STEM-Positive Movies: A Case Study on Film as a Beneficial STEM Influencer For Career Interests of Adolescents

AP Research

April 18, 2017

Word Count: 4925

Abstract

Society delineates film as a prominent pastime, as 69 percent of North America saw a movie at a movie theater at least once in 2015 (Motion Picture Association of America, 2016). Online film retrieval is popular too, with Netflix reaching 49.4 million subscribers and HBO reaching 49 million subscribers in the United States (Statistica, 2016). Through its popularity and easy accessibility, film has the capability of influencing a multiplicity of people. To utilize film's influence, research explores film as an advocator of Science, Technology, Engineering, and Mathematics (STEM) careers. I argue that film has the potential to progressively advocate STEM importance if it portrays STEM positively. This paper moreover examines how personal experiences and physical traits of the participants involved affect opinions on STEM and career decisions. The study's conclusion has implications for expanding STEM interests, evoking the awareness of the advantages of STEM fields.

1. Introduction

STEM-positivity is a concept in films that showcases the benefits of being in a STEM field. Currently, the majority of movies involving STEM aspects are not STEM-positive. Movies involving STEM aspects tend to exemplify detrimental depictions of STEM through their representation of STEM characters and STEM environments. Fields that moviemakers do not present as disapproving include social, environmental and evolutionary sciences, such as psychology, archeology, and botany (Chen & Simpson, 2015). Moviemakers do not cause negative impact on these fields, so analysis focuses on impacts regarding other STEM fields.

Past movies assist in the expansion of the stereotypes of STEM professionals. Weingart, former director of the Center for Interdisciplinary Research, Bielefeld, and associates Muhl and Pansegrau (2003), contended through research that the most prevalent stereotype of the "mad scientist" derives from the production of James Whale's adaptation of *Frankenstein* by Mary Shelley (Laemmle & Whale, 1931). The "mad scientist" ideology represents the destructive power of advanced technology from the industrial revolution age. Imitations of this prototype involve the same characteristics as Dr. Frankenstein, a middle-aged Caucasian male genius with socially awkward or harmful tendencies. This stereotype causes a negative image of STEM professionals and limits the notion that people with different traits can participate in STEM careers.

Imitations fail to provide realistic work efforts of STEM professionals, and cause viewers to perceive going into STEM fields as harmful and unachievable. Direct imitations of the "mad scientist" stereotype include surgeon Dr. Josef Heiter from *Human Centipede* (Six &

Six, & Six, 2009), genetic biologist Dr. Curt Connors *The Amazing-Spiderman* (Arad, Tolmach, & Ziskin, & Webb, 2012), and neorologist Dr. Dean Armitage from *Get Out* (Peele, Blum, McKittrick, & Hamm, & Peele, 2017). These characters show unethical interests in human modification and villainous qualities, as well as the "mad scientist" physical traits.

Moviemakers add in the "mad scientist" character to create the story's conflict and antagonist. This concept is seen in modern interpretations of the "mad scientist" trope. Modern films' release dates range from during late twentieth century to the twenty-first century. Modern interpretations of the "mad scientist" include characters with unethical interests in technological and engineering fields. Mechanical engineer Dr. Evil from *Austin Powers*: *International Man of Mystery* (Moore, Myers, Todd, & Todd, & Roach, 1997), biochemist and nanotechnology engineer Dr. Pym from *Ant Man* (Feige & Park, & Reed, 2015), and computer scientist Dr. Castor from *Transcendence* (Kosove et al., & Pfister, 2014) are examples of these interpretations, as these characters take part in the indicated fields of technology to fulfill their abusive desires for power. All characters showcase the physical traits of the "mad scientist" stereotype.

Modern interpretations particularly disservice a significant portion of the STEM community, as technological and math fields make up 46 percent of STEM employment but have little involvement from diverse groups of people (Langdon, Mckittrick, Beede, Khan, & Doms, 2011). The need for society to fill STEM careers to advance technological achievement is high, however. The President's Council of Advisors on Science and Technology (PCAST) stated that the success of the United States in the global marketplace relies on a STEM-educated populace (PCAST, 2012).

STEM fields are rewarding to STEM employees, as well, since they provide job opportunities and high income levels. The U.S. Bureau of Labor Statistics expected STEM occupations to have the largest growth rate of 18.7 percent, in comparison to the 14.3 percent growth rate of all occupations from 2010 to 2020 (Vilorio, 2014). 93 percent of these occupations had wages above the national average wage of $48,320 (Fayer, Lacey, & Watson, 2017).

59 percent of this growth rate in STEM careers comes from jobs in technological and mathematical fields. Expanding in other fields as well, technology and mathematics occupations are present in other fields, making up 33 percent to 67 percent of employment in numerous industries (Fayer, Lacey, & Watson, 2017).

Areas of Focus: Women and People of Color (POC) in STEM

The "mad scientist" stereotype's physical traits are similar to many real-life scientists. When reviewing scientists' traits, physicist Dr. Perowitz (2013) found that scientists tended to fit the "mad scientist" description, minus factors of unethicality and geniousity. The lack of representation of females and POC in STEM also matches the lack of the representation of female and POC in STEM shown in movies (Szelényi, Denson, & Inkelas, 2013).

To express the relations between categories, analysis consists of the causes and effects of overall STEM influences, including extrinsic and intrinsic factors for these groups. Women have a distinctive relationship with STEM fields. Although women are as active in biology, social sciences, and life sciences as men, they make up 25 percent of computer science and mathematic fields, and 15 percent of engineering fields (STEMconnector & My College Options, 2013).

Minority women make up less than 10 percent of these fields (Educational Research Center of America, 2016).

Likewise, minority groups are less present in STEM fields compared to Caucasians, who show the majority of application in STEM (U. S. News Staff/Raytheon STEM Index, 2015). Black, Hispanic, and American Indian students are behind Caucasian students in the number of STEM degrees, granted and exam scores in STEM fields (U. S. News Staff/Raytheon STEM Index, 2015).

Students are more likely to go into STEM fields if they had strong confidence in mathematics and alternate STEM areas (Moakler & Kim, 2014). Women overall show less confidence in STEM fields. Men and women, however, do not considerably differ in levels of skill in STEM academics (National Science Board, 2016). After graduating high school, women have equivalent preparation for a science career as men in the United States (Legewie & Diprete, 2014). Black, Hispanic, and American Indian students presented less confidence in STEM fields compared to Caucasian and Asian students (U. S. News Staff/Raytheon STEM Index, 2015). Meaning, education standards are not a conflict for either type of student wanting to pursue STEM fields after high school.

Conflict sources from the lack of role models. Increasing confidence in women implies creating encouraging role models for women (Moakler & Kim, 2014). STEM influencers therefore should involve relatability. Currently, the "mad scientist" ideology does not include diverse groups of people, creating a lack of representation. In order for STEM in the United States to excel, methods of reaching out to these diverse groups of people and presenting relatable role models must exist.

Current STEM-Positive Movies

The significance of having a STEM-positive film is for the viewers to associate STEM with enjoyable messages. A movie must possess distinct factors to qualify as an effective STEM-positive movie for multiple groups of people. The factors of these implications are relating to viewers in terms of racial diversity and gender.

These films offer Parental Guidance and Parental Guidance-13 ratings to ensure that adolescents and other deciding career interests have attainable access to viewing these films. These films come from notable mass media companies, including The Walt Disney Company and Twentieth Century Fox Film Corporation, to ensure that a large amount of viewers were able to see these films.

Several elements prompt increased effectiveness of STEM positivity. Elements of relatability and emotional appeal towards film indicate the level of effectiveness (Stengler, 2014). These elements connect to the main characters applying positive attitudes and purposeful reasoning towards their work in STEM fields. Positive attitudes are significant in influence, as they create emotional interest. Other elements presented include portrayals of ethical practices, morally good STEM characters showcasing problem-solving skills, friendly relationships between STEM workers, and safe and likeable STEM environments. These elements incline viewers to perceive STEM in a relatable manner. STEM environments defines as the physical setting of the characters. All films mentioned exhibit these elements.

Hidden Figures (Chernin, Gigliotti, Melfi, Topping & Williams, & Melfi, 2016) is a drama/history film founded on real events. The three main characters, based on former NASA employees Dorothy Vaughan, Mary Jackson, and Katherine Johnson, exhibit accomplishments in

aerospace engineering, mathematics, and physics. These characters prove their interest in STEM and exhibit STEM-positive attitudes throughout the movie. The movie meets introduced standards of being relevant to underrepresented groups by showing beneficial STEM representation for Black females. In terms of being ineffective in showing STEM-positivity, the movie portrays unfriendly situations for the protagonists in terms of the racial issues present during the movie's indicated time period. However, these protagonists overcome these issues, establishing a later safer setting.

Several fantasy and science fiction movies meet the requirements of STEM-positivity. Fantasy and science fiction movie *The Martian* (Huffman, Kinberg, Scott, Schaefer, & Sood, & Scott, 2015) delineates characters as successful employees at NASA. Characters exhibit strong work ethics and morally good behaviors when helping the main character, an astronaut stuck on Mars. Teamwork remains as a fundamental theme in the movie's storyline, reducing the stereotype of the socially-isolated "mad scientist" from STEM professionals.

Movies that describe a trial-and-error process help to disassociate stereotypes of STEM professionals as geniuses. In turn, viewers are able to find studying in STEM fields as more achievable. Fantasy movies *Meet the Robinsons* (McKim & Anderson, 2007) and *Tomorrowland* (Bird, Chernov, & Lindelof, & Bird, 2015) characterize protagonists with determination to pursue their scientific interests, despite having difficulty in overcoming obstacles. This element of hard-working and motivated characters inform viewers on the theme of being able to overcome conflicts, as suggested by California Lutheran University STEM professors Dr. Hoffmann and Dr. Gagliardo (personal communication, 2016).

Meet the Robinsons (McKim & Anderson, 2007) and *Tomorrowland* (Bird, Chernov, & Lindelof, & Bird, 2015) further qualify for components of effective STEM-positive movies due to the films' inclusions of men and women in various science fields including engineering and aeronautics. However, these movies center on White main characters and shortfall in representing POC.

Literary Review

The relationship between STEM-positive films and how viewers connect the clips' with reality is substantial to this research. As a result, analysis focuses on how researchers connect film strategies with current speculations and data relating to various groups. Scholarly research divides into three areas pertaining to the perspectives involved in the study: film influence, the current STEM environment, and psychological evaluation linked with career interests.

Results of Film Influences

Research relates STEM-positive movies with participant-answered surveys (See Methods), so it is necessary to emphasize the significance of surveys and survey formats containing film influences. Research found does not reveal understanding in STEM-positive film influence, causing a gap in this field of knowledge.

The first two reviews are experimental studies on film influences that impact adolescents, in relation to high school students being the focus of the design (See Participants). All studies define film as an influencer, proving that this study has plausibility. In research conducted by medical professionals Sargent et al. (2001), the outcome justified that the portrayal of cigarettes as desirable in films changed the mindset of adolescents. After watching films featuring cigarette usage, adolescents configured that using cigarettes was more of a social norm

afterwards, compared to before the viewing. In a similar study from researchers associated with the Radboud University Behavioural Science Institute, results indicated that films that promoted alcohol consumption directly contributed to young adults drinking more alcohol (Koordeman, Anschutz, van Baaren & Engels, 2010). This study resembles the format of the past mentioned analysis, as both showed film as a direct influencer. To conduct research, survey forms were utilized.

The last review focuses on film advocating concepts rather than concrete items, in relation to STEM-positivity being a concept. A Social Science Quarterly meta-analysis study and survey resulted in viewers changing their political views on topics pertaining to the political movies' topics (Adkins & Castle, 2013).

Career Personality Test

The design of this study aims at finding STEM interest indicators. As movies cannot interfere with participants' past interests, experience, and talents, personality tests are applicable more so than aptitude tests at revealing indicators. This study centers on personality in connection with vocational choices rather than on emotion expression. The career personality test design most applicable for this connection is Holland's theory of six personality types (1959): Realistic, Investigative, Artistic, Social, Enterprising, and Conventional (RIASEC). Holland's theory associates vocations that match the given personalities. The order in which participants rank the types reveals their career personality. The first letter is the most present personality type and the last letter is the least present personality type. In finding changes in RIASEC personality results, multiple tests are conducted. Participants that affirm an Investigative personality are the most likely to go into a STEM career (Chen & Simpson, 2015).

Any positive change in the amount of people that have Investigative as a more favored option offers that these film clips are beneficial in influencing viewers in terms of STEM careers.

2. Hypothesis

My intention is to apply film as a STEM-positive influence towards juniors and seniors in high school. The aim of participants watching STEM-positive movies is to teach viewers about what professionals in STEM subjects do, to advocate the benefits of STEM-related activities, and to strengthen STEM interests for viewers with already present STEM involvement.

I motioned that these movies incline participants toward the concept of STEM fields as positive and increasing participants' STEM interests if:

1. Participants related to at least one character based on gender, race, and/or personal situations.
2. Participants found at least one or more of the clips enjoyable.

I furthermore proposed that POC participants will have similar results to White participants, and female participants would have similar results to male participants, in terms of relatability to the characters. This inference forms from movie clips incorporating a diverse range of characters (See Methods).

This hypothesis raises additional questioning on how effective these STEM-positive film clips are on the viewers' career personality. A solution to questioning derives from participants' RIASEC order in the second career test showing Investigative as a more important choice, in accordance with the past career test's results.

3. Design

Participants

In order to classify precise results on individuals, it was necessary to provide a case study structure. Participants consisted of sixteen students that were currently in the Conejo Valley School District (CVUSD) and were ages sixteen or seventeen. This age group was ideal due to social pressures for choosing careers and career fields after required schooling. Participants were divided into halves, with one group stated as being in STEM classes and the other group stated as not being in STEM classes. These groups contained the same amount of males as females. Group categorization assisted in retaining consistency within the study. This study pursued institutional review board authorization. Participants and their legal guardians consented to the administered survey.

Participants in STEM classes were currently involved in one or more of the following courses: AP Biology, AP STEM Research, AP Calculus, Physics CP, AP Computer Science, Math Analysis H, Intro to Engineering, AP Environmental Science, Physiology H, and Sports Medicine CP. Research excluded students only in required STEM classes from categorization as participants in STEM classes as those in non-required STEM classes showed a direct correlation to liking STEM.

Method

This case study uses an experimental structure, comprised of two RIASEC career personality tests (See Appendix A), along with notable inquiry (See Appendix B). Participants underwent inquiry in a thirty to forty-five minute period. This period does not account for further questioning. Further questioning occurred for specific participants in order to clarify input.

This study is not intended to result in a general direct cause-and-effect relationship in which these films result as the sole influence to increase STEM interests. This study aims to view STEM-positive film as a potential approach to influence participants and explore personal factors that define individual film effectiveness. Students were able to ask or look up unknown careers mentioned in the surveys and personality tests to avoid misunderstandings.

Participants watched two movie clips from popular PG-rated movies, biographical movie *October Sky* ((Franco & Gordon, & Johnston, 1999)) and science fiction and action movie *Big Hero 6* (Conli & Reed, & Hall & Williams, 2014), with each at approximately three minutes long. The clips encompass most of the general conditions of an ideal STEM-positive movie. Factors of movies' popularity and of multiple movie clips helped to reach a broad range of students in terms of entertainment. The movies must identify as entertainment to let viewers have their "guards down" (Stengler, 2014). This concept is important for making viewers not perceive movies-watching primarily as educational events. The chosen movie clips feature characters exhibiting cheerful moods to provide film appeal and positive attitudes towards STEM characters. To relate to high school students in relevance to age, each movie clip presents the main characters as teenagers.

The movie *October Sky* was chosen for its portrayal of American high school students successfully launching a rocket, applying favorable outcomes to aerospace engineering. The *October Sky* movie clip displays males as the main characters, and these characters represent Caucasian descent. The movie *Big Hero 6* was chosen for the characters' range of career choices of chemical engineering, applied physics, and mechanical engineering. Each character demonstrates ethical inventions from their indicated majors. The *Big Hero 6* movie clip displays

males and female characters, and these characters typify various ethnicities outside of Caucasian descent.

Measures (See Appendix B)

Participants completed questions in periods before and after viewing the movie clips, depending on the type of question inquired. Questions before the movie clips pertained to STEM fields. Questions after the movie clips incorporated inquiry on the participants' opinions on the movie clips. This study contains measures taken in various formats based on the type of results desired.

Interests, Involvements, and Confidence in STEM Fields

Questions relating to the participants' connections to STEM fields provided the likelihood of the movie clips positively impacting the participants. Four yes-no answer questions served as indications of whether the participants liked and showed involvement in STEM-related fields. One short answer question served to confirm participants' reasoning for pursuance in a STEM major or career for participants in STEM classes. One short answer question served to confirm participants' reasoning for a lack of pursuance in a STEM major or career for participants not in STEM classes. Participants were encouraged to give multiple answers for the short answer portion to increase understanding of personal motivations.

Statements after involvement questions gave the participants sample reasoning answers (based on their category of involvement) in order for participants to know common reasons. Two questions pointed to the participants' confidence levels in STEM subjects. One question was in a yes-no-somewhat answer format; whereas for the second question, participants indicated on a five-point Likert scale to what extent they thought their performance in STEM

subjects was (ranging from poor to outstanding). Overall confidence was scored on a 0.20 to 1.00 scale.

Likeability and Effectiveness of Movie Clips

Likeability and effectiveness indicators offered input as to how entertaining and informational participants found the movie clips. Through the first indicator after watching the movie clips, participants stated which movies they liked. Through the second indicator, participants stated whether they have seen the durations of *Big Hero 6* and *October Sky* before the survey. Seeing the full movies impacted the chance of the participants liking the movie clip and relating to a character, based on how well the participants knew the storyline of the movies.

Relatability to Chosen Character

First, participants found which character they distinguished as the most likeable and relatable. Participants were able to choose from the main characters Homer Hickman from *October Sky* (1997) and Gogo Tamago, Honey Lemon, and Wasabi from *Big Hero 6* (2014). Exclusion of other characters is attributable to the other characters not being thoroughly examined in the movie clips. After participants gave this information, they answered three questions on how they related to the indicated character. Questions consisted of finding similarity based on race, gender, and personal situation. Participants chose their answers formed on a yes-no-somewhat structure. Overall relatability was scored on a 0.00 to 1.00 scale.

Limitations and Sources of Error in Methods

Limitations of methods lead to the potential of further research in STEM-positive film influence. Further research would incorporate modifications in future films and data collected from participants, attempting to make up these unfocused areas.

Regarding methods, lack of effectiveness from STEM-positive movie clips is plausible from the reduced time period of the movie clips, compared to the duration of the movies. Participants viewing the full length movies renders a greater impact on character relatability and overall enjoyment of the films (Roskos-Ewoldsen & Roskos- Ewoldsen, 2001).

Delimitations derive from current STEM-positive movies available. No current movie encases all mentioned standards of an ideal STEM-positive movie. Furthermore, modern movies meeting the basic qualifications of a STEM-positive film do not extend to main characters in medical fields. According to analysis of doctor characters in movies by medical professional Dr. Flores (2004), beneficial doctor portrayals have declined, whereas detrimental doctor portrayals have increased. As a consequence of the absence of popular, modern STEM-positive movies, this study is unable to produce results from STEM-positive movie clips with characters in medical fields.

4. Findings and Analysis

Findings separate into group data and individual participant information. Group data includes participant verification of the findings and categorized trends in the findings. Content analysis complies with these trends. Analysis focuses on specific participants to allow recognition into particular results found and detailed personal responses.

Group Data

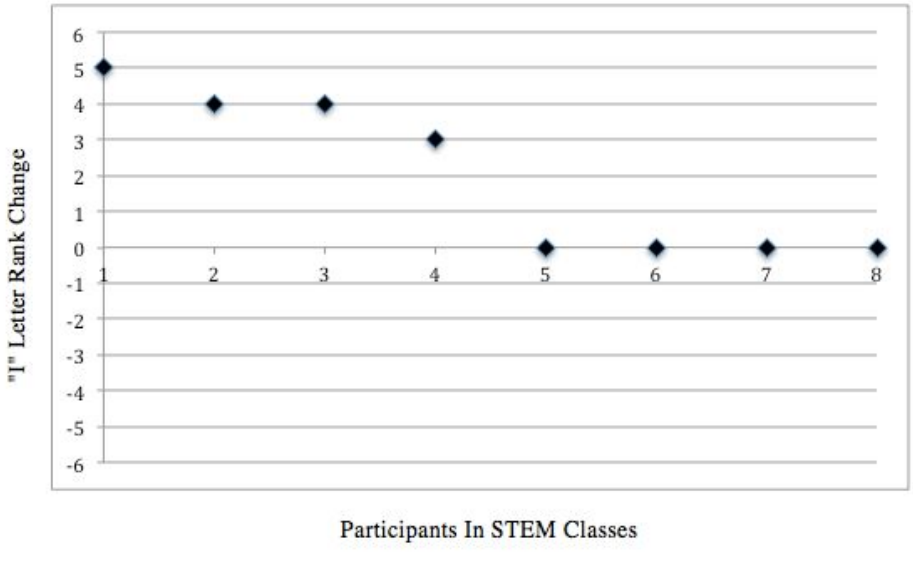
RIASEC scores are fundamental for group data findings referring to direct trends. Differences in data depended on whether the participants were in STEM classes or not. After testing, participants somewhat or fully confirmed the accuracy of RIASEC scores received, marking reliability in RIASEC score results.

Interest and confidence in STEM fields showed a direct correlation to whether students were involved in STEM classes, which points to concurrence with past research mentioned. POC participants in STEM classes revealed the same or less confidence in STEM performance, and the same or less relatability to their chosen character, compared to White participants in the same category. POC participants not in STEM classes showed less variation in the results to White participants in the same category. Female participants and male participants showed similar results in interest and confidence categories (See Appendix C).

All participants found at least one movie to portray STEM somewhat or fully satisfactorily, meaning participants corresponded STEM situations with positivity. All participants stated enjoyment of at least one of the film clips. The twelve participants that had seen the full length of one movie chose their most relatable and likeable character from the movie they had seen the full length of, offering confirmation with scholarship mentioned.

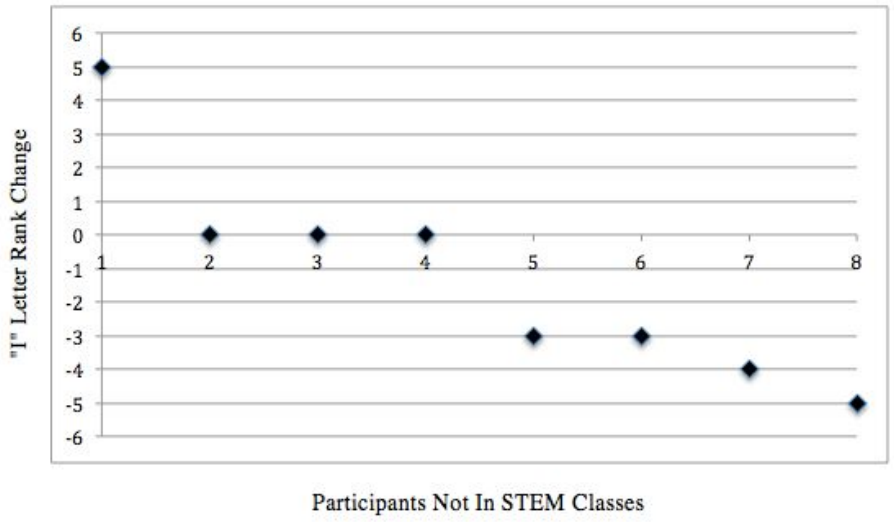
All the characters listed in the relatability section were chosen, meaning diverse characters allow for increased relatability. General high relatability to a chosen character did not correlate with an influence for RIASEC scores. Participants having similar personal experiences and interests to their chosen character correlated positively to whether the "I" letter rank raised.

Graph A - "I" Letter Rank Change for Participants In STEM Classes



Participants in STEM classes indicated a higher or the same ranking of the Investigative personality. Participants not showing change in the "I" letter ranking already had the "I" letter at the first or second ranking (See Appendix D). As none of the participants in STEM classes had lower rankings of the Investigative personality after viewing the movie clips, the movie clips had a beneficial impact on increasing or maintaining STEM interests for students in STEM classes.

Graph B - "I" Letter Rank Change for Participants Not In STEM Classes



The majority of the participants not in STEM classes had a lower ranking or the same ranking of the Investigative personality. One participant had a higher ranking. Multiple participants in this category showed a substantial change in their highest-ranking personality type choices, indicating inconclusive results (See Appendix D). To find reasoning behind these variances in RIASEC scores, participants not in STEM classes underwent further questioning concerning personal career interests. Career indecisiveness became a signifying component.

Individual Participant Data Examples (See Appendix D)

Relatability with indicated character and awareness of confidence levels are factors involved in the change of ranking of the Investigative personality trait. Examination includes results with a negative trend, a neutral trend, and a positive trend. Multiple participants' results are reviewed to demonstrate topics discussed. This section reviews reasoning for pursuance or non-pursuance in STEM classes, as reasoning entails personal explanation of career decisions outside of matters of confidence and interest (See Appendix E).

Participant 1B, a White female student not in STEM classes, showed a five-letter lower ranking of Investigative personality. She received a 0.20 performance level in STEM and confirmed no interest in math and science. This indication links to lowered chances of wanting pursuing a STEM career. She received a score of 0.17 on relatability to her most relatable and likeable character, Wasabi, from having a somewhat similar personal situation to the character. As Participant 1B had low scores in STEM confidence and character relatability, the STEM-positive movie clips were not effective for this participant. As this participant showed notable variance between RIASEC scores, further questioning persisted. This participant declared herself as career indecisive, though noted that she appealed to the research aspect of the Investigative personality type. An inference of change of rank of the “I” letter is pertinent to the modified wording from RIASEC Test 1 and RIASEC Test 2.

Participant 7A, a Mexican male in STEM classes Intro to Engineering and Math Analysis H, maintained the "I" letter ranking at the second highest rank from RIASEC Test 1 and RIASEC Test 2. Participant 7A received a 0.8 performance level in STEM. He confirmed that he likes STEM classes and has a specific interest in engineering. He commented that his reasoning

for going into a STEM field involved receiving a higher income, compared to other fields. Due to showing regular participation, high confidence levels, and personal reasoning towards STEM studies, this participant matches the results of the RIASEC tests. In inquiry from after viewing the films, Participant 7A mentioned that he liked the *October Sky* (Franco & Gordon, & Johnston, 1999) clip and he had seen the full movie. He established relatability to Homer Hickman. He received a relatability score of 0.50, from having a similar personal situation and gender to the character. Based on this participant's interest in engineering, Homer Hickman served as the most relatable character in terms of vocation. As the participant had already viewed the full movie, he confirmed that he had a better understanding of Hickman, in contrast to characters from *Big Hero* 6 (2014).

Participant 3A, an Asian female in STEM classes AP Calculus, AP Chemistry, AP STEM Research, and Physiology H, showed a four-letter higher ranking of the Investigative personality. She received a 0.80 performance level in STEM. She affirmed that she likes STEM classes and preferred aspects of STEM, including the high demand and availability of STEM employments, relevance of the fields, importance of the fields in society, and higher income, compared to other fields. Based on factors tested, this participant is disposed towards future STEM involvement. Participant 3A liked both movie clips and had seen the full length of *Big Hero 6* (Conli & Reed, & Hall & Williams, 2014). She liked and related to Wasabi the most, yet scored 0.17 in complete relatability. Relatability affiliated with the participant's somewhat similar personal situation with Wasabi. This factor did not appear as an issue, however, as she the "I" letter ranked as her highest career personality type.

5. Conclusion and Future Directions

The consequences of STEM-positive film as an effective influencer of career choices for adolescents in STEM classes call for implications of this type of movie. Outcomes of this study show that film is a motivator that helps students increase incentives towards interested fields. For participants involved in STEM classes, the film clips provided a relatable and confident role model in the form of entertainment. To ensure heightened influence, adolescent career counseling should incorporate film as a career-finding tool.

In the study, the movie clips informed participants about the real-life circumstances of the STEM careers portrayed. As participants found the clips to be entertaining, inferences emphasize that these STEM-positive films and similar films tend to be enjoyable, despite the popularity of negative STEM films. Meaning, STEM-positive films would not threaten the movie industry's success. Consequently, moviemakers should produce STEM-positive films, as they benefit STEM interests. Referenced factors of STEM-positivity should act as standards for filmmakers in making likeable and relatable STEM movies since they correlated with the likeability and positivity participants associated with the movie clips.

Current STEM-positive movies just act as the starting points for maximized future advocation of society-demanded STEM fields in film. Appropriately, using film as a favorable influencer could bring new awareness towards a variety of the topics mentioned.

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Appendix A

RIASEC Test 1

1. R: Check the number of activities you would LIKE to do.

Choices given: Lay brick or tile, Drive a taxicab, Assemble electronic parts, Drive a truck to deliver packages to offices and homes, Paint houses, Work on an offshore oil-drilling rig, Refinish furniture, Fix a broken faucet, Test the quality of parts before shipments, Operate a motorboat to carry passengers.

2. I: Check the number of activities you would LIKE to do.

Choices given: Study animal behavior, Study ways to reduce water pollution, Diagnose and treat sick animals, Study the personalities of world leaders, Study mathematics and data trends, Examine blood samples using a microscope, Develop psychological profiles of criminals, Research genetics, Study aeronautics, Fix computer software.

3. A: Check the number of activities you would LIKE to do.

Choices given: Write reviews of books or movies, Compose or arrange music, Dance in a Broadway show, Create special effects for movies, Conduct a musical choir, Audition singers and musicians for a musical show, Design sets for plays, Direct a movie, Sing in a band, Design artwork for magazines.

4. S: Check the number of activities you would LIKE to do.

Choices given: Give CPR to someone who has stopped breathing, Work with mentally disabled children, Give career guidance to people, Teach an elementary school class, Help people with family-related problems, Perform rehabilitation therapy, Help elderly people with their daily

activities, Teach sign language to people with hearing disabilities, Help people who have problems with drugs or alcohol, Plan exercises for disabled students.

5. E: Check the number of activities you would LIKE to do.

Choices given: Buy and sell stocks and bonds, Give a presentation about a product you are selling, Sell instruments at a music store, Manage a supermarket, Sell a soft drink product line to stores and restaurants, Negotiate business contracts, Sell hair-care products to stores and salons, Represent a client in a lawsuit, Negotiate contracts for professional athletes, Market a new line of clothing.

6. C: Check the number of activities you would LIKE to do.

Choices given: Develop a spreadsheet using computer software, Schedule conferences for an organization, Keep accounts payable/receivable for an office, Organize and schedule office meetings, Compute and record statistical and other numerical data, Calculate the wages of employees, Inventory supplies using a hand-held computer, Keep records of financial transactions for an organization, Stamp, sort, and distribute mail for an organization, Handle customers' bank transactions.

RIASEC Test 2

1. A: Check all the boxes next to the careers that interest you.

Choices given: Musician, Illustrator, State Director, Writer, Actor/Actress, Cast Director, Sports Announcer, Composer, Interior Decorator, Publisher.

2. B: Check all the boxes next to the careers that interest you.

Choices given: High School Teacher, Counselor or Therapist, Clinical Psychologist, Case Worker, Speech Therapist, Paramedic, Caretaker, Sports Coach for Children, Camp Counselor, Dental Hygienist.

3. C: Check all the boxes next to the careers that interest you.

Choices given: Cars Salesperson, Retail Store Manager, Business Executive, Television Producer, Sports Promoter, Art Buyer, Entrepreneur, TV Advertiser, Lawyer, Stock Broker.

4. D: Check all the boxes next to the careers that interest you.

Choices given: Bookkeeper, Court Reporter, Financial Analyst, Banker, Cost Estimator, Secretary, Tax Expert, Proofreader, Receptionist, Auditor.

5. E: Check all the boxes next to the careers that interest you.

Choices given: Automobile Mechanic, Aircraft Controller, Electrician, Surveyor, Hunter, Farmer, Plumber, Fire Fighter, Security Guard, Animal Trainer.

6. F: Check all the boxes next to the careers that interest you.

Choices given: Aerospace Engineer, Chemist, Detective, Mechanics Engineer, Investigative Journalist, Robotics Engineer, Marine Biologist, Judge, Astrophysicist, Computer Scientist.

Appendix B

Further Inquiry

Interests, Involvements, and Confidence in STEM fields
Are you interested or find enjoyment in STEM (Science, Technology, Engineering, and Mathematics) fields?
Are you involved in any STEM-related programs at school (i.e. a school club or class)? Are these STEM-related programs required for high school completion?
Do you think you work well in STEM fields?
How well do you think you perform at STEM subjects?
Why would you pursue a STEM major or career? Example Answers: Parent influence, Job stability, Good salary, Enjoyableness, Etc. Answer this question only if you are thinking about pursuing a STEM major or career.
Other than having another career interest, is there any reason why you wouldn't pursue a STEM major or career? Example Answers: Not enough high school preparation, Not enough confidence in STEM subjects, Etc. Answer this question only if you are thinking about not pursuing a STEM major or career.
Relatability to Chosen Character
Choose the most relatable and likeable character to you.
Does that character have the same or a similar race to you?
Does that character have the same gender as you?
Are the character’s personal experience and interests similar to your own personal experience and interests?
Likeability and Effectiveness of Movie Clips
Check which movie clips you enjoyed watching.
Check which movie clips you have already seen the full movie for.
Do you think these movies accurately portrayed STEM fields? Are these positive depictions?

Appendix C

Quantitative Inquiry Results

Participant In STEM Classes	**Confidence in STEM Performance Score**	**Relatability to Chosen Character Score**
POC Male	0.60	0.33
POC Male	0.80	0.50
POC Female	0.60	0.50
POC Female	0.80	0.17
White Male	1.00	0.83
White Male	0.80	0.50
White Female	0.80	0.66
White Female	0.80	0.83
Participant In Not STEM Classes	**Confidence in STEM Performance Score**	**Relatability to Chosen Character Score**
POC Male	0.60	0.17
POC Male	0.20	0.66
POC Female	0.60	0.17
POC Female	0.20	0.50
White Male	0.80	0.50
White Male	0.60	0.33
White Female	0.80	0.66
White Female	0.20	0.17

Appendix D

RIASEC Scores

Participant In STEM Classes	**RIASEC Test 1 Score**	**RIASEC Test 2 Score**
Participant 1A	RCAEIS	IRECAS
Participant 2A	CASIRE	ICSARE
Participant 3A	SCRIAE	IRSAEC
Participant 4A	CRAEIS	RICESA
Participant 5A	EICASR	EICSAR
Participant 6A	ISRACE	ISRACE
Participant 7A	AISREC	AIRSEC
Participant 8A	IEARSC	IEARSC
Participant Not In STEM Classes	**RIASEC Test 1 Score**	**RIASEC Test 2 Score**
Participant 1B	ISAERC	SAECIR
Participant 2B	AEISRC	AEISRC
Participant 3B	ASEIRC	AESIRC
Participant 4B	RAEICS	REAICS
Participant 5B	IERSAC	SAIECR
Participant 6B	SCEIAR	CSEARI
Participant 7B	SAIRCE	ASERCI
Participant 8B	SIACER	EACSRI

Appendix E

Reasoning for Pursuance/Non-Pursuance in STEM Fields

Participant In STEM Classes
Interest in Helping Others Through Advancing Technology
Job Stability
High Demand and Availability of STEM Employments
Relevance of STEM fields
Importance of STEM Fields in Society
Financial Security
Participant Not In STEM Class
Amount of Education Needed
Lack of Specialized STEM Classes in High School
Appropriate Preparedness Difficulty Level of STEM Fields Overall