest possible score for mathematics self-efficacy is 70. Percentage of maximum for the highest groups for each self-efficacy measure is 52.6% and 68.7% for chemistry and mathematics, respectively.

To analyze chemistry and mathematics self-efficacy, a stepwise discriminant function analysis (DFA) was conducted. An analysis of variance (ANOVA) was performed on the first variable to enter the DFA, which was the chemistry self-efficacy total score (Stevens, 2009). A multivariate analysis of variance was performed to investigate fan program differences in mathematics and chemistry self-efficacy and these scores acted as the two dependent variables. The independent variable was avid television program fan group. Preliminary assumption testing was conducted to check for normality, linearity, univariate and multivariate outliers, homogeneity of variance-covariance matrices, and multicollinearity, with no serious violations noted.

The MANOVA indicated significant differences among groups in the linear combination of mathematics self-efficacy and chemistry self-efficacy scores (Wilks' Lambda =.948, $F(8, 794) = 2.663$, $p = .007$). DFA indicated that chemistry self-efficacy was the best predictor of these differences (Wilks' Lambda = .967, $F(4, 398) = 3.380$, $p =$

.010). The effect size using partial eta squared was .033. Despite reaching a statistical significance, the actual difference in mean scores between groups was quite small. The mathematics self-efficacy tests scores did not enter the DFA. An ANOVA confirmed there are differences among chemistry self-efficacy scores across groups, F (4, 402) = 3.380, p = .010. The effect size, calculated using eta squared was .033. Post-hoc comparisons using Tukey HSD test indicated that the mean score for *Numb3rs* fans was significantly higher that of the avid fans of Any Other Program (*Numb3rs* M = 99.40, s.d. = 4.42 and Any Other Program M = 83.08, s.d. = 3.48).

Additionally, scores were analyzed based on collection locale and television program. Fans were grouped into two categories: (1) *Numb3rs* and all *CSIs* (2) All other programs including all *Law & Orders* and *Heroes*. Following the regrouping, t-tests were conducted to determine if group differences existed.

For the New York Comic Con data collection, all *CSIs* and *Numb3rs* fans reported higher overall self-efficacy towards chemistry (M = 96.18, s.d. = 49.01) than all *Law & Orders*, *Heroes* and fans of Any Other Program (M = 79.44, s.d. = 39.27). There were no notable differences in the all *CSI* and *Numb3rs* group and *Law & Orders*, *Heroes* and fans of Any Other Program fans' in their reported mathematics self-efficacy (M = 46.79, s.d. = 16.23 and M = 46.78, s.d. = 14.69, respectively). Results are presented in Tables 9.2 and 9.3.

Table 9.2

Descriptive Statistics for Chemistry Self-Efficacy and Mathematics Self-Efficacy at NY Comic Con – CSI & Numb3rs Fan versus Everyone Else

	Total Chemistry Self-Efficacy			Total Mathematics Self-Efficacy		
Television Group	*n*	*M*	*SD*	*n*	*M*	*SD*
All *CSIs* & *Numb3rs*	33	**96.18**	49.01	33	46.76	16.23
All Other Programs	216	79.44	39.27	216	46.78	14.69

Note. Bold indicates the highest mean. The highest possible score for chemistry self-efficacy is 189 and the highest possible score for mathematics self-efficacy is 70.

Table 9.3

Chemistry Self-Efficacy and Mathematics Self-Efficacy by Avid Television Fan Group (New York Comic Con)

	Chemistry Efficacy			Mathematics Efficacy		
Television Program	*n*	*M*	*SD*	*n*	*M*	*SD*
All *CSIs*	28	**94.25**	49.62	28	45.57	16.55
All *Law & Orders*	43	80.14	41.24	43	**48.77**	14.16
Numb3rs	5	**107.00**	49.23	5	**53.40**	13.96
Heroes	38	80.16	44.07	38	44.18	16.45
Any Other Program	135	79.02	37.48	135	46.88	14.33
Overall	249	81.66	40.98	249	46.78	14.87

Note. Bold indicates the highest means. The highest possible score for chemistry self-efficacy is 189 and the highest possible score for mathematics self-efficacy is 70.

There was a significant effect for the chemistry self-efficacy total scores, $t(247) = 2.208$, $p = .029$, with *CSI* & *Numb3rs* (M = 96.18, s.d. = 49.01) receiving higher scores than the other television groups (M = 79.44, s.d. = 39.27). There was no significant effect for mathematics self-efficacy total scores, $t(247) = .009$, $p = .993$.

For the online data collection, all *CSIs* and *Numb3rs* fans were similar in their chemistry self-efficacy (M = 99.85, s.d. = 48.91) compared to *Law & Orders*, *Heroes* and fans of Any Other Program (M = 97.87, s.d. = 49.50). There were no notable differences in the all *CSI* and *Numb3rs* group versus *Law & Orders*, *Heroes* and fans of Any Other Program fans' in their reported mathematics self-efficacy (M = 46.35, s.d. = 15.67 and M = 45.31, s.d. = 16.63, respectively). Results are presented in Tables 9.4 and 9.5.

Table 9.4

Descriptive Statistics for Chemistry Self-Efficacy and Mathematics Self-Efficacy (Online Sample) – CSI & Numb3rs Fan versus Everyone Else

	Total Chemistry Self-Efficacy			Total Mathematics Self-Efficacy		
Television Group	*n*	*M*	*SD*	*n*	*M*	*SD*
All *CSIs* & *Numb3rs*	115	99.85	48.91	115	46.35	15.67
All Other Programs	39	97.87	49.50	39	45.31	16.63

Note. The highest possible score for chemistry self-efficacy is 189 and the highest possible score for mathematics self-efficacy is 70.

Table 9.5

Chemistry Self-Efficacy and Mathematics Self-Efficacy by Avid Television Fan Group (Online)

	Chemistry Efficacy			Mathematics Efficacy		
Television Program	*n*	*M*	*SD*	*n*	*M*	*SD*
All *CSI*	19	**104.16**	42.79	19	44.21	11.70
All *Law & Orders*	8	85.00	53.62	8	**49.00**	20.62
Numb3rs	96	99.00	50.20	96	46.77	16.34
Heroes	3	87.67	43.43	3	32.67	11.06
Any Other Program	28	102.64	49.80	28	45.61	15.75
Overall	154	99.35	48.91	154	46.08	15.86

Note. Bold indicates the highest means. The highest possible score for chemistry self-efficacy is 189 and the highest possible score for mathematics self-efficacy is 70.

There was no significant effect for the chemistry self-efficacy scores, $t(152) = .218$, $p = .828$. There was no significant effect for mathematics self-efficacy, $t(152) = .353$, $p = .725$.

Cognitive Processing of Academic Text

Hypothesis 4. Four t-test were conducted to explore the impact of television avid group on the ability to extract information from text (as coded by the Elements, Purpose, Mechanism (EPM) coding system) before and after reading two short articles related to the second law of thermodynamics and ballistics. All participants' answers were coded for each item and a final score was calculated within each subsection. Scores were binned into three equal groups based on the percentage of responses. Participants were grouped according to their television program preference. Means for the entire group before and after reading both texts are listed below in Table 10.

Table 10

Means of All Subjects for Article Sections Before and After Scores (Second Law of Thermodynamics and Ballistics)

	Second Law Prior to Reading Score			Second Law After Reading Score			Ballistics Prior to Reading Score			Ballistics After Reading Score		
Television Group	*N*	*M*	*SD*	*n*	*M*	*SD*	*n*	*M*	*SD*	*n*	*M*	*SD*
All *CSIs* & *Numb3rs*	148	**1.36**	3.63	132	**3.11**	4.62	144	1.63	2.17	131	**2.63**	3.35
All Other Programs	255	.62	1.50	241	2.92	4.33	251	1.63	2.64	234	2.58	3.45

Note. Bold indicates the highest mean.

There was a statistically significant difference in pre-test scores prior to reading text related to the second law of thermodynamics for the five television groups: $t(401) = 4.057$, $p = .045$. In addition, there was no statistical significant in post-test scores after to reading text related to the second law of thermodynamics for the five television

groups: $t(371) = .727$, $p = .394$. There was no statistically significant difference in pre-test scores prior to reading text related to ballistics for the five television groups: $t(393) = .622$, $p = .431$. There was no statistically significant difference in post-test scores after to reading text related to ballistics for the five television groups: $t(363) = .067$, $p = .796$.

Additionally, scores were analyzed based on collection locale and television program. Fans were grouped into two categories: (1) *Numb3rs* and all *CSIs* (2) All other programs including all *Law & Orders* and *Heroes*. t-tests were conducted to determine if group differences existed.

Four t-tests were conducted to explore the impact of television avid group on the ability to extract information from text (as coded by the EPM coding system) before and after reading two short articles related to the second law of thermodynamics and ballistics. All New York Comic Con participants' answers were coded for each item and a final score was calculated within each subsection. Participants were grouped according to their television program preference. There was no statistically significant difference in pre-test scores prior to reading text related to the second law of thermodynamics for the five television groups: $t(247) = .625$, $p = .420$. Additionally, there was no statistically significant difference in post-test scores after to reading text related to the second law of thermodynamics for the five television groups: $t(232) = .371$, $p = .543$. Also, there was an approach to a statistically significant difference in pre-test scores prior to reading text related to ballistics for the five television groups: $t(243) = 3.241$, $p = .073$. Finally, there was no statistically significant difference in post-test scores after reading text related to ballistics for the five television groups: $t(226) = .008$, $p = .929$.

Four t-tests were conducted to explore the impact of television avid fan group on the ability to extract information from text (as coded by the EPM coding system) before and after reading two short articles related to the second law of thermodynamics and ballistics. All online participants' answers were coded for each item and a final score was calculated within each subsection. Participants were grouped according to their television program preference. There was no statistically significant difference in pre-test scores prior to reading text related to the second law of thermodynamics for the five television groups: F (1, 152) = .656, p =.199. In addition, there was no statistically significant difference in post-test scores after to reading text related to the second law of thermodynamics for the five television groups: F (1, 137) = .011, p = .917. There was a statistically significant difference in pre-test scores prior to reading text related to ballistics for the five television groups: F(1, 148) = 5.486, p = .020. There was no statistically significant difference in post-test scores after to reading text related to ballistics for the five television groups: F(1, 135) = .734, p = .393.

Television Processing Assistance

Hypothesis 5. Individuals were classified by "Television Program" (5 categories; all *CSIs*, all *Law & Orders*, *Numb3rs*, *Heroes* and Any Other Program) and by six concepts related to their television processing (Specific Characters, Specific Episode, General Themes, and General Character Actions). The first table displays findings for the entire sample and subsequent tables display findings based on collection locales (New York Comic Con attendees and online participants, respectively). In this study, the highest frequencies were derived from general theme references assisting with ballistic

processing. This was robust not only for the entire sample, but also for New York Comic Con attendees and online participants. The other television processing concepts were non-significant. All non-significant frequencies can be found in Appendix C.

Second Law of Thermodynamics processing & television assistance. Individuals were classified by "Television Program" (5 categories specified at the beginning) and by "Specific Episode(s) Assistance" (Yes/No) after a second law of thermodynamics reading in a 5x2 contingency table and a chi-square test for independence was conducted. The test indicated a significant association between television program group and identification of specific episode assistance in helping to extract information about the second law of thermodynamics, χ^2 (4, n = 403) = 9.182, p = .057. However, expected cell counts were less than five and the chi-square approximation may not be valid (Mendenhall et al., 2006). The analysis described above was repeated for general program themes, specific character assistance and general character assistance after participants completed the second law of thermodynamics reading.

Individuals were classified by "Television Program" (5 categories specified at the beginning) and by "General Theme Assistance" (Yes/No) after a second law of thermodynamics readings in a 5x2 contingency table and a chi-square test for independence was conducted. The chi-square test for independence indicated a statistically significant association between television program group and identification of general program themes assisting with the processing of information on the second law of thermodynamics, χ^2 (4, n = 403) = 14.307, p = .006. However, expected cell counts were less than five and the chi-square approximation may not be valid. Therefore, it would be inappropriate to trust the results of the test (Mendenhall et al., 2006).

A chi-square test for independence indicated no significant association between television program group and identification of specific characters assisting with the processing of information on the second law of thermodynamics, χ^2 (4, n = 403) = 6.384, p = .172. A chi-square test for independence indicated no significant association between television program group and identification of general character traits assisting with the processing of information on the second law of thermodynamics, χ^2 (4, n = 403) = 6.284, p = .179. Non-significant frequency tables can be found in Appendix C.

Ballistics processing & television assistance. Individuals were classified by "Television Program" (5 categories specified at the beginning) and by "Specific Episode(s) Assistance" (Yes/No) after a ballistics reading in a 5x2 contingency table and a chi-square test for independence was conducted. The test indicated a significant association between television program group and identification of specific episode assistance in helping to extract information about ballistics presented in their selected television program, χ^2 (4, n = 403) = 15.007, p = .005. However, expected cell counts were less than five and the chi-square approximation may not be valid (Mendenhall et al., 2006).

Individuals were classified by "Television Program" (5 categories specified at the beginning) and by "General Theme Assistance" after a ballistics reading (Yes/No) in a 5x2 contingency table (Table 11.1), and a chi-square test for independence was conducted. The chi-square test for independence indicated a statistically significant association between television program group and identification of general program themes assisting with the processing of information on ballistics, χ^2 (4, n = 403) = 20.211,

p = .001, V = .224. According to Gravetter and Wallnau (2004, p. 605) this is a medium effect size for a 5x2 contingency table.

Table 11.1

Contingency Table Representing Avid Television Fan Group and General Themes Assistance After Ballistics Reading

General Themes Assistance	All *CSIs*	All *Law & Orders*	*Numb3rs*	*Heroes*	Any Other Program	Total	χ^2	df	*p*
Yes	22	22	31	6	36	286	20.211	4	.001
No	25	29	70	35	127	117			

To follow-up on the TV group comparisons, a post-hoc analysis was conducted. Chi-square tests of independence were conducted on the 10 possible 2x2 contingency tables (i.e., to compare all *CSIs* vs. all *Law & Orders*; all *CSIs* vs. *Heroes*; all *CSIs* vs. *Numb3rs*; all *CSIs* vs. Any Other Program; all *Law* & *Orders* vs. *Heroes*; all *Law* & *Orders* vs. *Numb3rs*; all *Law & Orders* vs. Any Other Program; *Heroes* vs. *Numb3rs*; *Heroes* vs. Any Other Program; and finally *Numb3rs* vs. Any Other Program). To adjust for testing the 10 2x2 tables simultaneously, the Bonferroni correction was used; α = 0.5/10=.005 was used as the level of significance for each of the 10 tests. The analysis described above was repeated for general program themes, and specific character assistance and general character assistance after participants completed the second law of thermodynamics reading.

As a follow-up on group comparisons, a chi-square test for independence indicated significant associations between television program and identification of general program themes assisting with the processing of information on ballistics for all *CSIs* versus *Heroes* avid fans, χ^2 (1, 88) = 10.449, p =.001, phi = .345; all *CSIs* versus Any Other Program avid fans, χ^2 (1, 210) = 11.154, p =.001, phi = -.230; all *Law &*

Orders versus *Heroes* avid fans, χ^2 (1, 92) = 8.721, *p*=.003, phi = -.308; and all *Law & Orders* versus Any Other Program avid fans, χ^2 (1, 214) = 8.713, *p* =.003, phi = -.202. According to Cohen (1988), these effect sizes are approaching a medium effect size.

Scores were analyzed based on the collection locale and television program. Frequencies and percentages are presented in Tables 11.2 – 11.4.

Table 11.2

Percentages for Avid Television Fan Groups and Television Assistance in Processing Ballistics Text with General Program References

Ballistics General Program References	All *CSIs*	All *Law & Orders*	*Numb3rs*	*Heroes*	Any Other Program	Total
Yes	22	22	31	6	36	117
No	25	29	70	35	127	286
						403
% "Yes" Per Program	46.80	43.14	30.69	14.63	22.09	
% "Yes" Total Sample	5.46	5.46	7.69	1.48	8.93	29.03

Note. Yes/No lines indicate frequencies.

Table 11.3

Percentages of Avid Television Fan Groups and Television Assistance in Processing Ballistics Text with General Program References (New York Comic Con)

Ballistics General Program References	All *CSIs*	All *Law & Orders*	*Numb3rs*	*Heroes*	Any Other Program	Total
Yes	14	18	2	5	28	67
No	14	25	3	33	107	182
						249
% "Yes" Per Program	50.00	41.86	40.00	13.16	20.74	
% "Yes" Total Sample	5.62	7.23	0.80	2.01	11.24	26.91

Note. Yes/No lines indicate frequencies.

Table 11.4

Percentages of Avid Television Fan Groups and Television Assistance in Processing Ballistics Text with General Program References (Online Sample)

Ballistics General Program References	All *CSIs*	All *Law & Orders*	*Numb3rs*	*Heroes*	Any Other Program	Total
Yes	8	4	29	1	8	50
No	11	4	67	2	20	104
						154
% "Yes" Per Program	42.11	50.00	30.20	33.33	28.57	
% "Yes" Total Sample	5.19	2.60	18.83	0.65	5.19	32.47

Note. Yes/No lines indicate frequencies.

Finally, a chi-square test for independence indicated no significant association between television program group and identification of general character traits assisting with the processing of information on ballistics, χ^2 (4, n = 403) = 5.524, p = .238. A chi-square test for independence indicated no significant association between television program group and identification of specific characters assisting with the processing of information on ballistics, χ^2 (4, n = 403) = 6.384, p = .172.

CHAPTER V: DISCUSSION

Self-Concept Discussion

Hypotheses 1. Fans, by definition, are viewers who are more involved than average viewers. Involvement in television has negative connotations within society at large (Casey et al., 2008). However, from the results of the present study, a marginal relationship was shown to exist between avid fans and those having general career similarities not specific to any character in their television program of choice (see Appendix C, Tables 1a.-1c.). Fans are often chastised for living in the imaginary world of their favorite program(s), however, their characters (i.e. the law enforcer, detective and the unlikely mathematician/criminologist) are all portrayed as admirable professionals. Many of the avid fans surveyed in this study see the characters in their favorite programs as role models or as a person they would aspire to emulate. Contrast *Heroes*, in which characters do not have set careers; saving the world from destruction with superpowers is not a typical career path. However, we cannot rely on these self-concept results because the chi-square approximation may not be valid and there was a lower response rate for this type of self-concept indicated by television fans.

Numb3rs avid fans had a very strong relationship in regards to this role model definition among its fans (71% of those surveyed) as did *Heroes* (73% of those surveyed). This could be the result of its novel means of crime solving, which speaks to a fan base that was not otherwise served in primetime programming and the larger than life comic book-esque characters in *Heroes*. While these last statements lead to causation, at

this point in time the gathered research only showed an association between television program and role model exposure. Jenkins' (1992, 2006) research suggests, we live in a time where fans are not passive; meaning is organized around the ways they construct the realities viewed on a weekly basis. It is difficult to determine a line where a fan's realty is based on their affinity for a program's concepts or that the concepts they find interesting lead to their choice of program. This current study contends that individuals who view their programs as containing role models show a relationship to higher self-efficacy for the skills required by that role model to succeed. This promotes the idea that a sense of apperception and confidence can be instilled through television programs with specialized content.

As stated earlier, the purpose of this study was to create a starting point for such concepts. It is interesting to note that only the *Numb3rs* and *Heroes* avid fan groups felt their characters served as role models. In most cases, only half of those in the all *CSIs*, all *Law & Orders* and Any Other Program groups felt their characters were role models. Interestingly, the criminal investigation program that harnesses the power of mathematics (*Numb3rs*) is more similar to the program whose characters harness superpowers (*Heroes*) than it is similar to the other criminal investigation shows. As Betz and Hackett (1983) previously stated, pessimistic feelings towards mathematics have mostly been explained by negative attitudes and experiences related to mathematics. *Numb3rs* is a program that relies on the positive and powerful nature of mathematics skills to help others and captivate its television audience. This program is not at all pessimistic in nature and could explain the higher role model effects within this group. The easy use of

mathematics by a strong lead character may potentially alter previous negative connotations and/or support currently possessed positive connotations.

Finally, while the groups were uneven after a review of the collection locale frequencies, the percentages by television program based on their role model indications appeared to be similar to that of the entire sample (New York Comic Con and online participants treated as one sample). Thus, we can surmise there is an association between role model feelings and membership of any television program avid fan group. This further emphasizes the affinity fans have for their characters to a program that portrays characters with superpowers. Perhaps to fans of *Numb3rs*, higher order mathematical processing is a *superpower.*

Mathematics and Chemistry Self-Efficacy Discussion

Hypotheses 2. Analysis of the chemistry self-efficacy measure's three subgroups indicated fans of specific programs had more positive feelings about their comfort level in processing information related to this subject matter. As predicted, all *CSIs* and *Numb3rs* fans showed higher chemistry self-efficacy scores within cognitive skills, psychomotor skills and everyday skills. However, the MANOVA did not indicate a significant difference in groups. This is mostly due to the fact that scores from each subsection correlate and each score is derived from the same instrument. Instead, three ANOVAs support significant group differences across all program groups. However, by using this statistic as a means of support we are inflating the scores. *Numb3rs* fans also showed the largest group differences post-hoc in one-to-one group comparison testing against fans of any program for the three chemistry self-efficacy subsections. Perhaps

fans of *Numb3rs* and *CSI* programs are much more confident in their ability to process information related to chemistry than a group of fans who watch Any Other Program.

To test for collection locale confounding, means of each subsection were calculated as well as t-tests for group differences. New York Comic Con attendees appear to mirror the combined group results, having similar means and a significant difference in groups when *Numb3rs* and all *CSIs* avid fans are paired in comparison to all other participants (Any Other Program, all *Law & Orders*, and *Heroes*). However, when looking at group differences and means for online participants, the results are not the same as New York Comic Con attendees or the combined sample. This is interesting because the majority of *Numb3rs* fans were derived from the online sample. When looking at the online sample only, it was surmised, this group may potentially have the highest self-efficacy scores for each subsection. Yet, this was not the case. Possible reasons for these predictions were that online participants may have been more likely to have a quiet environment to participate in the study in comparison to the often loud conference environment at New York Comic Con. With an area mostly free of noise and distraction, participants who took the survey online were thought to be able to concentrate more effectively on the questions and various tasks. Perhaps, this was a benefit to both sides and a possible reason for the lack of group differences in chemistry self-efficacy based on television program preference.

According to Bandura (1994) the positive results of *Numb3rs* and all *CSIs* fans could be due to one of two things (a) modeling and (b) perceived self-efficacy. Modeling is described as a process of response acquisition that may result in a similar level of impact as that encountered by direct experience. Since the majority of actions within all

CSIs and *Numb3rs*, involve crime solving protocols interlaced with science references and applications, it is no wonder that these viewers may have had a more elevated sense of understanding of these topics. This by no means replaces the skill and contextual knowledge required to practice the science of chemistry, it simply explores the notion that one's comfort level with academics may be supplemented by avid fan group membership. Perhaps the entertainment factor makes the science less daunting and allows one to be more comfortable with the terminology since viewers already have a certain comfort level with the dramatic themes. It may also prime fans to access knowledge stores, making the processing of any related information easier, similar to the Hammer et al. (2007) study.

Bandura (1997, 2001) also developed the idea of perceived self-efficacy, defined as one's belief in their own capabilities to organize and execute actions for the purposes of goal attainment. This concerns one's own perceived notion of prevailing in a circumstance, rather than the intention of performing the task. As an increase in efficacy often results in the higher likelihood of learning, these results seem to point to the possibility that may be an indirect educational effect as a result of consistently viewing certain television programs. However, it is difficult to tease this out as a result of being an avid television fan (one who has a focused goal of consuming a program) or if affinity for the show is due to the inclusion of specialized content. It makes one wonder if fandom development could play a role in building knowledge confidence.

However, while there was a statistically significant association between the chemistry subgroups, we have to question the practical significance of the results. Statistically for each television groups, we found the following significance levels for

each section of $p = .014$, $p = .010$, $p = .009$ for the cognitive skills, psychomotor skills, and everyday skills domains, respectively. Yet, the differences between the means of each group were only based on a single highly-rated question. Therefore, while there is confidence in the statistics, there may not be a readily detectable difference between one fan and another based on program preference. Perhaps a more notable difference would be found if the sample was a more general sample, rather an online fan page and New York Comic Con attendees. Further testing would be needed.

Hypotheses 3. While results were modest, a review of the means scores can be used to show a relationship in how avid television fans feel about their abilities towards mathematics and chemistry. It was predicted that *Numb3rs* and all *CSI* fans would have the highest mathematics and chemistry self-efficacy total scores out of the five selected program groups. While, this was true for chemistry self-efficacy, it was not true for the mathematics self-efficacy total scores. For the chemistry self-efficacy scores, *Numb3rs* and all *CSIs* had the highest scores. However, for the mathematics self-efficacy *Law & Order* and *Numb3rs* avid fans had the highest scores, respectively. This was interesting as *Law & Order*, primarily a legal drama, rarely possesses any type of mathematical theme as a means of solving a crime, compared to the degree that *Numb3rs* does. Perhaps this could be due to the logical nature of most material in legal studies, which is similar to logical mathematics processes. Conceivably, these fans were able to realize the value of mathematics and self-report their own abilities to imply that mathematics is an important skill. After all, this was a test of one's *perceived* confidence of their ability, not their *actual* ability.

Concerning mathematics self-efficacy, the resulting similarity in scores across group was an interesting finding. This was contrary to our initial hypothesis, in which we predicted *Numb3rs* and all *CSIs* to have more positive feelings than the other television program fan groups. It is possible the sample has more positive feelings overall for mathematics, unrelated to their program of choice. This may have to do with the chosen sample selection, as we took information from individuals who may use computers more often than most (online survey participants) as well as those individuals attending a comic conference whose attendees stereotypically have a more positive affinity for these particular academic subjects (Bailey, 2011). Further, exposure to these programs results in coding new information and most fans share this information with others, which results in the elaboration of information - a method of learning optimization (Anderson, 2005; Anderson & Bower, 1973). Having these positive feeling towards an academic subject often results in positive achievement (Hampton & Mason, 2003; Multon et al., 1991; Pajares & Miller, 1994; Shell et al., 1995). Perhaps, these feelings towards an academic subject can serve as an academic motivator or as a means to stay cognitively active in later years.

Concerning group comparisons, we did find group differences in chemistry self-efficacy. This highest percentage of the maximum was reached in the mathematics self-efficacy measure (*Law & Order's* was the highest mean, M = 49.00; 62% of the maximum possible score) in comparison to the chemistry self-efficacy measure (*Numb3rs* was the highest mean, M = 99.40; 53% of the maximum possible score). While group differences are lacking in mathematics self-efficacy, there are noticeable chemistry self-

efficacy differences. However, these differences may not be powerful since they account for a lesser amount of the maximum possible score.

To ascertain the predictability of program preference, a stepwise discriminant function analysis (DFA) was conducted to predict possible group membership, in this case, membership within a television fan group suggesting the idea of relationship between viewing programs with additional academic content and positive chemistry self-efficacy. The possibility of a predictive factor was hypothesized, and this was verified for the sample in the form of chemistry self-efficacy. The degree of chemistry confidence was the only factor in suggesting the possibility of predicting program preference and suggesting a possible a relationship between viewing programs with additional academic content and the likelihood of elevated chemistry self-efficacy. Perhaps this finding is due to the scientific information often presented in today's criminal and science-fiction programs. If the characters make it look easy to understand this information and demonstrates seamless problem-solving, perhaps the viewers may feel more confident in this area causing them to gravitate toward other programs containing these entities. Yet, between the two areas of mathematics and chemistry self-efficacy, self-efficacy for chemistry is the stronger predictor. This is interesting in and of itself, since one program features mathematics prominently. Based on content, one would think both or only mathematics would be a key factor in predicting group membership.

Despite reaching statistical significance in the DFA, the effect size was quite small, meaning any results many not necessarily transcend into the general population (and for this study they mainly speak to avid fans, not casual viewers). It should be noted that *Numb3rs* fans' chemistry self-efficacy scores were significantly higher in post-hoc

testing than avid fans' scores of any television program. Since the data were collected from New York Comic Con and online fan forum members, there were higher instances of science fiction fans within this population. Additionally, it is unclear if we can differentiate between one's affinities towards chemistry as drawing them into the program or if the program creates the affinity. It is possible these programs are creating positive feelings but also possible fans watch because they have positive feelings. The study, while drawing conclusions based on associations does provide insight into the mind of an avid fan. However, a future study will assist in determining if these programs are the cause of positive feelings towards academics. An interesting future study might involve having participants watch a series of episodes from *CSI* and *Numb3rs* and noting any changes in chemistry and mathematics self-efficacy in comparison to those groups unexposed to these programs. For instance, interventions such as presenting a series of episodes along with pre- and post- test self-efficacy measures may yield causality.

The sample was additionally, reviewed based on collection locales, similar to the method of reviewing the chemistry self-efficacy subsections in Hypothesis 2. Similar results followed with New York Comic Con attendees producing similar means and group differences compared to online fans. The Any Other Program group produced high means as well as group differences similar to that of *Numb3rs* and all *CSIs*.' However, for the online sample, the Any Other Program group produced one of the highest means for the chemistry self-efficacy subsection. While not easily explained, this is an area worth investigating in the future with more equal group sizes, especially since there were no notable group differences when comparing all *CSIs* and *Numb3rs* to everyone else (all other programs, *Heroes*, and all *Law & Orders*). One would have thought that there

might have been a less notable difference in the means of the demographics of comic book fans who are often more likely to be more highly educated than the general population (Bailey, 2011).

Cognitive Processing of Academic Text Readings Discussion

Hypothesis 4. When comparing the mean scores for both the pretest questions and a difference in scores from both the pretest and posttest questions, within the article section of the survey, differences were only present within the second law of the thermodynamics pretest section. While contrary to the hypotheses of this study, we can conclude a few things as result. Since this study was devised to examine the confidence elevation and cognitive changes of television show avid fans, we can say to some degree we saw that occur.

For the ballistics sections, no significant differences were found in participants' ability to extract information from text. According to the elements, purpose, and mechanism scoring method, it appears there were no differences in the capacity to process technical information as related to the science of ballistics. Perhaps this was due to the influx of criminal investigation programs within the last decade. There are many varieties of these programs on the market today and while participants were selected based on their self-indication of being an avid fan of a single program, this does not preclude them from watching programs of similar format not represented in this study. This area of science proves to be difficult when trying to test for comprehension and confidence effects. Since there are many cases of this program format on today's television screen, it would make a wider range of viewers able to understand information

related to the subject matter. Since background information increases the likelihood of comprehension, and there are a myriad of instances of this program type, perhaps it is not surprising that group differences were not found (Harris et al., 1990).

For the second law of thermodynamics section of this survey, there were significant group differences in the pretest scores in participants' ability to extract text from the short reading. Within the five television groups, post-hoc tests showed *Numb3rs* scores were significantly higher than those who were avid fans of *Heroes* and Any Other Program. Thus, it is possible we can attribute the show's content and positive mathematics problem-solving entertainment examples to the difference in the viewers' ability to process information. However, differences in pretest and posttest scores for the second law of thermodynamics section did not yield significant results based on the elements, purpose and mechanism coding scheme. While it appears from the other sections that self-efficacy can be altered, content knowledge does not to appear to be altered based on avid fan group membership. Perhaps it is feasible to suggest that because each participant was an avid fan this might be a factor in their ability to extract information from text. Perhaps avid fans are those who possess prior experience and content knowledge about their program selection, and such domain-specific information may help in their ability to process information (Mares, 2007).

Finally, there is the issue of whether we can describe what is occurring to knowledge acquisition. When the participants read these short articles, are they really learning from the material at hand? Moreover, are they "learning" content information from their favorite television programs? We have to concede that this may not be completely true given the thumbnail sketch of information provided. Yet, what may be

possible is something similar to the study of expert video game players conducted by Hammer et al. (2007).

In this work, groups of fans extremely familiar with two games, *SimCity* and *Civilization* were tested on their ability to process historical information based on the system and procedural knowledge gained from avid video game play. What is thought to have occurred is that participants who read the presented information primed their pre-existing knowledge, so they could better access their understanding of the subject matter (Hammer et al., 2007). Perhaps this is the case with these avid television program fans as well. Also, similar to this video game study, is the issue of whether knowledge acquisition or priming is the culprit. *Numb3rs* and all *CSI*s fans, seem to have higher pre-test scores for the second-law of thermodynamics section than all other television fans (including *Heroes* and all *Law & Order* fans). However, this was not the case for the ballistics text section. This could be due to the overriding criminal and investigative themes many of these shows take on, including *Heroes* because the characters for the majority of the program are trying to find an explanation to the superhuman powers they possess. Since ballistics is an ever present theme in most program (even outside of the ones we attempted to focus on), this could explain the lack of differences in means and groups. The result could imply, like the Hammer et al. (2007) study, that television viewing may prepare people for learning. However, more research would have to be conducted to determine the means of how that is achieved.

For future work, this area of research ought to focus on all television viewers including those who self-identify as causal viewers, in addition to avid fans. It may not be the program itself that results in these differences in confidence and knowledge

processing, rather the status of being an avid fan. If anything, the mostly non-significant results from this hypothesis have led to a realization of the need for a future study examining this prospect.

Hypothesis 5. After participants processed information related to science and mathematics, they were asked to indicate what parts of their program assisted in this task. The only helpful area participants found assistance in answering these questions were from general themes as related to elements of ballistics information. Perhaps this has to do with the elements of procedural knowledge displayed by characters within most criminal investigation programs. Many of the participants indicated steps, terminology or technical references similar to those found in the study of ballistics. This was inclusive of all television fans across all groups within this study. Often seeing these rules displayed in programs while a situation unfolds and characters take action in the forms of methods, is accompanied by instructions or customs (Ohlsson, 1994).

Perhaps, this information provides a step in how to solve a crime and is helpful for the processing of similar material found in other programs. Mathematics, where non-significant results were found, is an area thought to yield high scores for those who watch *Numb3rs.* Yet, it appears the criminal investigation element of the program was more helpful in processing the given test information than the inclusion of the mathematical content. Overall, it looks as though there was little information avid fans were able to garner that they felt assisted in the processing of this academic material. Again, this could reiterate the idea that their priming to access information provides them with the means to process academic material, rather than acquire new content. Perhaps we can conclude there is only an association in how they feel about their ability to understand the material

and prepare their thinking for processing, but there is limited information to theorize about the ability to pull concrete information from television programs for practical use.

Summary

When looking at our modest findings, it is possible we can combine some of our original hypotheses in order to learn more from the results. For instance, we could examine the relationship between participants' beliefs that the characters are role models and their self-efficacy for chemistry. *Heroes* and *Numb3rs* fans showed the highest indication of their characters as role models, which makes sense because these two programs, in comparison to the others selected, have very developed character arcs. This is contrary to *CSI* and *Law & Order* where most viewers feel they can watch any episode and a crime is identified and solved within the span of an episode. The major character arcs in *CSI* and *Law & Order* appear to be secondary. In *Heroes* and *Numb3rs*, longer character arcs are well developed and plots are carried over during multiple seasons and episodes. These programs are of two different types, one led by crime solving steps and the other by strong lead personalities. There may be a difference in motivation that could explain the differences in chemistry self-efficacy. We can surmise there may be a relationship since we have a high role model rating instance and elevated group differences in chemistry self-efficacy for *Numb3rs* and *CSI* fans. Perhaps, an assumption can be made that motivation for areas of science can be delivered by strong character arcs. It may be that there is one main character in *Numb3rs* who has a particularly strong handle on his area of expertise. Why this was not mathematics, is something of an enigma. Yet, it may be they use entertainment as a motivational vehicle to steer viewers

into the appreciation of academics. Overall, *Numb3rs* seems a likely match to both role model feelings and positive feelings towards academics. There also appears to be a negative correlate worth further investigation: a smaller number of strong characters may increase positive feelings towards academics.

As mentioned earlier, McLuhan (1964) defined television as a non-linear and multi-thread visual artifact. The advent of this medium has changed the way viewers' process information since its original inception and will continue to do so along with online additives for years to come. This study can be viewed as not only an argument on what can possibly be gained from time spent viewing television, but on how one's outlook, confidence and priming of pre-existing knowledge of academic material is altered by television exposure. To date, this is one of very few studies that place the study of television consumption in a positive light. Current studies reiterate the usual hotly contested argument that television decreases attention span (Lillard & Peterson, 2011), however, these are only the results of research conducted on children (after an exhaustive literature search no research could be found using adults). Hence, part of the objective of this dissertation was to set a new positive outlook for future study in this area of adult education through television.

The results from this study provide the beginning of understanding the relationship between avid fans and the concepts of self-efficacy and television program preference, albeit information processing differences as predicted. Results were not as hoped in terms of avid fans' ability to process academic information defined by their ability to extract information from text based on their program preference. However,

there were some gains made in understanding what fans believe they utilize from their selected program when processing material on mathematics and science.

Lastly, what did we learn from this project? Overall, there is limited information gained from television as a learning tool. The research results did not seem to indicate a relationship between specific programs and knowledge gains. This was one of our key research hypotheses. We also cannot make any statements as to the system processing capabilities of avid fans. While there were some gains in the ballistic readings sections, this may be a function of the number of television programs on the air related to criminal investigations. Thus, we cannot be as hopeful about an information or system transfer as we would have liked. We have, however, made some elementary strides in the study of academic self-efficacy. Since there are yet to be studies devoted to this area, we believe we have scratched the surface on something positive. There appears to be a relationship between higher levels of chemistry self-efficacy and television program likability, which may serve in a reverse-order relationship as a potential motivating factor towards academics. Perhaps one method of elevating viewers' self-efficacy is through the link between a program's strong character and that character's knowledge display within the program. *Numb3rs'* character Charlie serves as a good example of this, often displaying higher than average subject know-how with an admirable sureness. This study opens the door to study other television programs. For instance, *The Big Bang Theory* has a prominent know-all physicist, named Sheldon. This strong lead character may serve as a good model in future experiments as a physics motivational tool (Lorre & Prady 2007 to 2011).

Suggestions, Limitations & Future Directions

One possible limitation of this study is the question of how well the results will generalize to other populations of viewers. Participants in the present study were NY Comic Con attendees and members of online fan forums who all self-declared their program loyalty as being more than "average fans." In other words, those fans studied were those that turned in each week and rarely missed an episode. The participants were quite diverse in their occupational backgrounds but most fans had obtained some college level education. It is believed some of the results may generalize to other populations, such as non-online fan forum members and those who are not New York Comic Con attendees. However, the question of how well the results would generalize to a wider set of television viewers is an important question for future research.

While the results may not describe all television viewers, finding participants to study for this type of research remains a difficult task. Television is often an at home task. To get multiple viewers together with limited funding is challenging. In addition, there are many variables that we cannot control, some of which were not included in this study, such as science and mathematics interests. While occupation descriptives were provided by each participant, asking if mathematics, science, or chemistry is part of their job, it does not take into account if they have other positive feelings or experiences with these areas; an occupation is not a full picture of a person's hobbies, interests, or passions.

The participant selection for this study may also change in future projects. While, the programs selected were relevant to our research goals, it is difficult to determine if we truly selected the most pertinent ones. For instance, the selections were made around an

initial interest in *Numb3rs*. It was from that program that we determined which programs would be similar in the criminal template and in presence of academic content in an effort to create testing groups. Only future studies will determine if this is the best possible method for selecting testable programs. Finally, in reference to the large numbers obtained, it may be possible that the indicated significant results are driven by the large number of participants obtained for this study. We could determine if this were true with a future study or perhaps a participant matched-based study.

Since participant locating is complicated, there are a few things learned from this study that may be helpful for those who attempt to replicate something similar. Popular conventions often mean numerous attendees. Thus, it seems like an ideal place to collect data for any study, as long as the study is relevant to the convention. The first thought that comes to mind when speaking of a comic book convention is not television. However, there are many shows that possess similar dramatic themes. Today, more program production teams and their actors attend these events to meet fans and promote their product. It makes sense to seek these types of venues, when there are no other "primetime television fan" conventions currently in existence. One of the many difficulties in obtaining a set of television fans for the purposes of study is locating them. This study sought out these fans in a novel setting, rather than using participants close at hand (i.e., the often over sampled undergraduate psychology class). Seeking out fans from another arena can offer surprises as well.

For those who attempt to conduct a similar television fan study, there are some interesting things to consider if one chooses to collect data in a convention setting (a) sell your "product"(b) be willing to participate in the culture (c) offer a seat. Attending a large

convention with thousands of attendees can be daunting, especially if you have limited funding. The goal of any booth at New York Comic Con is to introduce their unique style and story. They are there to present their media artifact in the hopes of acquiring new fans and maintaining interest for those who are already loyal followers. Flashy signs, costumes and free giveaways are just a few of the ways a media outlet attracts attendees. Since this study was academic in nature, data collectors were educated on the goals of the study, and talked with attendees about the novel theory that television could alter their cognition. Since this study was the first of its kind to obtain information from New York Comic Con fans, most who agreed to participate felt it was worthy of their time. Additionally, New York Comic Con has its own culture. If fans were entertained by the notion of someone studying television as it affects fans, they often persuaded their friends and family who were fans of these programs to file a survey as well.

Again, the culture is a factor when looking at fandom as reviewed by the literature and by attending an event of this size. As stated previously, many participants arrived donned in costumes of their favorite comic book characters. Many of these fans spend hours and dollars creating just the right outfit to simply walk around the venue. The more authentic or outrageous the garb, the more well received they are by other attendees. It seems for one weekend, these fans that go the extra mile are treated like celebrities. Other attendees want pictures and beg to hear how they pulled off such great outfits. One fan in particular created a gigantic Incredible Hulk costume. He had yards of green fabric wound to create larger than life muscles, accurate green make-up, torn purple shorts, and stilts to create a towering height effect. As he moved, slowly through the crowd, fans stopped to take his picture and applauded him for his efforts. As he passed by our booth,

a small elderly woman stopped by to inquire about our research study and this large man in green sulked down the hall. We came to find out, this woman was the hulk's grandmother. "I am so proud of him," she sighed. "He spent so much time getting ready for this day." While some may find this a strange way to spend their weekend, to these fans, it is not just a convention, but part of who they are as fans. In making an attempt to collect data from this type of setting, it is important to take it all in and go the extra mile of putting on an appropriate outfit.

The next point involves participant compensation versus offering a seat. Typically, in most psychological research, in order to attract participants, some sort of compensation is provided as a thank you for participation. This can be in the form of money, gift cards, or extra course credit. Due to the limited funding for this study, it was decided, with what little money was available, a free song download would be given as compensation. A gift card company was contacted and for a single dollar each, a plastic card with the study title was created. If the participant completed the study, they were provided with a gift card for one song. While this was minimal at best, it seemed to be the best way to give those who helped something for their time besides a thank you.

Due to development restrictions from the gift card company there was no feasible way to provide this compensation to online research participants. This most likely affected the online participation rate. At New York Comic Con the gift did seem to attract some attention. But there was something that was more attractive than the song downloads – having a place to sit! Since the survey took about 20 minutes to complete, it was decided early on that chairs and stools would be brought to the convention. Since a long table was provided by the New York Comic Con production team, placing a few

seats around provided ample room for participants to complete their survey. In fact, we had such high responses at times that people were willing to sit on the floor near our table. At a large area like the New York Javits Center, there are rarely seats provided to attendees, which makes sense, they want to keep the traffic moving. Yet, potential participants were so thankful to see a free seat and happened to be television fans; they gladly gave us their time and talked others into doing the same. In sum, there are several positives with using this type of sample and a few things to consider for future studies. While these pointers do help in data collection, overall, studies in any type television research are often complicated.

Studying how avid fans process information similar to the information characters of their favorite program process is a complex endeavor. One reason for this is that viewers watch these programs mainly for their entertainment value, not for the educational content. Thus, if there are any strides in acquiring information, they may not be cognizant of it even while sharing the week's dramatic conflicts with others in casual conversation. On the other hand, it is possible they are drawn to these programs for the specialized content as either an area of existing or potential interest. Whether its inclusion truly affects viewers as Johnson (2005) proclaims, is another topic for future research that was a question not resolved in this study. Additionally, avid fans may switch their interest and watch other programs during their favorite show's tenure. While most fans indicated they are fans of a single program out of those selected for this study, this does not mean they are not watching the other television programs studied here. Thus, it is difficult to proclaim a single television show caused any particular reaction it could be the case that avid fan identification could be the culprit rather than the program itself.

We plan to further develop and refine how fans extract information from those programs containing specialized content and describe the effects on their self-efficacy. It also would be beneficial to study the short-term effects of these programs with non-fans as well as taking a deeper look into the effects of a program's academic content on one's ability to extract information from text. For the latter, a more content-specific measure needs to be created. The two topics within the present survey were centered on ballistics and the second law of thermodynamics. Each contained similar sized descriptions and propositional content. Next time, episode-specific material will be selected in conjunction with viewing the program by those unfamiliar with a program's premise. This is not to negate the value of avid fan identification, but to determine gains by a more generalized population. Avid fan studies are also a future area of interest studied through academic motivation or self-efficacy as a method to increase confidence in other cognitive tasks. In addition, since participants did not watch television at the time of data collection and we did not record their history of television viewing (i.e. if they watched the program during its scheduled tenure or if they often watch reruns), we have no way of knowing if they accessed information from the distant past or closer to the time of this project.

Results from this research could initiate a number of future studies, including a study concerning the differences between avid and casual television fans. Similar to expert and novice problem solvers, avid television fans are perhaps better at matching schemas in predicting dramatic outcomes than casual viewers, another area for future research. Experts may tend to internalize their visual representations as well as devise steps in order to achieve a goal (Craik, 1943; Ohlsson, 1994; Sweller, 1988). For

example, it may take a novice longer to figure out why a particular character's actions will result in finding the perpetrator in a criminal drama, while an expert may take less time to predict the result. Likewise, expert viewers may categorize the information differently for future use or make connections to prior episodes by further understanding the webbed system they first sought for entertainment purposes. However, if fans could predict plot developments they may no longer tune in. Also, what is the benefit of "predicting" plot progressions? It may be that it is system processing skills that are applied to other areas of thought.

Additionally, this study sought fans of various backgrounds hoping to highlight the significance of the findings based on exposure to the program, rather than the background information avid fans possess. While 54% of participants had no mathematics, chemistry or science occupation related backgrounds, it is still unknown if their prior knowledge affected their feelings towards these subject areas rather than the shows themselves. While they indicated their current occupation and education, their interests outside of their respective occupations remain unclear. Again, a future study may be required in order to determine if those unfamiliar with these areas feel more positively after exposure to television programs with a specific academic focus.

It was hoped this study would indicate that television programs containing a specialized content would show a relationship to one's cognitive processing ability. However, the bigger question for the future is how this information can be used in a practical manner. It appears that avid viewers may not be aware of the fact that they are learning or having to challenge their thinking with more complicated programming. Most felt they did not understand the material, and posttest question comparisons from the law

of thermodynamics article showed there was no difference in extracting information from the text by all avid fans. This result could be different if casual fans were also studied. Thus, it is another area for future research.

This study serves as a first step in understanding how any viewer is affected by today's media. As program accessibly continues to increase in the digital world and production companies continue to hire content experts, fans will exercise their minds more so than fans of prior decades. This might lead to more successful presentation of academic information in these types of programs, thus further challenging the viewers to exercise their minds even more. We feel satisfaction in our ability to process information, especially, when a lead character becomes a hero and saves the day as a result of her knowledge. Most adult avid fans are not situated in an educational setting and thus the cognitive skills gained from the processing of this information can only be applied to one's day-to-day existence. If that can be entertaining, then television is not as inherently 'bad' as some believe. Perhaps we can support Johnson's (2005) notion that pop culture does make us smarter, as long as "smarter" is a feeling of confidence, rather than obtaining direct content knowledge.

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APPENDIX A:

Dissertation Instrument

TELEVISION SURVEY
2010

RESEARCHER USE ONLY

SUBJECT #: _____

DATE: _____

WELCOME, DEMOGRAPHIC INFORMATION SECTION

1. City: _____ **State**: _____ **Zip Code**: _____ **Country**: _____

2. Gender (Check One): ☐ Male ☐ Female

3. Age: _____ **Race:** _____

4. What is Your highest Level of Education?	**5. Regarding Your Occupation, Select All That Apply:**
☐ Doctorate ☐ Masters Degree ☐ Some Graduate School ☐ Bachelors Degree ☐ Some College ☐ High School ☐ Some High School ☐ N/A	☐ Occupation Involves Mathematics ☐ Occupation Involves Science ☐ Occupation Involves Chemistry ☐ None of the Above

6. Please describe your current occupation as it relates to question #5.

7. How often do you use the internet?

☐ Always
☐ Sometimes
☐ Never

TELEVISION FAN INQUIRY SECTION

1. Please indicate your MOST favorite television show. ONLY CHECK <u>ONE</u> PROGRAM.

☐ Any CSI Show
☐ Heroes
☐ Medium
☐ Law & Order
☐ Numb3rs
☐ Other: _____

2. For the program you indicated in Television Fan Inquiry question #1, do you consider yourself a loyal and/or devoted fan of your most favorite program?

☐ Yes, I am a loyal fan of the program I indicated.
☐ No, I am not a loyal fan of the program I indicated.
☐ I selected none of the above and did not indicate a program of choice in the "Other Television Program" space.

3. How do you view your favorite television program selected in Television Fan Inquiry question #1?

Please select all that apply	☐ TV	☐ Online	☐ DVD	☐ DVR Recording	☐ Other	☐ Did NOT indicate program in Question # 1.

4. Please rate your identity as a fan of your favorite program selected in Television Fan Inquiry question #1.

Choose One:	□ **Extreme**	□ **Moderate**	□ **Minor**	□ **Not a Fan of Any Program**

5. Are you a fan of any other program? Please select all that apply:

- ☐ Any CSI Show
- ☐ Heroes
- ☐ Medium
- ☐ Law & Order
- ☐ Numb3rs
- ☐ None of the Above
- ☐ Other: _____

6. Do you ever miss an episode of your program selected in Television Fan Inquiry question #1? (If you watch an episode outside its timeslot on DVR, DVD or online to catch up, please select: NO).

□ **Yes**	□ **No**	□ **Does Not Apply**

7. Do you talk to others about your favorite television program selected in Television Fan Inquiry question #1?

□ **Yes**	□ **No**	□ **Does Not Apply**

8. How does watching your favorite television program selected in Television Fan Inquiry question #1 affect your idea of what you want to be like (in other words, what you aspire or want to be)?

9. Is there a character in your favorite television program selected in Television Fan Inquiry question #1 you would want to be like (please include show and character name)? Why this character?

SCIENCE SECTION

1. **Please answer the following (in the rating section there are two levels of Poorly, Average, Well, and Very Well. Select the most appropriate level when answering the question):**

	Very poorly	Poorly		Average		Well		Very well	
1. To what extent can you explain chemical laws and theories?	1	2	3	4	5	6	7	8	9
2. How well can you choose an appropriate formula to solve a chemistry problem?	1	2	3	4	5	6	7	8	9
3. How well can you establish the relationship between chemistry and other sciences?	1	2	3	4	5	6	7	8	9
4. How well can you describe the structure of an atom?	1	2	3	4	5	6	7	8	9
5. How well can you work with chemicals?	1	2	3	4	5	6	7	8	9
6. How well can you describe the properties of elements by using periodic table?	1	2	3	4	5	6	7	8	9
7. How well can you read the formulas of elements and compounds?	1	2	3	4	5	6	7	8	9
8. To what extent can you propose solutions to everyday problems by using chemistry?	1	2	3	4	5	6	7	8	9
9. How well can you interpret chemical equations?	1	2	3	4	5	6	7	8	9
10. How well can you explain the particulate nature of matter?	1	2	3	4	5	6	7	8	9
11. How well can you construct laboratory apparatus?	1	2	3	4	5	6	7	8	9
12. To what extent can you explain everyday life by using chemical theories?	1	2	3	4	5	6	7	8	9
13. How well can you collect data during the chemistry laboratory?	1	2	3	4	5	6	7	8	9
14. How well can you interpret graphs/charts related to chemistry?	1	2	3	4	5	6	7	8	9
15. How well can you use the equipment in the chemistry laboratory?	1	2	3	4	5	6	7	8	9
16. How well can you understand the news/documentary you watched on television related to chemistry?	1	2	3	4	5	6	7	8	9
17. How well can you interpret data during the laboratory sessions?	1	2	3	4	5	6	7	8	9
18. How well can you write a laboratory report summarizing main findings?	1	2	3	4	5	6	7	8	9
19. How well can you solve chemistry problems?	1	2	3	4	5	6	7	8	9
20. How well can you carry out experimental procedures in the chemistry laboratory?	1	2	3	4	5	6	7	8	9
21. How well can you recognize the careers related to chemistry?	1	2	3	4	5	6	7	8	9

MATHEMATICS SECTION

1. Please Check the Appropriate Box as it Applies to You:	1 Definitely False	2 False	3 Mostly False	4 More False Than True	5 Mostly True	6 True	7 Definitely True
I find many mathematical problems interesting and challenging.							
I have hesitated to take courses that involve mathematics.							
I have generally done better in mathematics courses than other courses.							
Mathematics makes me feel inadequate.							
I am quite good at mathematics.							
I have trouble understanding anything that is based upon mathematics.							
I have always done well in mathematics classes.							
I never do well on tests that require mathematical reasoning.							
At school, my friends always came to me for help in mathematics.							
I have never been very excited about mathematics.							

PRIOR KNOWLEDGE SECTION

1. What do you KNOW about the Second Law of Thermodynamics?

2. How well do you feel you UNDERSTAND the Second Law of Thermodynamics?

- ☐ Very Well
- ☐ Well
- ☐ Average
- ☐ Not Well
- ☐ Not Well At All

3. What do you KNOW about Ballistics?

4. How well do you feel you UNDERSTAND Ballistics?

- ☐ Very Well
- ☐ Well
- ☐ Average
- ☐ Not Well
- ☐ Not Well At All

PLEASE READ THE ARTICLE AND ANSWER ALL QUESTIONS.

The Second Law of Thermodynamics is expressed mathematically as entropy (S). When a body absorbs an amount of heat (Q) from a reservoir at temperature (T), the body gains and the reservoir loses an amount of entropy S = Q/T. If an amount of heat Q flows from a hot to a cold body, the total entropy increases; because S = Q/T is larger for smaller values of T, the cold body gains more entropy a hot body loses. Originally defined in thermodynamics in terms of heat and temperature, entropy indicates the degree to which a given quantity of thermal energy is available for work, the greater the entropy, the less available the energy. Consider a system composed of a hot body and a cold body. This system is ordered because the faster, more energetic molecules of the hot body are separated from the less energetic molecules of the cold body. If the bodies are placed in contact, heat will flow from the hot body to the cold body. This heat flow can be utilized by a heat engine or a device converting thermal energy into mechanical energy (work). Once the two bodies have reached the same temperature, there is no more work. The combined lukewarm bodies cannot separate themselves into hot and cold parts to repeat the process. Although no energy has been lost by the heat transfer, the energy can no longer be used to do work. Thus, the entropy of the system has increased. In the second law of thermodynamics, during any process the change in entropy of a system and its surroundings is either zero or positive.

1. How well do you feel you understand the Second Law of Thermodynamics?

- ☐ Very Well
- ☐ Well
- ☐ Average
- ☐ Not Well
- ☐ Not Well At All

2. If the amount of Q heat flows from hot to cold, then the total entropy:

- ☐ Remains the Same
- ☐ Decreases
- ☐ Increase
- ☐ Disappears

3. What do you know now about the Second Law of Thermodynamics?

4. Thinking about your favorite program, what helped you to answer these questions? You can reference episodes, characters or plot sequences.

PLEASE READ THE ARTICLE AND ANSWER ALL QUESTIONS.

Ballistics is science of projectiles. Interior ballistics deals with the propulsion and the motion of a projectile within a gun or firing device. Its problems include the ignition and burning of the propellant powder, the pressure produced by the expanding gases, the movement of the projectile through the bore, and the designing of the barrel to resist resulting stresses and strains. Exterior ballistics is concerned with the motion of a projectile while in flight and includes the study not only of the flight path of bullets but also of bombs, rockets, and missiles. All projectiles traveling through the air are affected by wind, air resistance, and the force of gravity. These forces induce a curved path known as a trajectory. The trajectory varies with the weight and shape of the projectile, with its initial velocity, and with the angle at which it is fired. The general shape of a trajectory is that a conic section cut by a plane parallel to one of the elements of the cone also known as a parabola. The total distance traveled by a projectile is known as its range. A ballistic missile in the first stage of its flight is powered and guided by rocket engines. After the engines burn out, the warhead travels in a fixed arc as does an artillery shell. In firearms identification, the term ballistics is applied to the identification of the weapon from which a bullet was fired. Microscopic imperfections in a gun barrel make characteristic scratches and grooves on bullets fired through it, but use causes the marks a particular gun makes to change over time.

1. How well do you feel you understand Ballistics?

- ☐ Very Well
- ☐ Well
- ☐ Average
- ☐ Not Well
- ☐ Not Well At All

2. Which of the following DOES NOT affect traveling projectiles?

- ☐ Force of Gravity
- ☐ Bullet Composition
- ☐ Wind
- ☐ Air Resistance
- □ None of the Above
- □ All of the Above
- □ Not Sure

3. What do you know now about Ballistics?

4. Thinking about your favorite program, what helped you to answer these questions? You can reference episodes, characters or plot sequences.

If you have any questions about this study, please contact the survey researchers. Thank you!

APPENDIX B:

Second Law of Thermodynamics & Ballistics: Elements, Purposes and Mechanisms Target Lists

Table 1

Second Law of Thermodynamics Elements, Purposes and Mechanism Target List

Second Law of Thermodynamics Elements

Target List	**Target Item Notes**
Cold Body/Source	
Cool Air	
Earth/Nature /Universe/ World	
Energy/Thermal Energy/Mechanical Energy/Work	
Engine/Device	If the concept of a machine is mentioned, then assign a point.
Entropy (S)	
Equilibrium/Balance	If "equal temperatures" are mentioned, then assign a point. If "remains the same" is mentioned, then assign a point. If "room temperature" is mention as an indication of the equalization of temperature, then assign a point.
Flow/Transfer	
Heat (Q)/Hot Air	If the concept of warming or cooling is mentioned, then assign a point.
Hot Body/Source	
Molecule/Atom/Matter	
Reservoirs/Sources/Bodies=warm body/source, cold body/source	If "bodies/reservoirs" is mentioned, then assign a point for this general Element. If "bodies/reservoirs" and examples are mentioned, and examples are identified correctly, then assign a point for the general Element and a point for each example. If an example such as "hot body" is mentioned, but not the general Element "bodies/reservoir," then assign a point for the Element representing the example only.
System	
Temperature (T)	

Second Law of Thermodynamics Purposes

Target List	**Target Item Notes**
Body/Reservoir: The purpose of a body/reservoir is to absorb and store heat (Q) within a reservoir then providing temperature (T).	
Equilibrium: The purpose of equilibrium is to create a balance of heat between hot and cold bodies as it flows from hot to cold.	
Heat Energy/Thermal Energy/Work: The purpose of heat /thermal energy is that is can be utilized by an engine or device for mechanical energy (work).	

Second Law of Thermodynamics Mechanisms

Target List	Target Item Notes
Entropy (S): The mechanism of entropy formation results from the flow of heat from a hot body to a cold body. The system is ordered because energetic molecules from the hot body are separated from the less energetic molecules from the cold body. When this happens the total entropy increases.	
Equilibrium: The mechanism of equilibrium is created through a balance between the total amount of heat a hot body/reservoir uses and a cold body/reservoir gains. Once the two bodies have reached the same temperature (T), there is no more work (energy/mechanical energy).	To receive a point, the participant should indicate some interaction between heat from a hot body as it flows to cold beyond the Purpose defined for equilibrium.
Second Law of Thermodynamics: The mechanism of the second law of thermodynamics results from heat flowing from a hot body to a cold body. When this happens the total entropy increases. Entropy indicates the degree to which a given quality of energy is available for work. The greater the entropy the less energy. Once the two bodies have reached the same temperature, there is no more work.	

Table 2

Ballistics Elements, Purposes and Mechanisms Target List

Ballistics Elements

Target List	Target Item Notes
Air/Air Resistance	
Angle Fired	
Behavior/Projectile Behavior	
Composition/Bullet Composition	
Exterior Ballistics	
Factors Affect(ing) Projectile Travel = wind, air resistance, gravity, compositing	If “factors affect(ing) projectile travel” is mentioned, then assign a point for this general Element. If “factors affect(ing) projectile travel” and examples of factors are mentioned, and examples are identified correctly, then assign a point for the general Element and a point for each example. If an example such as “wind” is mentioned, but not the general Element “factors affect(ing) projectile travel,” then assign a point for the Element representing the example only.
Firing Device/Firearm/Gun	
Force/Propulsion	
Gas/Expanding Gas/Molecules	
Gravity/Gravitational	
Identify/Identification	
Ignition	
Interior Ballistics	

Marks/Stria/Micro Imperfections/Scratches/Grooves	
Mass/Weight	
Motion	
Parabola/Conic Section Cut by Plane/Arc	
Path/Flight Path/Trajectory	
Physics	
Projectile/Bullets/Rockets/Missiles/Ammunition	If "object" is mention in the context of something that travels along a trajectory, then assign a point**.**
Propellant Powder	
Range/Distant Traveled	
Rocket Engines	
Science	
Shot/Shooting	
Velocity/Initial Velocity/Speed/Acceleration	
Weapons Identification/Analysis/Criminal Analysis/ C***riminalistics/Forensic Science***	If "ballistics" is mentioned in the context of "forensic ballistics" which is used for the purposes of weapons identification, based on unique marks on a bullet after firing, then assign a point.
Wind	
Work or Mechanical Energy	

Ballistics Purposes

Target List	**Target Item Notes**
Air Resistance: The purpose of air resistance is that it affects all projectiles traveling thought the air.	
Angle of Fire: The purpose of angle of fire is that as it varies, it also varies the projectile trajectory/path.	
Ballistics: The purpose of ballistics is study the science behind the behavior or flight of projectiles.	
Firearms Identification: The purpose of weapons identification is to study of microscopic imperfections in a barrel that create scratches and groves on bullets over time in order to identify the weapon used to file said bullet.	
Gravity: The purpose of wind is that it affects all projectiles traveling thought the air.	
Initial Velocity: The purpose of projectile initial velocity is that as it varies, it also varies the projectile trajectory/path.	
Interior Ballistics vs. Exterior: The purpose of Interior Ballistics is to deal with the propulsion and motion of a projectile within a gun/firing device. The purpose of Exterior Ballistics is concerned with the motion of a projectile while in flight and includes not only bullets, but bombs, rockets, and missiles.	

Rocket Engines: The purpose of rocket engines is to power and guide a projectile in flight. After the engines burn out, it travels in a fixed arc.	
Weight/Shape: The purpose of projectile weight is that as it varies, it also varies the projectile trajectory/path.	
Wind: The purpose of wind is that it affects all projectiles traveling thought the air.	

Ballistics Mechanisms

Target List	**Target Item Notes**
Ballistics: The mechanism of ballistics is to deal with the propulsion and motion of a projectile within a gun/firing device. The purpose of Exterior Ballistics is concerned with the motion of a projectile while in flight and includes not only bullets, but bombs, rockets, and missiles. The purpose of Interior Ballistics is to deal with the propulsion and motion of a projectile within a gun/firing device. All projectiles are affected by wind, air resistance, gravity and projectile composition. Different from firearms identification.	
Trajectory: The mechanism of trajectory is that that all are affected by wind, air resistance and force of gravity. The curved path is called the trajectory. A trajectory varies with the weight and shape of projectiles, its initial velocity and the angle fired. The general shape of a trajectory is a conic section cut by a plane parallel to one of the elements of the cone, also known as a parabola.	

APPENDIX C:

Non-Significant Results: Additional Data Tables

Hypothesis 1. Numb3rs and CSI avid fans would indicate episode and character references affecting their self-concept more so than Law & Order, Heroes and "Other" program avid fans.

GENERAL TELEVISION PROGRAM CAREER SIMILARITIES

Table 1a

Percentages of Avid Television Fan Groups and Overall General Program Career Similarities

General Career Similarities	All CSIs	All Law & Orders	Numb3rs	Heroes	Any Other Program	Total
No	44	47	88	39	157	375
Yes	3	4	13	2	6	28
						403
% "Yes" Per Program	6.38	7.84	12.87	4.88	3.68	
% "Yes" Total Sample	0.74	0.99	3.22	0.49	1.49	6.93

Table 1b

Percentages of Avid Television Fan Groups and General Program Career Similarities (New York Comic Con Sample)

General Career Similarities	All CSIs	All Law & Orders	Numb3rs	Heroes	Any Other Program	Total
No	26	39	5	36	131	237
Yes	2	4	0	2	4	12
						249
% "Yes" Per Program	7.14	9.30	0	5.26	2.96	
% "Yes" Total Sample	0.80	1.60	0	0.80	1.61	4.82

Table 1c

Percentages of Avid Television Fan Groups and General Program Career Similarities (Online Sample)

General Career Similarities	All CSIs	All Law & Orders	Numb3rs	Heroes	Any Other Program	Total
No	18	8	83	3	26	138
Yes	1	0	13	0	2	16
						154
% "Yes" Per Program	5.26	0	13.54	0	7.14	
% "Yes" Total Sample	0.65	0	8.44	0	1.30	10.39

GENERAL TELEVISION PROGRAM SELF SIMILARITIES

Table 2a

Percentages of Avid Television Fan Groups and Overall General Program Self Similarities

General Self Similarities	All CSIs	All Law & Orders	Numb3rs	Heroes	Any Other Program	Total
No	38	43	75	33	127	316
Yes	9	8	26	8	36	87
						403
% "Yes" Per Program	19.15	15.69	25.74	19.51	22.09	
% "Yes" Total Sample	2.23	1.99	6.45	1.99	8.93	21.59

Table 2b

Percentages of Avid Television Fan Groups and General Program Self Similarities (New York Comic Con Sample)

General Career Similarities	All CSIs	All Law & Orders	Numb3rs	Heroes	Any Other Program	Total
No	24	37	4	32	105	202
Yes	4	6	1	6	30	47
						249
% "Yes" Per Program	14.29	13.95	26.04	66.66	22.22	
% "Yes" Total Sample	1.61	2.42	0.40	2.41	12.05	18.88

Table 2c

Percentages of Avid Television Fan Groups and General Program Self Similarities (Online Sample)

General Career Similarities	All CSIs	All Law & Orders	Numb3rs	Heroes	Any Other Program	Total
No	14	6	71	1	22	114
Yes	5	2	25	2	6	40
						154
% "Yes" Per Program	26.32	25.00	26.04	66.66	21.43	
% "Yes" Total Sample	3.25	1.30	16.23	1.30	3.90	25.97

GENERAL TELEVISION PROGRAM ROLE MODEL OR ASPIRATIONS

Table 3a

Percentages of Avid Television Fan Groups and Overall General Program Role Model/Aspirations

General Aspirations	All CSIs	All Law & Orders	Numb3rs	Heroes	Any Other Program	Total
No	31	29	61	26	100	247
Yes	16	22	40	15	63	156
						403
% "Yes" Per Program	34.04	43.14	39.60	36.58	38.65	
% "Yes" Total Sample	3.97	5.45	9.93	3.72	15.63	38.70

Table 3b

Percentages of Avid Television Fan Groups and General Program Role Model/Aspirations (New York Comic Con Sample)

General Aspirations	All CSIs	All Law & Orders	Numb3rs	Heroes	Any Other Program	Total
No	17	22	2	24	80	145
Yes	11	21	3	14	55	104
						249
% "Yes" Per Program	39.29	48.84	38.54	36.84	40.74	
% "Yes" Total Sample	4.42	8.43	1.20	5.62	22.09	41.77

Table 3c

Percentages of Avid Television Fan Groups and General Program Role Model/Aspirations (Online Sample)

General Aspirations	All CSIs	All Law & Orders	Numb3rs	Heroes	Any Other Program	Total
No	14	7	59	2	20	102
Yes	5	1	37	1	8	52
						154
% "Yes" Per Program	26.32	12.50	38.54	33.33	28.57	
% "Yes" Total Sample	3.25	0.65	24.03	0.65	5.20	33.77

SPECIFIC CHARACTER CAREER SIMILARITIES

Table 4a

Percentages of Avid Television Fan Groups and Program Career Similarities for Specific Character(s)

Character Career Similarities	All CSIs	All Law & Orders	Numb3rs	Heroes	Any Other Program	Total
No	47	51	99	41	161	399
Yes	0	0	2	0	2	4
						403
% "Yes" Per Program	0	0	1.98	0	1.23	
% "Yes" Total Sample	0	0	0.50	0	0.65	0.99

Table 4b

Percentages of Avid Television Fan Groups and Program Career Similarities for Specific Character(s) (New York Comic Con Sample)

Character Career Similarities	All CSIs	All Law & Orders	Numb3rs	Heroes	Any Other Program	Total
No	28	43	5	38	134	248
Yes	0	0	0	0	1	1
						249
% "Yes" Per Program	0	0	0	0	0.74	
% "Yes" Total Sample	0	0	0	0	0.40	0.40

Table 4c

Percentages of Avid Television Fan Groups and Program Career Similarities for Specific Character(s) (Online Sample)

Character Career Similarities	All CSIs	All Law & Orders	Numb3rs	Heroes	Any Other Program	Total
No	19	8	94	3	27	151
Yes	0	0	2	0	1	3
						154
% "Yes" Per Program	0	0	2.08	0	3.64	
% "Yes" Total Sample	0	0	1.30	0	0.65	1.95

SPECIFIC CHARACTER SELF-SIMILARITIES

Table 5a

Percentages of Avid Television Fan Groups and Program Self Similarities for Specific Character(s)

Self-Similarities	All CSIs	All Law & Orders	Numb3rs	Heroes	Any Other Program	Total
No	46	50	95	40	150	381
Yes	1	1	6	1	13	22
						403
% "Yes" Per Program	2.12	1.96	5.94	2.44	7.93	
% "Yes" Total Sample	0.25	0.25	1.49	0.25	3.23	5.46

Table 5b

Percentages of Avid Television Fan Groups and Program Self Similarities (New York Comic Con Sample)

Self-Similarities	All CSIs	All Law & Orders	Numb3rs	Heroes	Any Other Program	Total
No	27	42	5	37	124	235
Yes	1	1	0	1	11	14
						249
% "Yes" Per Program	3.57	2.32	0	2.63	8.15	
% "Yes" Total Sample	0.40	0.40	0	0.40	4.41	5.61

Table 5c

Percentages of Avid Television Fan Groups and Program Self Similarities (Online Sample)

Self-Similarities	All CSIs	All Law & Orders	Numb3rs	Heroes	Any Other Program	Total
No	19	8	90	3	26	146
Yes	0	0	6	0	2	8
						154
% "Yes" Per Program	0	0	6.25	0	7.14	
% "Yes" Total Sample	0	0	3.90	0	1.30	5.19

Hypothesis 5: *Numb3rs* and *CSI* avid fans will note more program references as helpful to processing academic material than *Law & Order, Heroes* and any program avid fans.

TELEVISION ASSISTANCE SECOND LAW OF THERMODYNAMICS *SPECIFIC CHARACTER REFERENCES*

Table 6a

Percentages of Avid Television Fan Groups and Television Assistance in Processing Second Law of Thermodynamics Text with Specific Character References

Second Law Specific Character References	All CSIs	All Law & Orders	Numb3rs	Heroes	Any Other Program	Total
No	47	51	97	41	161	397
Yes	0	0	4	0	2	6
						403
% "Yes" Per Program	0	0	3.96	0	1.23	
% "Yes" Total Sample	0	0	0.99	0	0.49	1.49

Table 6b

Percentages of Avid Television Fan Groups and Television Assistance in Processing Second Law of Thermodynamic Text with Specific Character References (Comic Con Sample)

Second Law Specific Character References	All CSIs	All Law & Orders	Numb3rs	Heroes	Any Other Program	Total
No	28	43	5	38	133	247
Yes	0	0	0	0	2	2
						249
% "Yes" Per Program	0	0	0	0	1.48	
% "Yes" Total Sample	0	0	0	0	0.80	0.80

Table 6c

Percentages of Avid Television Fan Groups and Television Assistance in Processing Second Law of Thermodynamic Text with Specific Character References (Online Sample)

Second Law Specific Character References	All CSIs	All Law & Orders	Numb3rs	Heroes	Any Other Program	Total
No	19	8	92	3	28	150
Yes	0	0	4	0	0	4
						154
% "Yes" Per Program	0	0	4.17	0	0	
% "Yes" Total Sample	0	0	2.60	0	0	2.60

TELEVISION ASSISTANCE SECOND LAW OF THERMODYNAMICS
SPECIFIC EPISODE REFERENCES

Table 7a

Percentages of Avid Television Fan Groups and Television Assistance in Processing Second Law of Thermodynamics Text with Specific Episode References

Second Law Specific Episode References	All CSIs	All Law & Orders	Numb3rs	Heroes	Any Other Program	Total
No	47	51	94	41	157	390
Yes	0	0	7	0	6	13
						403
% "Yes" Per Program	0	0	6.93	0	3.68	
% "Yes" Total Sample	0	0	1.74	0	1.49	3.23

Table 7b

Percentages of Avid Television Fan Groups and Television Assistance in Processing The Second Law of Thermodynamics Text with Specific Episode References (Comic Con Sample)

Second Law Specific Episode References	All CSIs	All Law & Orders	Numb3rs	Heroes	Any Other Program	Total
No	28	43	5	38	130	244
Yes	0	0	0	0	5	5
						249
% "Yes" Per Program	0	0	0	0	3.70	
% "Yes" Total Sample	0	0	0	0	2.00	2.00

Table 7c

Percentages of Avid Television Fan Groups and Television Assistance in Processing The Second Law of Thermodynamics Text with Specific Episode References (Online Sample)

Second Law Specific Episode References	All CSIs	All Law & Orders	Numb3rs	Heroes	Any Other Program	Total
No	19	8	89	3	27	146
Yes	0	0	7	0	1	8
						154
% "Yes" Per Program	0	0	7.29	0	3.57	
% "Yes" Total Sample	0	0	4.55	0	0.65	5.19

TELEVISION ASSISTANCE SECOND LAW OF THERMODYNAMICS
GENERAL PROGRAM REFERENCES

Table 8a

Percentages of Avid Television Fan Groups and Television Assistance in Processing Second Law of Thermodynamics Text with General Program References

Second Law General Program References	All CSIs	All Law & Orders	Numb3rs	Heroes	Any Other Program	Total
No	37	46	87	37	156	363
Yes	10	5	14	4	7	40
						403
% "Yes" Per Program	21.28	9.80	13.86	9.76	4.29	
% "Yes" Total Sample	2.48	1.24	3.47	0.99	1.74	9.92

Table 8b

Percentages of Avid Television Fan Groups and Television Assistance in Processing The Second Law of Thermodynamics Text with General Program References (Comic Con Sample)

Ballistics General Program References	All CSIs	All Law & Orders	Numb3rs	Heroes	Any Other Program	Total
No	25	38	3	35	130	231
Yes	3	5	2	3	5	18
						249
% "Yes" Per Program	10.71	11.62	40.00	7.89	3.70	
% "Yes" Total Sample	1.20	2.00	0.80	1.20	2.00	7.23

Table 8c

Percentages of Avid Television Fan Groups and Television Assistance in Processing The Second Law of Thermodynamics Text with General Program References (Online Sample)

Ballistics General Program References	All CSIs	All Law & Orders	Numb3rs	Heroes	Any Other Program	Total
No	12	8	84	2	26	132
Yes	7	0	12	1	2	22
						154
% "Yes" Per Program	36.84	0	12.50	33.33	7.14	
% "Yes" Total Sample	4.55	0	7.80	0.65	1.30	14.29

TELEVISION ASSISTANCE SECOND LAW OF THERMODYNAMICS
GENERAL CHARACTER REFERENCES

Table 9a

Percentages of Avid Television Fan Groups and Television Assistance in Processing Second Law of Thermodynamics Text with General Character References

Second Law General Character References	All CSIs	All Law & Orders	Numb3rs	Heroes	Any Other Program	Total
No	46	50	93	36	154	379
Yes	1	1	8	5	9	24
						403
% "Yes" Per Program	2.13	1.96	7.92	12.20	5.52	
% "Yes" Total Sample	0.25	0.25	1.98	1.24	2.23	5.95

Table 9b

Percentages of Avid Television Fan Groups and Television Assistance in Processing Second Law of Thermodynamics Text with General Character References (Comic Con Sample)

Second Law General Character References	All CSIs	All Law & Orders	Numb3rs	Heroes	Any Other Program	Total
No	28	42	5	33	128	236
Yes	0	1	0	5	7	13
						249
% "Yes" Per Program	0	2.33	0	13.15	5.19	
% "Yes" Total Sample	0	0.40	0	2.01	2.81	5.22

Table 9c

Percentages of Avid Television Fan Groups and Television Assistance in Processing Second Law of Thermodynamics Text with General Character References (Online Sample)

Second Law General Character References	All CSIs	All Law & Orders	Numb3rs	Heroes	Any Other Program	Total
No	18	8	88	3	26	143
Yes	1	0	8	0	2	11
						154
% "Yes" Per Program	5.26	0	8.33	0	7.14	
% "Yes" Total Sample	0.65	0	5.20	0	1.30	7.14

TELEVISION ASSISTANCE BALLSTICS
SPECIFIC CHARACTER REFERENCES

Table 10a

Percentages of Avid Television Fan Groups and Television Assistance in Processing Ballistics Text with Specific Character References

Ballistics Specific Character References	All CSIs	All Law & Orders	Numb3rs	Heroes	Any Other Program	Total
No	45	51	98	41	161	396
Yes	2	0	3	0	2	7
						403
% "Yes" Per Program	4.26	0	2.97	0	1.23	
% "Yes" Total Sample	0.50	0	0.74	0	0.50	1.74

Table 10b

Percentages of Avid Television Fan Groups and Television Assistance in Processing Ballistics Text with Specific Character References (Comic Con Sample)

Ballistics Specific Character References	All CSIs	All Law & Orders	Numb3rs	Heroes	Any Other Program	Total
No	28	43	5	38	134	248
Yes	0	0	0	0	1	1
						249
% "Yes" Per Program	0	0	0	0	0.74	
% "Yes" Total Sample	0	0	0	0	0.40	0.40

Table 10c

Percentages of Avid Television Fan Groups and Television Assistance in Processing Ballistics Text with Specific Character References (Online Sample)

Ballistics Specific Character References	All CSIs	All Law & Orders	Numb3rs	Heroes	Any Other Program	Total
No	17	8	93	3	27	148
Yes	2	0	3	0	1	6
						154
% "Yes" Per Program	10.53	0	3.13	0	3.57	
% "Yes" Total Sample	1.23	0	1.95	0	0.65	3.89

TELEVISION ASSISTANCE BALLSTICS
SPECIFIC EPISODE REFERENCES

Table 11a

Percentages of Avid Television Fan Groups and Television Assistance in Processing Ballistics Text with Specific Episode References

Ballistics Specific Episode References	All CSIs	All Law & Orders	Numb3rs	Heroes	Any Other Program	Total
No	43	48	88	40	160	379
Yes	4	3	13	1	3	24
						403
% "Yes" Per Program	8.51	5.88	12.87	2.44	1.84	
% "Yes" Total Sample	0.99	0.74	3.23	0.25	0.74	5.95

Table 11b

Percentages of Avid Television Fan Groups and Television Assistance in Processing Ballistics Text with Specific Episode References (Comic Con Sample)

Ballistics Specific Episode References	All CSIs	All Law & Orders	Numb3rs	Heroes	Any Other Program	Total
No	27	40	5	37	133	242
Yes	1	3	0	1	2	7
						249
% "Yes" Per Program	3.57	6.98	0	2.63	1.48	
% "Yes" Total Sample	0.40	1.20	0	0.40	0.80	2.81

Table 11c

Percentages of Avid Television Fan Groups and Television Assistance in Processing Ballistics Text with Specific Episode References (Online Sample)

Ballistics Specific Episode References	All CSIs	All Law & Orders	Numb3rs	Heroes	Any Other Program	Total
No	16	8	83	3	27	137
Yes	3	0	13	0	1	17
						154
% "Yes" Per Program	15.79	0	13.54	0	3.57	
% "Yes" Total Sample	1.95	0	8.44	0	0.65	11.04

TELEVISION ASSISTANCE BALLSTICS
GENERAL CHARACTER REFERENCES

Table 12a

Percentages of Avid Television Fan Groups and Television Assistance in Processing Ballistics Text with General Character References

Ballistics General Character References	All CSIs	All Law & Orders	Numb3rs	Heroes	Any Other Program	Total
No	44	51	96	39	160	390
Yes	3	0	5	2	3	13
						403
% "Yes" Per Program	6.38	0	4.95	4.88	1.84	
% "Yes" Total Sample	0.74	0	1.24	0.50	0.74	3.22

Table 12b

Percentages of Avid Television Fan Groups and Television Assistance in Processing Ballistics Text with General Character References (Comic Con Sample)

Ballistics General Character References	All CSIs	All Law & Orders	Numb3rs	Heroes	Any Other Program	Total
No	26	43	5	36	133	243
Yes	2	0	0	2	2	6
						249
% "Yes" Per Program	7.14	0	0	5.26	1.48	
% "Yes" Total Sample	0.80	0	0	0.80	0.80	2.40

Table 12c

Percentages of Avid Television Fan Groups and Television Assistance in Processing Ballistics Text with General Character References (Online Sample)

Ballistics General Character References	All CSIs	All Law & Orders	Numb3rs	Heroes	Any Other Program	Total
No	18	8	91	3	27	147
Yes	1	0	5	0	1	7
						154
% "Yes" Per Program	5.26	0	5.21	0	3.57	
% "Yes" Total Sample	0.65	0	3.25	0	0.65	4.55

APPENDIX D:

Breakdown of Any Other Television Program Group

Table 13

Breakdown of Any Other Television Program Group

Television Program	n
24	1
American Dad	1
Anime	3
Anime Shaffle!	2
Avatar	1
Battlestar Galactica	2
Big Bang Theory	5
Boardwalk Empire	1
Bones	7
Breaking Bad	1
Buffy the Vampire Slayer	3
Burn Notice	2
Castle	2
Chuck	3
Colbert Report	1
Covert Affairs	1
The Late Late Show with Craig Ferguson	1
Criminal Minds	4
The Daily Show with John Stewart	4
Dancing with the Stars	1
Deadliest Catch	1
Desperate Housewives	1
Destination Truth	1
Dexter	4
Doctor Who	13
Entourage	2
Eureka	2
Family Guy	2
Forensic Files on truTV	1
Fringe	7
Glee	2
The Good Wife	1
Grey's Anatomy	1
House	6
Life Unexpected	1
Leverage	1
Lost	8
Mad Men	6
Medium	12
The Mentalist	1
Merlin	1
Modern Family	1
Monk	1

Television Program	n
MST3K	1
Naruto	1
NCIS	3
The Office	2
Parenthood	1
The Prisoner	1
Project Runway	1
Psych	1
Rubicon	1
Samurai Jack	1
The Sopranos	1
The Simpsons	1
Smallville	2
Sons of Anarchy	1
South Park	1
Stargate Atlantis	1
Supernatural	6
The Today Show	1
The Vampire Diaries	1
The Wire	1
The World's Dumbest on truTV	1
True Blood	4
Veronica Mars	1
West Wing	2
White Collar	1
Wipeout	1
Without A Trace	1
Xena: Warrior Princess	1
Total	163