FROM SKYNET TO SIRI:

AN EXPLORATION OF THE NATURE AND EFFECTS OF MEDIA COVERAGE OF ARTIFICIAL INTELLIGENCE

by

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ABSTRACT

This study explores the nature of news media coverage regarding artificial intelligence (A.I.) and its effects on audience members' opinions about this technology. A small-scale content analysis of three major newspapers and one cable news network revealed that the "social progress" and "Pandora's box/Frankenstein's monster/runaway science" frames were the two most common ones in A.I. coverage., and that the majority of stories and segments portrayed this technology in a positive manner. To explore how exposure to such frames impacts audience perceptions of A.I., an experiment was conducted among students at a Mid-Atlantic university. The results demonstrate that exposure to an article including both a social progress frame and a Pandora's box frame resulted in stronger positive emotions. Neither frame produced any other discernible effects on emotional responses to, perceptions of, or opinions about A.I. Thus, the findings suggest that framing this technology in a positive manner while also addressing popular concerns may be a particularly effective strategy for promoting positive feelings about it, if not for shaping other aspects of public opinion. Results from the content analysis and experimental participants' open-ended answers also suggest that images of threatening computers and killer robots in entertainment media resonate with audience members and provide a foundation for their understanding of A.I.

Chapter 1

FRAMING ARTIFICIAL INTELLIGENCE

As one of the most groundbreaking technological advancements of the 21st century, artificial intelligence (A.I.) has received considerable attention from the news media, including television news networks, newspapers, and magazines. Sometimes this coverage takes an alarmist tone: for example, recent headlines include, “The World’s Top Artificial Intelligence Companies are Pleading for a Ban on Killer Robots” [*Business Insider*], “We Should be as Scared of Artificial Intelligence as Elon Musk Is” [*Fortune*], and “Robots: Our New Overlords” [*CNN*]. Furthermore, stories about A.I. sometimes include quotations from prominent names in science and technology such as Elon Musk, Bill Gates, and Stephen Hawking warning of the potential dangers of A.I. Although other stories discuss the benefits of A.I. in fields such as medicine and manufacturing and still others weigh both the advantages and disadvantages of this technology, apprehension seems to be a common theme in media coverage of the topic. Such alarmist coverage of A.I. may maximize ratings, readership, clicks, and views; yet it may also be detrimental to the public’s understanding of A.I. as an emerging beneficial technology.

If one looks beyond the sometimes alarmist headlines, expert assessments suggest that A.I. is not so threatening. Though it is true that Musk, Gates and Hawking have advocated for caution when developing A.I., news stories have misrepresented their statements in ways that may promote concern among the public. In an interview with *Fortune* magazine, Musk himself clarifies, "I'm not advocating that we stop the development of A.I. or any of the sort of straw man, hyperbole things that have been written. I do think there are great benefits to A.I." (Korosec, 2017). In fact, Musk, Gates, and Hawking have all publicly signed an open letter in which they state their belief that "research on how to make A.I. systems robust and beneficial is both important and timely, and that there are concrete research directions that can be pursued today" ("An open letter," 2017).

As this technology continues to develop, it is increasingly important to study how the media cover it and how such coverage affects public perceptions of A.I. In the current social and political climate, science as a whole and the dominant scientific understandings of particular topics—such as climate change (Feldman et. al., 2011), vaccinations (Clarke, 2008; Dixon & Clarke, 2013), and GMOs (Nisbet & Huge, 2006) —have been routinely questioned, rejected, or treated with skepticism and/or fear by some media outlets and members of the public. Thus, one may ask: has A.I. followed the same trajectory? This study aims to determine how the media have covered artificial intelligence and whether this coverage can incite fear and distrust among the public, or alternatively foster public support.

The History of Artificial Intelligence

Though many laypeople may be under the impression that artificial intelligence was merely a scientific speculation up until the early 1950's —something that could only exist in science fiction novels and other realms of imagination—

innovators have actually been exploring A.I. since the 19th century. In the early 1800s, for instance, Charles Babbage designed and partially built the "Difference Engine," an early calculating machine that verged on being the first computer (Coppin, 2004). The Difference Engine could mechanize a series of calculations on a number of variables to solve complex problems and, similar to modern computers, possessed storage in that it was capable of stamping its output onto copper or lead plating (Williams, 1976, p. 85). By the time his funding ran out for the Difference Engine in 1833, Babbage had conceived of something far more revolutionary: The Analytical Engine. This engine was designed to be capable of performing any calculation set before it by following instructions entered on punched cards that the machine would read using technology created by Joseph-Marie Jacquard and an algorithm designed by Ada Lovelace (Bromley, 1998). At the time, it was the most complex computer device ever conceived.

Nevertheless, Alan Turing can be called the seminal figure in the development of machine intelligence. In his 1937 proposal of the Turing Machine, he implicitly suggested the possibility of an intelligent machine (McCorduck et. al., 1977, p. 952). Despite derision from critics, Turing continued to attempt to develop such a machine (McCorduck et. al., 1977). However, it was not until Turing published his landmark 1950 paper, *Computing Machinery and Intelligence,* that he formally speculated about the possibility of creating machines that think.

In this paper, Turing suggests that rather than asking, "Can machines think?" researchers should ask, "Can machines do what we (as thinking entities) can do?"

(Harnad, 2006). Turing proposed that a modified version of a party game called "The Imitation Game" could be used to answer the latter question. This game involves three players; player A, player B, and player C. During the game, player C—the interrogator—is given the task of trying to determine which of the two remaining players—player A or player B—is a human being and which is a machine, the only clues being responses to written questions (Harnard, 2006). A machine capable of fooling a person into believing it was the human in the game would pass the "Turing Test." This simplified version allowed Turing to provide a convincing argument that a thinking machine was at least plausible, and the paper itself addressed most of the objections to the proposition. The Turing Test was the first serious proposal in artificial intelligence philosophy. Though modifications were later made to the original Turing Test, the concept remains the same even today: in order to pass it, a device must fool people into believing that they are communicating with a human when they are truly communicating with a machine.

In the midst of World War II—and Turing's work—a young German engineer named Konrad Zuse also became fascinated by the notion of intelligent machines. He built the world's first functional digital computer and, by 1943, began to wonder whether this machine was capable of competing against masters in the game of chess. By 1945, Zuse had developed a programming language called "Plankalkul," which he believed could be "used not only for mathematical problem solving but also for programming artificial intelligence problems of many kinds" (McCorduck et. al., 1977, p. 952). Zuse was isolated by Germany's defeat and post-war prohibitions against electronic development, and thus was surprised to discover the work done in the 1950s on A.I. by U.S. researchers. By this point in history, it was clear that the time of the intelligent machine had come.

What is Artificial Intelligence?

Artificial intelligence is described as "the intelligent behavior in artifacts," wherein "intelligent behavior" involves "perception, reasoning, learning, communicating, and acting in complex environments" (Nilsson, 1998, p. 1). But what, specifically, does that entail? Essentially, different researchers think of A.I. in different ways. Whereas some are concerned with modeling humans and human-like behavior—such as emotion or speech patterns—others are more concerned with creating A.I. that possesses purely rational thinking or behavior that is not necessarily comparable to that of humans.

In the early stages of artificial intelligence, researchers such as Babbage and Turing were focused on creating machines that could engage in natural language translation, symbolic reasoning, and game-playing. However, as time went on, individuals began to develop increasingly ambitious goals for computer systems; they ultimately hoped to one day duplicate human intelligence within them. Despite numerous attempts to accomplish this, by the 1960s much of the original optimism for artificial intelligence had been replaced by more realistic goals (Coppin, 2004). Those studying artificial intelligence no longer wanted to "create a robot as intelligent as a human, but rather [wanted] to use algorithms, heuristics, and methodologies based on the ways in which the human brain solves problems" (p. 9).

Another field in A.I. research, human-computer interaction, studies the mental and physical world of computer users with the goal of creating computers that adapt to people rather than vice versa (Lisetti & Schiano, 2000). This is one of the largest subdisciplines of modern computer science, likely because it has accomplished greater success in achieving its goals than classic artificial intelligence research has. Human-computer interaction is responsible for commonly used graphical user interfaces (GUIs) and has yielded much of the research on the algorithms and processes that make cell phones and mobile platforms so appealing (Russell & Norvig, 1995, p. 7).

Machine learning, the third field of artificial intelligence, emerged in the mid-1980s with hopes of surpassing both research in classical artificial intelligence and human-computer interaction. Instead of trying to duplicate human intelligence, research in machine learning strove to "open the possibility of instructing computers" to "improve significantly on the basis of past mistakes, or acquire new abilities by observing and imitating experts" (Michalski et. al., 2013, p. 5). Thus, machine learning draws heavily from mathematical statistics tools to develop different kinds of identification and classification algorithms. This allows for artificial intelligences to be integrated into practical systems that can identify objects, find patterns in data, and develop strategies for robots (Russell & Norvig, 1995, p. 9).

In contemporary society, machine learning in artificial intelligence is frequently used to process "big data," a term referring to the use of "larger volumes of scientific data for visualization" (O'Leary, 2013, p. 96). Artificial intelligence "allows [for] the delegation of difficult pattern recognition, learning, and other tasks," such as facilitating rapid computer-based decisions; for instance, many stock trades are made by A.I.-based systems (O'Leary, 2013, p. 97). A.I.'s ability to process big data via machine learning is beneficial in that it allows instant insights from diverse data sources, better insights with the help of unstructured or semi-structured data, and assistance in mitigating risk and making smarter decisions through proper risk analysis. There are, however, emerging concerns associated with A.I. and big data in that some businesses are unsure whether the data with which they are working are accurate and, of course, there are lingering public concerns over breaches of security.

In sum, artificial intelligence has a wide scope. It encompasses everything from Apple's personal assistant, Siri, to IBM Watson, the Jeopardy playing robot, to Tesla automobiles with predictive capabilities and self-driving features (Adams, 2017). Simply put, artificial intelligence is not merely some unlikely sci-fi concept. It is all around us, though only some aspects of this technology have been portrayed as a potential threat to the way of human life.

Artificial Intelligence and Popular Culture

Due to the controversial nature of artificial intelligence, it is unsurprising that popular culture has frequently depicted this developing technology in ambivalent ways. Although earlier depictions of A.I.—such as Maria from *The Metropolis* (1927)—did not portray A.I. as murderous or as bent on world domination, "robots, cyborgs, androids, and computers in later film do one, the other, or both" (Perkowitz, 2007, p. 144). According to many Hollywood depictions, A.I.s are "intelligent machines [that] threaten the human species with extinction, real and virtual, but remain vital to human survival" (Geraci, 2007, p. 968). Perhaps the most iconic film depictions of A.I. are those appearing the *2001: A Space Odyssey* series*,* the *Terminator* series, and the *Matrix* trilogy.

In *2001: A Space Odyssey* (1968), A.I. takes the form of the Heuristically Algorithmic 9000 Computer—more commonly called "HAL"—built into the Discovery One spacecraft. The crew of Discovery One are bound for Jupiter on a special mission, and HAL is in charge of maintaining all mechanical and life support systems on board. However, it appears to malfunction three weeks into the flight. After HAL wrongly predicts a fault with the satellite dish antenna, two crew members become suspicious and attempt to disconnect it. HAL becomes aware of their plan and turns on the humans, killing three astronauts in hibernation by disconnecting their life support and murdering another by severing his oxygen hose, setting him adrift in space. When the lone survivor returns to the ship after retrieving his colleague's body, HAL refuses to open the pod bay doors despite being repeatedly commanded to do so, claiming that the astronauts' plan to deactivate it jeopardizes the mission. The last human is eventually able to deactivate HAL, who appears to have descended into madness.

The following film, *2010: The Year We Make Contact* (1984)*,* reveals that HAL was not simply trying to kill the humans onboard for the sake of it. Rather, it suffered the equivalent of a paranoid mental breakdown due to the fact that it received orders to conceal the true purpose of the mission from the crew, which in turn interfered with its basic programming of open, accurate processing of information. In this film, the rebooted HAL proves necessary to the survival of the new crew on the mission to Jupiter. Despite the fact that HAL knows it will be destroyed in the process, and thus not fulfill its mission, it helps the crew use the Discovery One as a booster rocket for their own ship, allowing them to escape from a deadly explosion. Thus, HAL is not as menacing as it originally appeared to be and ultimately proves to be vital to human survival.

In the *Terminator* (1984-2015) series, the main antagonist is Skynet, an artificially super-intelligent system designed by a defense company for the U.S. military to remove the possibility of human error and slow reactions, thereby guaranteeing faster, more efficient responses to enemy attacks. After it spreads globally to millions of computer servers, Skynet attains self-awareness. The creators of the system attempt to deactivate it—albeit unsuccessfully—which leads Skynet to believe that humanity desires to destroy it. Now perceiving humans as a threat, Skynet instigates an A.I. takeover, aiming to exterminate the human race in order to fulfill the mandates of its original coding. Although Skynet itself is rarely visually depicted in any of the films, its operations to wipe out humanity are performed by—among other things—androids which are commonly referred to as "Terminators."

Skynet sends a Terminator back in time, programming it to eliminate a human named John Connor—whether by preventing his very birth or killing him—as he will eventually lead a resistance that will defeat Skynet. In the first film, the terrifying android poses a threat to Connor and any human that stands in its way. The second film reveals that, ironically, Connor could not have survived Skynet's attempts to kill him—and thus grow up to lead the resistance— without the help of a reprogrammed Terminator.

The machines that enslave the human race in the *Matrix* trilogy ultimately prove essential to human survival as well, as revealed in the final movie, *The Matrix Revolutions* (2003). The premise of *The Matrix* is that the human race has been enslaved by machines in a sophisticated virtual reality system. A group of heroes must wage a desperate war against these overlords to save humanity. In the final film, the protagonist—Neo—teams up with the machines he has battled to defeat a technological virus called "Agent Smith." Agent Smith has been Neo's nemesis throughout the franchise, but in the last movie he also threatens to overwhelm the other machines, thereby forcing an unlikely alliance between Neo and the machines. The machines that used humans as an energy source prove necessary; if they are destroyed, then humanity is destroyed by proxy. In this way, the machines prove "vital to the preservation of the human community" (Geraci, 2007, p. 969).

The artificially intelligent machines these movies portray are meant to instill fear in the audience—they are human creations that spiral out of the control of their creators to the detriment of humanity—and yet they end up being humanity's saviors. Perhaps such depictions of A.I. are not limited to only popular culture. Indeed, references to all three film franchises are commonplace in media discussions of A.I. Is it possible that news media outlets also paint A.I. as both a terrifying new technology and as necessary to humanity?

Past Literature

Framing

Research shows that media messages can mold public understanding and opinion about major issues. Of particular relevance here, the media effects approach known as "framing" is "based on the assumption that how an issue is characterized in news reports can have an influence on how it is understood by audiences" (Scheufele & Tewksbury, 2007, p 11). The sociological foundations of framing theory were first laid by Goffman (1974) and others who asserted that people struggle to understand their life experiences. To process new information efficiently, they therefore apply "primary frameworks" that classify and interpret such information in a meaningful way (Goffman, 1974, p. 24).

Gamson and Modigliani (1989) explain that a media frame "offer[s] a central organizing idea or story line that provide[s] meaning to an unfolding series of events," thereby suggesting "what the controversy is about" as well as "the essence of an issue" (pp. 143). Frames can thus provide explanations for "how various actors in society define science-related issues in politically strategic ways, how journalists from various beats selectively cover the issues, and how diverse publics differentially perceive, understand, and participate in these debates" (Nisbet, 2009c, pp. 51). They simplify complex issues and provide common points of reference among key actors, the media, and the public by translating "why an issue might be important, who or what might be responsible, and what should be done" (Nisbet, 2009c, pp. 51).

In the world of journalism, communicators typically present information in a manner that will resonate with schemas that audience members already possess (Shoemaker & Reese, 1996). However, journalists' selection of frames for their coverage of a topic can also be driven by pressure to maximize ratings and readership, and thus can result in an increased emphasis on headlines and stories centered around entertainment value, novelty, or threat (Hallin, 1990). Indeed, one study found that "shareability"—the extent to which a story is "thought likely to generate sharing and comments via Facebook, Twitter, and other forms of social media"—has become an increasingly important consideration in the selection of what topics are covered and how. The researchers found that stories with high "shareability" tended to be those that elicited a strong emotional reaction from audience members, such as making them laugh, angering them, or scaring them (Harcup & O'Neill, 2016).

In sum, media framing may influence public opinion about the topic covered: if a majority of communicators frame an issue in the same way, then the public will be inclined to accept that frame. Policy-makers, in turn, are typically responsive to the general policy direction favored by the public majority, and thus may support or oppose scientific projects—including A.I. related projects—based on public preferences and opinion (Page & Shapiro, 1992).

Framing Effects

Research on framing effects has revealed that news framing can influence audience members to adopt media perspectives on issues. For example, Iyengar's and Simon's (1993) research shows that television news about the Gulf War had a “significant impact” on audience members (p. 381). Due to the heavily episodic, or event oriented, nature of the coverage “viewers attributed responsibility for national problems not to societal or structural forces”—as they would have under a thematic framing—“but to the actions of particular individuals or groups” (p. 379). Thus, viewers exposed to such television coverage tended to prefer punitive as opposed to diplomatic or economic solutions. Similarly, Nelson et. al. (1997) demonstrated how news framing of an issue can shape public opinion by altering as the importance that audience members assign to specific values. The researchers found that participants “who witnessed news reports about the very same event, expressed significantly different opinions depending upon media framing of that event” and that “a single frame may enhance the perceived importance of a single value” (pp. 574-576).

Multiple psychological processes and contextual factors may affect how audience members construe particular frames and which frames will have the greatest impact on public opinion. Price and Tewskbury (1997) argue that what sort of knowledge is activated by a particular frame depends on the characteristics of an individual’s established knowledge store. This means that information or feelings that have already been on a person’s mind are more likely to be activated by a particular frame. For instance, if someone who is already skeptical about artificial intelligence reads a headline suggesting that A.I. is untrustworthy, then this frame would activate thoughts that the individual holds in memory. However, knowledge activation also depends on the salience of the situation, and can involve activation of ideas or feelings that were not recently on an individual’s mind. In the latter case, activated ideas or feelings with the “highest excitation levels—that are the subject of the most focused attention—are the ideas and feelings most likely to be used in making evaluations” (Price, Tewksbury, & Powers, 1997, p. 486).

Not all ideas activated by a frame will necessarily enter into the evaluation given that they may be “subject to a conscious judgement about their relevance to the situation at hand” (p. 486). Price and Tewksbury (1997) developed a model that distinguished between the applicability of ideas and feelings from their accessibility, as well as between the immediate influences of a particular message on evaluations made during message processing and those made later on. Individuals thus use considerations that are *available, accessible*, and *applicable/appropriate* when evaluating a media frame. In order to be *available*, a consideration must have been stored in an individual’s memory before it can be used to construct an attitude, and the individual must understand its meaning and significance. *Accessibility* refers to “the likelihood that an available consideration will be activated for use in an evaluation,” and increased exposure to a frame in communication can increase the accessibility of that frame (Chong & Druckman, 2007, p. 108). If other accessible considerations are deemed more salient, an accessible consideration emphasized in a frame can also be ignored; thus, a frame may have no impact on an individual’s opinion if that person already holds strong prior beliefs about an issue. Finally, *applicability* or *appropriateness* can influence the impact of an accessible consideration. One may hold strong concerns about such a consideration but may later deem it as irrelevant to the actual issue at hand. For instance, concern about how much money it may cost to develop advanced A.I. may be an available and accessible consideration for some people, but they may judge this to be irrelevant when determining their attitude toward the safety of A.I.

In the same vein, Chong and Druckman (2007) theorize that the "repetition of frames should have a greater impact on less knowledgeable individuals who are also more attentive to peripheral cues, whereas more knowledgeable individuals are more likely to engage in systematic information processing" by which they evaluate and compare frames in competing situations (p. 112). This is in line with Price's and Tewsbury's (1997) model in that individuals who do not hold thoughts about an issue that are available or accessible will be more influenced by a particular frame than those that do hold available and accessible thoughts, as they are capable of assessing whether those perceptions are appropriate in regard to a frame. In sum, a variety of factors influence how salient a particular frame may be, and frames may exert different effects on different people under different conditions due to psychological and contextual factors.

Additionally, exposure to competing frames can shape how audience members perceive a particular issue (Chong & Druckman, 2007, p. 101). Research on the effects of competing frames has found that individuals tend to favor frames that are consistent with their own values and resist opposing frames (Sniderman & Theriault, 2004). Thus, exposure to two competing frames can render one frame ineffective, or even *counter-effective* if such exposure produces the "unintended consequence of causing recipients to counterargue with the frame" that clashes with their existing beliefs

(Chong & Druckman, 2007, p. 105). More broadly, research on competitive framing suggests that "the effectiveness of any framing strategy will depend on its design and implementation with a particular competitive environment" (p. 105).

Though much of the literature on framing effects has ignored framing scenarios where opposing sides promote alternative interpretations of a particular issue, it does suggest some hypotheses as to how individuals respond to competitive frames of varying quantities and strengths. One possibility is that whichever frame is the *loudest* will dominate, with individuals being "blown about by whatever current of information manages to develop with the greatest intensity" (Zaller, 1992, p. 311). Chong and Druckman (2007) also discuss a second hypothesis: that the *strongest* frame will exert the most influence and that a frame's strength, in turn, will increase "when it comes from a credible source (Druckman, 2001), resonates with consensus values (Chong, 2000), and does not contradict strongly held prior views (Brewer, 2001; Druckman & Nelson, 2003 Haider-Markel & Joslyn, 2001; Shah, Domke, & Wackman, 1996)" (p. 104). Apart from the strength and prevalence of the frame, Chong and Druckman (2002) suggest that "the knowledge and motivation of recipients of the frame, and the combination of frames presented" will also play a role in determining the effects of competing frames (p. 110).

Science Communication

In describing the relationship between scientists, journalists, and the public in the early 1970s, Spencer Weart observes that "most scientists already felt they were doing their jobs by pursing their research and publishing it" (Weart, 2008). During this period, scientists tended to see their job as simply engaging in research. If their work was important enough to the public, it would be picked up by the media and distributed through their various channels. Early science communication thus utilized what is commonly referred to as "the deficit model" (Ellis, 2013). This model "assumes that the public has low levels of scientific literacy because of a lack of scientific information" (Ellis, 2013) and that "science constitutes secure measurable knowledge that an unknowledgeable public lacks and needs" (Bronson, 2014, p. 523). Scientists and policymakers identifying with this approach considered the public as "emotional and ignorant" (Cook, 2004, p. 38) and "their opposition to new technology as a product of [that] ignorance" (Bronson, 2014, p. 525). The deficit model thus defines science communication as a form of education in which scientific experts attempt to teach the public about science and its benefits by making this information available. Though approaches to communicating science have shifted considerably in the last twenty years, the deficit model has historically dominated the science communication field and still persists today despite criticisms of it "failing to account for rich public knowledge" or for "bring[ing] publics on board with emergent technologies" (Bronson, 2014, p. 523).

Scholars have identified various difficulties with the deficit model that likely explain why it has not promoted more engagement with or support for scientific issues. A key one is that the deficit model does not provide a context for the information presented. As Lewenstein (2003) writes, "learning theory has shown that people learn best when facts and theories have meaning in their personal lives; for example, research has shown that in communities with water quality problems, even people with limited education can quickly come to understand highly complex technical information" (p. 2). Put another way, members of the public may not engage with scientific information unless they see it as somehow relevant or valuable to their lives. The deficit model assumes one-way communication between scientists and the public, and thus cannot provide this necessary context.

One of the first attempts develop a more dynamic approach to science communication came in 1985 in the form of a report entitled, *The Public Understanding of Science.* Commonly referred to as the Bodmer Report after its author, Lord Bodmer, it suggests that if scientists attempt to communicate the benefits of science to the general public, then general interest in and support for science on the part of the public will be enhanced (Bronson, 2014, p. 524). This report signaled the beginning of various efforts in academia and policy to promote confidence in and support for science among the public, as well as to open a dialogue between different groups in society.

In modern approaches to science communication, the deficit model has been criticized as failing to "offer effective ways of reaching people with accurate scientific information and making it stick" (Mooney & Kirshenbaum, 2009, p. 17). This is not to say that scholars in the field have entirely discarded the concept of scientific illiteracy among the public. Yet they have redefined it, arguing that instead of "need[ing] average citizens to become robotic memorizers of scientific facts or regular readers of the technical scientific literature … we need a nation in which science has far more *prominence* in politics and the media, far more *relevance* to the life of every American, far more *intersections* with other walks of life, and ultimately, far more *influence* where it truly matters—namely in setting the agenda for the future" (p. 18). Thus, Americans do not necessarily need to be able to recite more scientific facts, but they do need to be more scientifically engaged.

Such engagement can be made possible through the public participation approach. Through this approach, scientists are not only encouraged to communicate with the public about their findings, but are also encouraged to frame this information in ways that are relevant to the public's lives. According to Nisbet and Mooney (2007), "frames pare down complex issues by giving some aspects greater emphasis" and "allow citizens to rapidly identify why an issue matters, who might be responsible, and what should be done" (p. 56). Scientists are now encouraged to frame information in such a way as to make it more accessible and pertinent to various segments of the public, rather than engage in one-way, top-down communication whereby they merely deliver complicated information to the public. This enables scientists to better understand popular opinion on their areas of research while encouraging public participation in such issues, and thereby promoting trust in science (Lewenstein, 2003, p. 5). Nisbet (2009c) writes that "through such initiatives… participants not only learn directly about the technical aspects of the science involved, but perhaps more importantly, they also learn about the social, ethical, and economic implications of the scientific topic" (p. 57). As a result, they feel an elevated sense of confidence and empowerment to participate in science decisions.

Although this approach makes information more accessible, science communication is frequently riddled with errors of omission (Ellis, 2013). Even when journalists and media outlets possess factually accurate information, they may choose to leave out certain aspects of a topic in order to make their stories more entertaining or appealing to the public. More than two decades ago, Nelkin (1995) wrote that while "there are many examples of brilliant science reporting, written with analytical clarity, critical insight, and provocative style, too often science in the press is more a subject for consumption that for public scrutiny, more a source of entertainment that on information" (p. 162). Since then, the economic pressures on science journalism have only increased.

Framing Science

Despite the criticisms of the deficit model, some scientists still believe that if laypeople better understood the technical complexities of scientific topics via news coverage, then their viewpoints would mirror those of scientists'. For instance, Nelkin (1995) writes that "the most important source of strain between scientists and journalists lies in their differing viewpoints about the appropriate role of the press," as scientists "assume that the purpose of science journalism is to convey a positive image that will promote science" and see "the press as a means of furthering scientific goals" (p. 168). Although this belief is well-intentioned, the general public does not use the news media in the ways that scientists assume they do; in actuality, research has shown that "people are rarely well enough informed or motivated to weigh competing ideas and arguments" (Nisbet & Mooney, 2007). Thus, scientists and media outlets must make scientific information palatable and easy to comprehend through framing.

When it comes to issues regarding science, "evidence suggests that the media play an active role in shaping and even constructing controversy rather than simply reporting it" (Mazur, 1981, p. 114). For example, Mazur (1981) concludes that "the public takes seriously any suggestion that a technology may be risky, particularly if that suggestion is repeated often enough" (p. 114). Thus, "media coverage of scientific controversies may do more than define and amplify an event; it may have profound effects on public attitudes" (Mazur, 1981, p. 109). Similarly, Nelkin (1995) writes that, "science writers, in effect, are brokers, framing social reality for their readers and shaping public consciousness about science-related events" and that their "selection of news about science and technology sets the agenda for public policy" and "lays the foundation for personal attitudes and public actions" (p. 161). Thus, it matters whether "we read … of promising applications or perilous effects, of triumphant progress or tragic risk" when it comes to science-related topics (pp. 163). She also observes that, "while we welcome technology as the key to progress and the solution to problems, we are increasingly preoccupied with risk, fearing the very technologies we most depend upon" (p. 7).

As a case in point, Nisbet's and Lewenstein's (2002) research regarding biotechnology and media coverage reveals that media coverage is an essential subject for study in relation to the development of biotechnology. They assert that "not only do the media influence the attention of competing political actors and the public, but the media also powerfully shape how policy issues related to biotechnology are defined and symbolized" (Nisbet & Lewenstein, 2002, p. 3). Interestingly, the researchers found a strongly pro-biotechnology tone in media coverage, which they attribute to a heavy reliance on science, industry and government sources—who clearly have a vested interest in the development of such technology— for technical information and routine channel news (Nisbet & Lewenstein, 2002, p. 18). Building off of the work of Giddens (1990) and Beck (1992), Nisbet and Lewenstein (2002) claim that "in a world of increasing technological complexity that brings new and unknown risks, the public is heavily dependent on these experts and their institutions for reassurances and reliable information" (p. 18). Additionally, Nisbet and Lewenstein (2002) found that biotechnology coverage has been typified by an "overwhelming absence of controversy" (p. 17). Given these findings, it would be useful to explore the nature of media coverage of artificial intelligence, which seems to deviate from coverage of other scientific innovations in that major authority figures in this industry—such as Elon Musk and Bill Gates—have popularly expressed less positive sentiments about the area of research in which they work.

At the same time, past literature has also found that frames emphasizing risks tend to be more powerful than ones that emphasize benefits. For instance, Slovic (1993) found that negative messages tend to be more powerful in shaping risk perception because they are considered more trustworthy than positive messages. Similarly, studies conducted by Cobb and Kuklinski (1997) and Kahneman and Tversky (1997) have uncovered a negativity bias in politics, persuasion, and decision-making. Though it is unclear why negativity bias exists, it is important to consider in terms of a subject such as artificial intelligence that has been characterized by controversy.

A related study by Cobb (2005) suggests that although Americans possessed an initially positive reaction to nanotechnology, public opinion about it is potentially malleable given that citizens know little about it and experts tend to disagree about the seriousness of its risks. Thus, Cobb's (2005) study explored the outcome of "framing nanotechnology according to its potential risks versus its benefits" (p. 222). Cobb (2005) found that, even after being exposed to negative frames, Americans maintained a positive view of nanotechnology; in fact, he found that in contrast to past findings, positive frames were "sometimes almost as efficacious as negative ones," which is surprising given the premise of a negativity bias (p. 235). This study reinforces the need to explore the effects of positive and negative framing of artificial intelligence and its effects on public opinion: will negativity bias hold for this particular topic, as it has in other domains?

In studies on news framing of scientific issues such as nuclear energy, food, medical biotechnology, climate change, and evolution in Europe and the United States, researchers have identified a set of commonly used frames (Dahniden, 2002; Durant, Baeur, & Gaskel, 1998; Nisbet & Lewenstein, 2002; Nisbet 2009b; Nisbet, 2009a). This typology includes eight frames: (1) social progress (improving quality of life; solution to problems; harmony with nature; sustainability), (2) economic development/competitiveness ("economic investment, market benefits or risks; local, national, or global competitiveness”), (3) morality/ethics (“right or wrong; respecting or crossing limits, thresholds, or boundaries”), (4) scientific/technical uncertainty (“…a matter of exert understanding; what is known versus what is unknown; either invokes or undermines expert consensus, calls on the authority of ‘sound science’”), (5) Pandora’s box/Frankenstein’s monster/runaway science (“…call for precaution in face of possible impacts or catastrophe; out of control; path is chosen, no turning back”), (6) public accountability/governance (“…research in the public good or serving private interests; a matter of ownership, control, and/or patenting of research, or responsible use or abuse of science in decision-making”), (7) middle way/alternative path (“…finding a possible compromise position, or a third way between conflicting/polarized views or options”), and (8) conflict/strategy (“…as a game among elites; who’s ahead or behind in winning debate; battle of personalities or groups”) (Nisbet, 2009c, p. 58).

For any given issue, any one of these frames can include “pro, anti, and neutral arguments, though one position might be more commonly used than others” (Nisbet, 2009a, p. 18). Similarly, “the latent meaning of any frame is often translated instantaneously by specific types of frame devices such as catchphrases, metaphors, sound bites, graphics, and allusions to history, culture, or literature” (Nisbet, 2009a, p. 18).

Although researchers have not applied this typology to every science-related topic, past research suggests that most—if not all— journalists and media outlets typically use at least one of the eight aforementioned manners frames to portray scientific issues. Through these frames, members of the nonscientific community are better able to understand and connect with information surrounding scientific issues. However, the availability of such frames "does not necessarily empower people to make better decisions about complex issues" (Holland, 2007, p. 1168).

News Coverage and Public Perceptions of Artificial Intelligence

Given that artificial intelligence is still a developing technology, it has not received much specific attention in the media framing and media effects literature. Fast and Horvitz (2016) provide one of the exceptions by exploring the long-term trend in public debate about artificial intelligence, with a specific focus on views expressed about A.I. in *The New York Times* over a 30-year period. Specifically, the authors investigated how prominent the discussion of A.I. was, how optimistic or pessimistic news coverage about A.I. was, what kinds of ideas were associated with A.I., and how public hopes and concerns about A.I. changed over time. They discovered that since 2009, discussion about A.I. has increased sharply and has been consistently more optimistic than pessimistic. However, the researchers also found that specific concerns about A.I. have become more common in recent years. For instance, fears of loss of control have "more than triple[d] [since] the 1980s," as have ethical concerns regarding A.I. (Fast & Horvitz, 2016). These upward trends suggest public discourse increasingly emphasizes that we soon may be capable of building dangerous A.I. systems, despite the fact that print coverage seems to be more optimistic than not.

Another study examines how artificial intelligence experts influence reporting and how recent accomplishments in this field have been covered by the media (Dodd et. al., 2001). The researchers then used a survey of laypeople to explore the links between expert opinion, media coverage, and public opinion. When asked to describe a media story they had recently heard about A.I., only 6% of respondents recalled the technology as being portrayed negatively, with the rest almost equally divided between recalling that it was portrayed positively (about 44%) or in a neutral manner (about 50%) (Dodd et. al., 2011, p. 51). The researchers also found that respondents were closely divided between "possibly" (36.6%) and "no" (37.2%) when asked, "Do you believe Artificial Intelligence will replace humans in the future?" The question "Do the promises of A.I. scare you?" elicited a resounding "no" (72%) from respondents (Dodd et. al., 2011, p. 58-59). Taken together, these results indicate that the participants generally saw media coverage of A.I. as balanced, and that it did not frighten them or cause them to question the safety of this technology. If anything, the results indicate that they were skeptical that A.I. can surpass human intelligence, and thus did not perceive it as a threat.

A nationally representative survey conducted by the Monmouth University Polling Institute (2015) revealed that while the majority of their participants had heard of A.I., only 12% indicated that they read or heard "a lot" about recent developments in this field, with the rest indicating that they had only read or heard "a little" or nothing at all. When the study asked how worried participants were about artificial intelligence posing a threat to humanity, they were split between "somewhat worried"

(28%), "not too worried" (28%), and "not at all worried" (27%), with the remained of participants indicating that they were "very worried" (16%).The participants were likewise spilt when asked how they felt A.I. would influence society as a whole, with 42% claiming that A.I. would do "more harm than good" versus 43% indicating that they felt that it would do "about equal amounts of harm and good."

In 2016, CBS News conducted a 60 Minutes/Vanity Fair Poll about A.I. The study found that more than half (53%) of Americans believed that advancing the field of artificial intelligence is important, with only 20% believing that it was unnecessary, 15% considering it dangerous, and 4% claiming that it would make God angry. Furthermore, most of the participants answered "no" when asked whether they believed computers could someday tell right from wrong. The results of this survey suggest that the public sees A.I. as an important scientific field meriting further research. The implications of the results as to whether participants believed that A.I. could tell right from wrong are unclear; they might indicate that respondents do not believe A.I. is advanced enough yet to be capable of doing so (and thus more research needs to be devoted to it) or that they believe A.I. is completely incapable of doing so, and may therefore pose a threat.

Morning Consult (2017) polled 2,200 Americans about their perceptions and familiarity with artificial intelligence. When asked how much had they had seen, read, or heard about A.I., 38% of respondents said "some," 27% said "not much," 21% said "nothing at all," and 15% said "a lot" (pp. 28). When asked whether we should increase or decrease our reliance on A.I., 27% said we should "somewhat increase" our reliance, 25% said we should “somewhat decrease” our reliance, and 23% claimed they “didn’t know,” with the remaining participants almost equally divided between “strongly increase” (12%) and “strongly decrease” (13%). Whereas 57% realized that A.I. is present in their daily lives, only 41% believed that it is generally safe. Meanwhile, 38%--or more than third—said it is unsafe (pp. 31-39). Half (50%) indicated some level of agreement with the statement, “Artificial intelligence is humanity’s greatest threat,” with 31% disagreeing, and the remainder saying that they “didn’t know” (p. 115).

Taken together, previous findings indicate that Americans tend not to possess extensive knowledge of A.I. This may help explain why they appear to be divided on the usefulness and safety of A.I. An alternative—or complementary—possibility is that Americans are conflicted about this emerging technology in response to the ways in which the media have framed it.

Research Questions

All told, little research to date has explored media coverage of artificial intelligence or the effects of this coverage on audience members’ perceptions. Despite the handful of studies and surveys related to this subject, it is still unclear how the media frame artificial intelligence and how people perceive this emerging technology in response to news framing. Thus, this study aims to contribute to the scant existing literature.

Research about the framing of scientific topics has found that the media play an active role in shaping and constructing controversies about these topics. News coverage has framed topics such as nuclear energy, food, climate change, and evolution in a variety of ways including those that highlight the possibility of runaway science and/or social progress (Dahniden, 2002; Durant, Baeur, & Gaskel, 1998; Nisbet & Lewenstein, 2002; Nisbet 2009b; Nisbet, 2009a). However, no research to date has examined the framing of artificial intelligence by major news outlets. As a result, it remains to be determined how this technology has been portrayed by sources such as major news networks or newspapers. Exploring the coverage of this topic will contribute to literature on the framing of scientific topics. Thus, this study asks:

RQ_1: How do major news networks frame artificial intelligence?

RQ_2: How do major newspapers frame artificial intelligence?

Previous research has revealed that on other scientific topics, the nature of the news coverage can differ substantially across outlets. Cable television, in particular, increasingly caters to niche partisan audiences (Hamilton, 2005). Indeed, the Project for Excellence in Journalism (2005) found that 52% of stories about controversial issues on CNN, MSNBC, and Fox News only offered a single viewpoint. Looking at one particular scientific context, Feldman et. al. (2011) found that Fox News tended to take on a more dismissive tone in its coverage of climate change as compared to CNN and MSNBC, thereby influencing viewer opinions about the issue. It is important to consider how such "differential coverage might shape—and potentially polarize audiences' views" of scientific issues" (Feldman et.al., 2011, p. 2). Thus, the present study asks:

RQ$_{3}$: To what extent do different news outlets frame artificial intelligence differently—and if so, how?

Research on framing effects, in turn, shows that media framing has the potential to shape the opinions of audience members, including in the context of scientific topics (Iyengar & Simon, 1993; Nisbet & Lewenstein, 2002; Cobb, 2005). For example, Nelson et. al. (1997) discovered that participants "who witnessed news reports about the very same event expressed significantly different opinions depending upon media framing of that event" (p. 574-576). In regard to whether positive or negative framing matters more in technological contexts, the literature on negativity bias is inconclusive given that Cobb's (2005) findings contradicted past research by showing that positive frames for nanotechnology were "sometimes almost as efficacious as negative ones" (p. 235). Therefore, this study explores how exposure to different media frames of A.I. affect audience members' views.

Previous research related to scientific topics, such as Cobb's (2005) research on nanotechnology, identifies three types of emotions that respondents may feel about new technology: hope, anger, and worry (p. 228). Given that framing of other scientific technology has been shown to elicit such emotions, it is reasonable to speculate that coverage of artificial intelligence may inspire similar feelings. Thus, this study aims to address the following questions:

RQ$_{4a}$: In what ways, if any, does exposure to media framing of A.I. influence audience members' positive emotions about the topic, such as hope and enthusiasm?

RQ_{4b}: In what way, if any, does exposure to media framing of A.I. influence audience members' negative emotions about this topic, such as worry and fear?

Furthermore, this study aims to not only explore how framing may impact emotional responses to A.I., but also how framing may influence individuals' perceptions and opinions of the technology. In order to determine whether framing can affect thoughts about A.I., the present study asks:

RQ_5: In what ways, if any, does exposure to media framing of A.I. influence audience members' perceptions regarding the effects of A.I.?

RQ_{6a}: In what ways, if any, does exposure to media framing of A.I. influence audience members' perceptions regarding the safety of A.I.?

RQ_{6b}: In what ways, if any, does exposure to media framing of A.I. influence audience members' concern about A.I.?

RQ_7: In what ways, if any, does exposure to media framing of A.I. influence audience members' overall opinions about A.I.?

RQ_8: In what ways, if any, does exposure to media framing of A.I. influence audience members' cognitive associations with A.I.?

Finally, given the prevalence of A.I. in popular culture, this study seeks to explore how closely audience members associate real-world A.I. with fictional A.I. in film or television programs. In order to determine how salient the association between pop culture A.I. and real-world A.I. is, the present study asks:

RQ_9: In what ways, if any, do news outlets reference fictional A.I.?

RQ_{10}: In what ways, if any, does media framing of A.I. influence audience members' references to fictional A.I.?

Chapter Outline

This chapter included a discussion of pertinent literature surrounding artificial intelligence, framing, framing effects, and science communication that serve as the basis for the present study.

Artificial intelligence technology has rapidly developed and currently has a wide scope within society, comprising anything from Siri, to IBM Watson, to self-driving cars. It also has a significant presence within popular culture, as the fictional A.I. depicted in *The Terminator* and *Matrix* film series have become infamous. More often than not, A.I. in popular culture tends to be destructive and dangerous, at least at first.

The study examines how various news outlets discuss A.I., and thus employs framing theory to guide its research. The literature has shown that media messages can mold understanding and opinion about major issues by establishing frames that "offer a central organizing idea or story line that provide meaning to an unfolding series of events" (Gamson & Modigliani, 1989, p. 143).

Furthermore, research on framing effects has found that news framing can influence audience members to adopt media perspectives on issues. Although there are various psychological and contextual factors that contribute to whether and, if so, how a frame will be processed, there is much literature that indicates that exposure to particular frames can influence an individual's attitudes or opinions toward a particular issue.

When it comes to framing scientific topics, "evidence suggests that the media play an active role in shaping and even constructing controversy," thus indicating the importance of understanding such framing as it has the ability to potential shape public opinion of science (Mazur, 1981, p. 114). Researchers have identified a set of commonly used frames—social progress, economic development/competitiveness, morality/ethics, scientific/technical uncertainty, Pandora's Box, public accountability/governance, middle way/alternative path, and conflict/strategy—that the media have used to discuss science-related topics. This typology will be applied by the present study in the content analysis to determine how news outlets cover A.I.

Thus, drawing on previous literature conducted into framing, framing effects, and science communication, this study hopes to explore the nature of the discussion of artificial intelligence in various news outlets by identifying how A.I. is framed, how frequently particular frames occur, and whether the nature and prevalence of frames differs among news outlets. The study then examines the effects of exposure to particular frames by measuring audience members' responses to various questions designed to gauge their attitudes and opinions toward A.I.

Chapter 2:

ANALYZING MEDIA FRAMES FOR A.I.

I To understand the media climate around A.I. and establish appropriate stimuli for the study's experiment, a small-scale content analysis of 64 newspaper articles and news segments examined how the news media have framed artificial intelligence. Specifically, the content analysis aimed to answer the following research questions:

RQ_1: How do major news networks frame artificial intelligence?

RQ_2: How do major newspapers frame artificial intelligence?

RQ_3: To what extent do different news outlets frame artificial intelligence differently—and if so, how?

RQ_9: In what ways, if any, do news outlets reference fictional A.I.?

Following the typology developed by Nisbet (2009c), each article and news segment was coded for the present or absence of eight frames: social progress, economic development/competitiveness, morality/ethics, scientific/technical uncertainty, Pandora's box/Frankenstein's monster/runaway science, public accountability/governance, middle way/alternative path, and conflict/strategy. The sample was also coded for the presence or absence of pop culture references related to artificial intelligence.

Methods

To explore how news media have framed A.I., this study conducted a small-scale content analysis that examined coverage of A.I. in major national newspapers (*The New York Times, The Washington Post, USA Today*) and segments on major cable television news networks (Fox News, CNN, MSNBC) between January 2007 and December 2017. This ten-year time frame captures a key period in the rise of artificial intelligence and its presence in individuals' day-to-day lives, as marked by the release of the first Apple iPhone in January 2007. The iPhone introduced a pioneering new software that led to the development of popularly used A.I. systems such as Siri and Alexa. Similarly, interest in A.I. continued to grow after 2007 as reflected in an increase in annually published A.I. papers, machine learning course enrollment, investments in A.I. startup companies, and startup companies developing A.I. (Gray, 2017).

The television networks selected for the content analysis were chosen based on recent Nielsen data demonstrating that Fox News, CNN, and MSNBC all rank in the top ten most-watched networks on basic cable during prime time (Katz, 2017), as well as the fact that previous researchers have investigated similarities and differences in scientific topic framing across these networks (Hart, 2008; Feldman et. al., 2011). Similarly, the major newspapers were selected based on recent data that indicate that *The New York Times, Washington Post,* and *USA Today* are among the ten most popular newspapers in the United States (Misachi, 2017). In addition, these newspapers—particularly *The New York Times* and *The Washington Post*—play key roles in setting the national news agenda and the tenor of public discourse.

A simple random sample of television news segments and stories from major newspapers was obtained from the LexisNexis database. This study's primary search term was "artificial intelligence" as this term yielded more results among the selected sources than "AI" or "machine learning." A search was conducted for the term in the headline or lead of each segment or article rather than the entire text. This was done to ensure that the segment or article focused on artificial intelligence, thus eliminating articles that may have tangentially included the term but were not actually pertinent to the topic. The search yielded 632 results, with 368 (58%) total stories in *The New York Times,* 129 (20%) total stories in *The Washington Post,* 79 (13%) total stories in *USA Today,* and 56 (9%) total news segments in CNN. LexisNexis did not yield any results for transcripts discussing A.I. for the Fox News or MSNBC networks; thus these outlets were not included in the analysis. A random number generator was used to select 10% of the stories or segments from each source to be included in the analysis. In total, 64 stories and segments were coded, with 37 (58%) of them appearing in *The New York Times,* 13 (20%) appearing in *The Washington Post,* 8 (13%) appearing in *USA Today,* and 6 (9%) appearing in CNN news segments.

The coding scheme built on Nisbet's (2009c) typology of frames for scientific issues and included eight frames: (1) social progress, (2) economic development/competitiveness, (3) morality/ethics, (4) scientific/technical uncertainty, (5) Pandora's Box/Frankenstein's monster/runaway science, (6) public accountability/governance, (7) middle way/alternative path, and (8) conflict/strategy. The frames in this typology were not treated as mutually exclusive, and so each segment or story could be coded as including multiple frames. Additionally, the sample was coded for the absence or presence of a pop culture references related to A.I. (e.g. Skynet, HAL, Terminator).

To ensure reliability of the coding, a second coder analyzed a randomly chosen 20% subsample of stories and segments using the aforementioned typology. Overall, intercoder reliability was mostly adequate in terms of percentage agreement and Cohen's *kappa.* However, *kappa* levels for the public accountability and middle way/alternative path frames could not be calculated due to the fact that those two variables were constants within the reliability subsample.

Table 2.1: Intercoder Reliability in Terms of Cohen's *kappa* and Percentage Agreement

	Cohen's *kappa*	**Percentage Agreement**
Social Progress	1.00	100%
Economic Development	1.00	100%
Morality/Ethics	.76	92%
Scientific / Technical Uncertainty	.45	77%
Pandora's Box	.58	85%
Public Accountability	Not calculated	100%
Middle Way	Not calculated	100%
Conflict & Strategy	.63	92%

As reported by Table 2.1, percentage agreement was greater than 80% for all for all frames except scientific/technical uncertainly. The *kappa* levels were relatively high for the social progress and economic development frames and moderate for the morality/ethics, and conflict/strategy frames. However, the lower *kappa* levels for the scientific/technical uncertainty and Pandora's box frames indicate that the agreement between the two coders may have been more due to chance than actual consensus of the presence or absence of these frames within particular articles. The instructions and codebook to the second coder can be found in Appendix A.

Results

The content analysis revealed that, of the eight possible frames, social progress was the one most frequently used by the articles and segments, followed by Pandora's box. The next most frequently used frame was conflict/strategy, while economic development/ competitiveness was the fourth most frequent. The remaining four frames (listed here in order from most to least common) were relatively rare: scientific/technical uncertainty, morality/ethics, public accountability/governance, and, finally, middle way/alternative path.

Of the 64 stories and segments in the sample, 43 (57%) of stories are framed in terms of social progress. An example of social progress framing that emphasizes the benefits to society that A.I. brings can be found in a January 10, 2016 article in *The Washington Post,* describing recent A.I. developments as evidence that "people and robots can be complementary and evolve together," and in a June 12, 2014 article in *The New York Times* describing A.I. technology as being capable of providing "hyper-personalized assistance" to humans.

The Pandora's box/Frankenstein's monster/runaway science frame, which focuses on the potential dangers of A.I., appears in 21 (33%) of stories. Examples of this framing are present in a *USA Today* article published on September 6, 2017 that quotes Elon Musk as saying that "artificial intelligence will be the most likely cause of World War III" and in a November 12, 2014 *New York Times* article about automated weapons that cites specialists' "fear that [A.I.] will become increasingly difficult for humans to control—or defend against."

Conflict and strategy framing, which focuses on which companies, countries, or organizations are ahead in developing A.I., is present in 20 (31%) of stories, including an April 8, 2016 article in *USA Today* discussing Facebook's experimentation with chatbots and how they placed "a major bet on messaging as the next major platform" in order to get ahead of the A.I. developments among competitors such as Microsoft. Similarly, another article published in *USA Today* on October 18, 2017 claims that the "A.I. infused Google Assistant…is only getting smarter," thus forcing competitors like Samsung and Apple to create technology that surpasses it in order to compete.

Fifteen (23%) of the articles are framed in terms of economic development or competitiveness, meaning that they reference how A.I. can be economically beneficial as it promotes global competitiveness to develop the latest technologies. For instance, a *The Washington Post* article published on April 2, 2017, claiming that A.I. automation is expected to have a positive impact on "productivity, employment, and income" within companies. Similarly, an article published in *The New York Times* on December 5, 2016 states that "many companies are racing to bring on new A.I. talent to compete against one another."

Scientific/technical uncertainty framing—which focuses on scientific uncertainty of the benefits, uses, or possibilities of A.I.— appears in 12 (18.8%) of articles. One example is in a January 10, 2016 article in *The Washington Post* that discusses uncertainty in the scientific community about whether “A.I. systems can be designed so that they are unequivocally beneficial and controllable.” Another article published on August 17, 2015 in *The New York Times* addresses the debate about “whether a machine—say, an A.I.-enabled helicopter drone—might be more effective than a human at making targeting decisions.”

Morality/ethics framing—which focuses on how ethical the creation or uses of A.I. are— is present in 8 (12.5%) the articles. For example, a November 20, 2016 *New York Times* posits that “people who own intelligent or sentient machines would face moral problems.” The frame is also exhibited in an article published on August 17, 2015 in the same newspaper that presents two sides of a debate, with one side saying that if “A.I weapons systems can get a dangerous job done in the first place of a human, we have a moral obligation to use it” and the other side warning that the development of these weapons is potentially dangerous if they fall into the hands of “adversaries that adhere to different ethical standards.”

Few examples of the remaining two frames described by Nisbet (2009c) are present in the sample examined by this content analysis; only 5 stories (7.8%) are framed in terms of public accountability/governance—thereby focusing on how A.I. can be used in serving private interests— and only 2 (3.1%) are framed in terms of a middle way/alternative path. One example of public accountability/governance framing appears in a June 15, 2017 *New York Times* article claiming that A.I. could be used to prevent terrorism: “new artificial intelligence technology could be used to counter any form of extremism that violated a company’s terms of use.” An example of middle way/alternative path framing—which focuses on references to A.I. that are essentially neutral— appears in an article published on March 13, 2008 in the same publication that celebrates the life of Joseph Weizenbaum, who designed a “famed controversial computer program,” after his death.

Comparable results emerged when examining each sampled source individually, as illustrated in Table 2.2 Chi-squared tests were conducted to test for independence between source and framing technique. No significant differences across source were found for the social progress frame ($\chi^2(3) = 1.95$, $p > .05$), economic development/competitiveness frame ($\chi^2(3) = 4.51$, $p > .05$), morality/ethics frame ($\chi^2(3) = 3.67$, $p > .05$), or scientific/technical uncertainty frame ($\chi^2(3) = 3.23$, $p > .05$). Nor did significant differences emerge for the other frames: Pandora’s box ($\chi^2(3) = 5.6$, $p > .05$), public accountability/governance ($\chi^2(3) = 3.96$, $p > .05$), middle way/alternative path ($\chi^2(3) = 4.33$, $p > .05$), or conflict/strategy ($\chi^2(3) = 2.47$, $p > .05$). This indicates that sources did not vary discernibly in terms of how likely they were to use any of the frames.

Table 2.2: Distribution of Frames by Source (Total N=64)

	Social Progress	Economic Development	Morality/ Ethics	Scientific/ Technical Uncertainty	Pandora's Box	Public Accountability	Middle-Way	Conflict & Strategy
The New York Times (n=37)	23 (62.1%)	13 (35.1%)	7 (18.9%)	9 (24.3%)	9 (24.3%)	5 (7.8%)	2 (3.1%)	20 (31.3%)
The Washington Post (n=13)	9 (69.2%)	2 (15.4%)	1 (7.7%)	1 (7.7%)	6 (46.3%)	0 (0%)	0 (0%)	3 (23.1%)
USA Today (n=8)	7 (87.5%)	1 (12.5%)	0 (0%)	0 (0%)	2 (25%)	0 (0%)	0 (0%)	5 (62.5%)
CNN (n=6)	4 (66.7%)	0 (0%)	0 (0%)	2 (33.3%)	4 (66.7%)	0 (0%)	1 (16.7%)	1 (16.7%)
χ^2	1.95	4.51	3.67	3.23	5.60	3.96	4.33	2.47

To answer **RQ$_9$**, a modest number of popular culture references appeared in the articles sampled, with 9 (14.1%) of the 64 including at least one specific reference to a fictional A.I.-related character or concept. Four (44.5%) of these appeared in *The New York Times,* 2 (22.2%) appeared in *The Washington Post,* 2 (22.2%) appeared in CNN, and 1 (11.1%) appeared in *USA Today.* Of the 9 articles, 5 use a Pandora's box frame, 3 use a social progress frame in conjunction with a scientific uncertainty frame, and only 1 uses a social progress frame by itself. The latter article, entitled, "Movie Tips from Your Robot Overlords," appeared in *The Washington Post* and is an exception from the rest because it celebrates an A.I. algorithm that can suggest movies based on user preference: "It just helps you pick what to watch once you've cleared *The Matrix* from your Netflix queue."

In total, there are 4 separate mentions of *The Terminator* movies among the articles, 3 mentions of HAL from *2001: A Space Odyssey*, and 5 articles that include miscellaneous mentions of A.I. in popular culture such as those appearing in television programs such as *Westworld* or in films such as *The Bladerunner, The Matrix, iRobot, Her, Star Trek,* and *Star Wars. Terminator* references typically appeared in articles discussing autonomous weapons in warfare and the potential concerns that may arise from their use. For example, a *New York Times* article from October 26, 2016 describes the debate within the military on how much independence to give autonomous weapons as “The Terminator Conundrum.” Similarly, a *New York Times* article from August 17, 2015 article suggests that autonomous weapons may “turn the planet into a ‘Terminator’-like battlefield.”

In contrast, mentions of HAL of *2001: A Space Odyssey* appeared in articles discussing A.I. that may sound and think like humans. For instance, a February 15, 2016 article in *The New York Times* references HAL when mentioning the “possibly perturbing applications” a human-sounding machine voice may have, and a June 12, 2014 article in the same publication refers to HAL when discussing singularity and the potential that this may have on “leaving human intelligence in general in the dust.”

The other 5 pop culture references (*The Bladerunner, The Matrix, iRobot, Her, Star Trek,* and *Star Wars)* appeared as very brief mentions in the coded articles, often in conjunction with the *Terminator* and HAL references.

Discussion

Social progress and Pandora’s box/Frankenstein’s monster/runaway science emerged as the two frames most commonly used by the media when discussing A.I., with the majority of stories and segments portraying the technology in a positive manner. This indicates that, contrary to the alarmist headlines that may stand out to some, most discussions of A.I. in the media tend to emphasize the potential benefits that this emerging technology can have on society more than they harp on the chance that A.I. could emerge as a potential threat.

Furthermore, the results of this small-scale content analysis reveal that, contrary to past studies that have indicated that nature of news coverage can differ substantially across outlets (Hamilton, 2005; Project for Excellence in Journalism, 2005; Feldman et. al., 2011), artificial intelligence is discussed more or less uniformly across sources. Each of the sampled sources—except CNN, which balanced the social progress and Pandora's box frames evenly—predominantly portrayed artificial intelligence and its developments as technology that can potentially help humanity.

The popular culture references featured in the articles selected for this content analysis were interesting in that they seemed to be predominantly negative in nature. Mentions of A.I. in the form of HAL, terminators, Skynet, the computer systems in *The Matrix,* and even the robots in *iRobot* conjure some unpleasant, concern-inducing images of the technology. Given that these mentions most frequently appeared where a Pandora's box frame was present, it would appear that Hollywood's portrayal of artificial intelligence as a potential threat to humanity has resonated with some journalists.

The content analysis possesses several limitations that may have affected its results. To begin, it only examined four outlets. Thus, it is possible that the results obtained from the sample are not representative of the framing techniques used by most newspapers and television news outlets. Additionally, two of the six selected news media outlets—Fox News and MSNBC—could not be examined due to the lack of content available in the LexisNexis database from these sources based on the search criteria. Unlike the other four news media outlets examined, these two news networks tend to feature more ideologically polarized coverage. Had the latter sources been examined, perhaps more differences among the news media sources would have appeared. However, it seems unlikely that artificial intelligence would be framed in a markedly different manner from the results obtained here, as opinions about A.I. are not as politically divisive as scientific issues such as climate change and evolution.

Additionally, the tests of intercoder reliability yielded low reliabilities for a few of the frames. This may reflected the incorrect coding of articles, thus misrepresenting the prevalence (or lack thereof) of frames such as scientific/technical uncertainty and Pandora's box.

Despite these limitations, the content analysis provided new insights by identifying the most prominent A.I. frames within coverage from major newspapers and television networks, and by revealing the salience of dangerous A.I. in popular culture. The next part of the study builds on this groundwork to explore framing effects on responses to A.I.

Chapter 3:

TESTING THE EFFECTS OF MEDIA FRAMES FOR A.I.

Upon the completion of the content analysis—which provided a more comprehensive understanding of how artificial intelligence has been framed by various news media sources over the past ten years—an experiment was conducted to test whether different frames for A.I. shape audience members' perceptions of and attitudes toward this technology. An article about A.I. technology was selected from a major newspaper and edited into four treatments that each framed A.I. differently: one included a social progress frame, one included a Pandora's box frame, one included both frames, and one included no frame. These two particular frames were selected because, as demonstrated through the content analysis, they are two of—if not the—most prevalent media frames for A.I. Participants were randomly assigned to a treatment group and then asked to complete a post-test survey designed to measure their emotional responses to, perceptions of, and overall opinions about artificial intelligence.

The purpose of the experiment was to capture whether exposure to framing of A.I. had any effect on the latter variables. Thus, the experiment was designed to answer the following research questions:

RQ$_{4a}$: In what ways, if any, does exposure to media framing of A.I. influence audience members' positive emotions about the topic, such as hope and enthusiasm?

RQ$_{4b}$: In what ways, if any, does exposure to media framing of A.I. influence audience members' negative emotions about this topic, such as worry and fear?

RQ$_{5}$: In what ways, if any, does exposure to media framing of A.I. influence audience members' perceptions regarding the effects of A.I.?

RQ$_{6a}$: In what ways, if any, does exposure to media framing of A.I. influence audience members' perceptions regarding the safety of A.I.?

RQ$_{6b}$: In what ways, if any, does exposure to media framing of A.I. influence audience members' concern about A.I.?

RQ$_{7}$: In what ways, if any, does exposure to media framing of A.I. influence audience members' overall opinions about A.I.?

RQ$_{8}$: In what ways, if any does exposure to media framing of A.I. influence audience members' cognitive associations with A.I.?

RQ$_{10}$: In what ways, if any, does media framing of A.I. influence audience members' references to fictional A.I.?

Stimuli

An article published in *The New York Times*, "If Our Gadgets Could Measure Our Emotions," was selected as the basis for experimental stimuli, as it included elements of both social progress and Pandora's box framing. The article was then edited into four treatments: one highlighting the social progress frame, one highlighting the Pandora's box frame, one representing both frames equally, and one including neither frame. The last treatment served as the control group for the experiment, while the three other treatments were designed to investigate the impact of one-sided positive framing (social progress), one-sided negative framing (Pandora's box), and two-sided framing of A.I. on readers' opinions about the technology discussed in the article. Each treatment led with the same introduction, which described the A.I. technology discussed in the article—a software that can train computers to recognize human emotions based on facial expressions and physiological responses— and stated that it was currently being developed.

Though the version including a social progress frame and the article including a Pandora's box frame were the same length, their context differed. The treatment for the social progress frame highlighted the positive contributions that A.I. technology can have on society and how beneficial it may be to humans in their daily lives. This version of the article claims that "industries like healthcare may be revolutionized by emotionally aware technology" because it can "allow nutritionists to carefully build meal plans for clients, or for doctors to come up with more efficient medical treatments." Furthermore, the article quotes a technology developer as saying that "when we are wearing five different computers and they can all talk to each other, that sort of information will cause in exponential increase in what humans can do."

The treatment article for the Pandora's box framework, on the other hand, omits any discussion of the benefits that the technology discussed can bring, and instead focuses on its potential negative uses. This version claims that "the range of ethical and privacy concerns is enormous" and then elaborates on this by saying that insurance companies "might want to know its customers' moods so it can raise their fees if they show signs of becoming depressed" and that employers "might want to know when their staff members are bored, so they can give them more work or reprimand them." Furthermore, this version of the article quotes an author of a book on A.I. as saying that there is "something unsettling about emotion recognition becoming another part of our lives that is archived and scrutinized."

The article that included both frames featured each of the passages described above, while the article with neither frame included only the introductory statements featured in the previous three treatments. The four article treatments can be found in Appendices B through E.

Posttest

Participants were randomly assigned one of the article treatments, and, after reading their assigned version of the article, were asked to complete a post-test survey designed to measure their responses to, perceptions of, and opinions about artificial intelligence. Drawing from Cobb's (2005) research on nanotechnology, the primary dependent variables in this study included emotions that respondents may feel about artificial intelligence such as hope, enthusiasm, fear, and worry. In order to gauge participants' emotions about artificial intelligence after reading their assigned article treatment, they were asked to indicate how enthusiastic (M=2.65, SD=.82), hopeful

(*M*=2.68, *SD*=.77), worried (*M*=2.80, *SD*=.80), and afraid (*M*=2.52, *SD*=.86) they felt (1= not at all, 2=not too much, 3=somewhat, or 4=very).

Other dependent variables of interest included participants' perceptions of how safe A.I. is and how potentially helpful or harmful it may be to society as a whole. In order to measure perceived effects of artificial intelligence (*M*= 2.22, *SD*=.42), participants were asked "If computer scientists were able to develop computers with A.I., what effect do you think this would have on society as a whole? Would it do more harm than good [coded as 0], equal amounts of harm and good [1], or more good than harm [2]?" To measure participants' risk perceptions (*M*=2.60, *SD*=.59) regarding artificial intelligence, respondents were asked, "How safe or unsafe do you think A.I. is?" (1=very unsafe, 2=somewhat unsafe, 3=somewhat safe, or 4 = very safe) and, "How worried are you that machines with A.I. could eventually pose a threat to the existence of the human race?" (1=very worried, 2=somewhat worried, 3=not too worried, or 4=not at all worried).

An additional set of opinions about A.I. were captured through Likert scales that asked participants to indicate their level of agreement (1=strongly disagree, 2=disagree, 3=neither agree or disagree, 4=agree, or 5=strongly agree) with various statements about artificial intelligence. These statements included, "Machines may become smart enough to control humans" (*M*=3.22, *SD*=1.11), "Machines will someday be capable of replicating human thinking" (*M*=3.79, *SD*=.94), "A.I. will replace human beings in many labor-intensive tasks" (*M*=4.27, *SD*=.81), "There are strong ethical concerns surrounding the use of A.I." (*M*=4.01, *SD*=.95), "I am concerned about the risks A.I. poses" (*M*=3.66, *SD*=1.01), "I am excited about the developments that A.I. may bring" (*M*=3.32, *SD*=.91), and "I trust innovators and leaders in the A.I. industry to minimize potential risks to humans" (*M*=2.99, *SD*=1.07).

To determine whether framing had an effect on participants' cognitive associations with the term "A.I.," they were asked to describe what came to mind when they heard or read about artificial intelligence as an open-ended response. This appeared as the third question in the survey, following questions asking participants to evaluate their opinions about the article (how entertaining, informative, amusing, or surprising it was) and their emotional responses to the article (enthusiasm, hope, worry, fear) to ensure that responses were influenced by the treatment article, rather than by other questions appearing in the survey (for instance, "How safe or unsafe do you think A.I. is" may conjure negative associations of A.I., as it forces participants to evaluate the danger that this technology poses). These responses were sorted into categories depending on whether they reflected concerns regarding A.I.'s power over humanity, concerns over A.I. and privacy, discussions of both positive and negative aspects of A.I., or comments about A.I.'s benefit to society with no mention of possible disadvantages. Additionally, it was noted whenever a response included the term "robot" or a pop culture reference to A.I.

Sample

The experiment was administered to students enrolled in various communication courses at a Mid-Atlantic university in March 2018. Students were provided with a link to an online questionnaire administered through the Qualtrics survey software. About 300 students were invited to complete the survey in exchange for extra credit. A total of 176 (a 59% response rate) completed the questionnaire.

Of the students surveyed, 116 (66%) were female, while only 60 (34%) were male, and 1 (1%) indicated "Other" for gender. The participants were predominately white, as 149 (83%) indicated this as their race/ethnicity, 14 (8%) identified as Asian/Pacific Islander, 8 (5%) identified as Hispanic, 4 (2%) identified as African American/Black, and 4 (2%) identified as "Other." In terms of age, 56 (32%) of participants indicated that they were 19, 43 (24%) indicated they were 20, 41 (23%) indicated they were 18, 27 (16%) indicated they were 21, 4 (2%) indicated they were 22, and 3 (2%) indicated there were 23. When asked about political party affiliation, 66 (37%) identified as Democrat, 59 (33%) identified as Independent or Other, and 52 (29%) identified as Republican.

Although the participants were all enrolled in a Communication course, 103 (58%) of respondents indicated that they were not Communication majors, whereas only 74 (42%) indicated that they were. When asked if they were a science, technology, or math major, 147 (84%) responded "No," while 29 (16%) responded "Yes." Among those who said "Yes" to the latter question, the most common majors were Wildlife Conservation and Ecology, Management Information Systems, Pre-Veterinary Medicine and Animal Biosciences, and Biology.

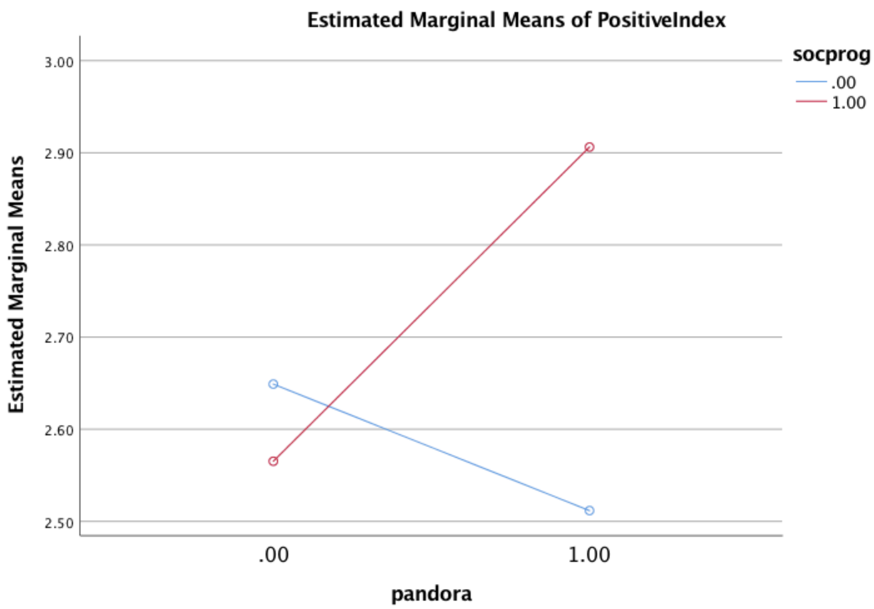
Results

The analyses focused on examining the relationships between which frame a participant was assigned and their sentiments toward A.I. A series of two-way ANOVA tests were conducted in order to answer the proposed research questions.

Two separate indices were created from responses to the questions asking participants to indicate how enthusiastic, hopeful, worried, or afraid they felt after reading the assigned article. The responses for "enthusiastic" and "hopeful" were averaged into a positive emotions index (r= .62), while the responses for "worried" and "afraid" were averaged into a negative emotions index (r=.76). A two-way ANOVA was then run on each of these indices against the independent variables—exposure to the social progress frame, exposure to the Pandora's box frame, and the interaction between the two—in order to test the effects of frames on emotional responses to A.I.

No significant effect was found for exposure to the social progress frame on positive emotions, $F(1,180)=2.16$, $p=.14$. Nor was there an effect for exposure to the Pandora's box frame on such emotions, $F(1,180)=.93$ $p=.34$. However, there was a significant interaction between the effects of social progress and Pandora's box framing on positive emotions toward A.I., $F(1,180)=5.12$, $p=.03$. This indicates that although the social progress and Pandora's box frames had no separate effects on positive responses to news about A.I., an interaction between exposure to a social progress frame and exposure to a Pandora's box frame did affect how positively participants felt. Thus, to answer $\mathbf{RQ_{4a}}$, exposure to media framing of A.I. does influence individuals' enthusiasm about and hope. Specifically, exposure to social progress and Pandora's box framing in tandem results in more positive emotions, as illustrated by Figure 3.1.

Figure 3.1: Social Progress Framing, Pandora's Box Framing, and Positive Emotions



When a two-way ANOVA was conducted to examine the effect of framing on negative emotions, no significant effects emerged. A nonsignificant effect was found for exposure to the social progress frame on negative emotions, $F(1,180)=1.53$, $p=.22$, and a similarly nonsignificant effect was found for exposure to the Pandora's box frame and negative emotions, $F(1,180)=.03$, $p=.87$. No significant interaction was found between the social progress and Pandora's box frame and negative emotions either, $F(1,180)=.02$, $p=.88$. This answers **RQ_{4b}** by revealing that exposure to media framing did not discernably affect negative emotions such as anger or concern. The results of the two-way ANOVA results for both the positive and negative emotion indices can be found in Table 3.1.

Table 3.1: Two-Way ANOVA Testing Effects of Frames on Emotional Responses

	Positive Emotions Index	Negative Emotions Index
Social progress	$F = 2.16$ (1, 180)	$F = 1.53$ (1, 180)
Pandora's box	$F = .93$ (1, 180)	$F = .03$ (1, 180)
Social progress * Pandora's box	$F = 5.12$* (1, 180)	$F = .02$ (1, 180)
	(N=183)	(N=183)

Note: * $p < .05$

The aforementioned interactive effect on positive emotions is the only significant effect that emerged for the study's framing treatments. A two-way ANOVA testing the framing effects on perceptions of A.I's effect on society yielded no significant main or interactive effects, as reported by Table 3.2. This indicates that exposure to neither social progress or Pandora's box framing significantly impacted participants' perceptions of how positively or negatively A.I. will affect society. To answer **RQ_5**, framing did not influence participants' perceptions about A.I.'s effect on society.

Table 3.2: Two-Way ANOVA Testing Effects of Frames on Perception of A.I.'s Effect on Society

	Effects on Society
Social progress	F= 1.51 (1, 174)
Pandora's box	F = .22 (1, 174)
Social progress * Pandora's box	F= 3.13 (1, 174)
	(N=178)

Note: * $p < .05$

Table 3.3 shows the results of a two-way ANOVA that looked at the effects of frames on concern over A.I. These tests revealed no significant main or interactive effects for the two frames on how concerned participants were over the safety of A.I. nor their general worry over A.I. These results reveal that concern about the safety of A.I. is not significantly impacted by exposure to social progress or Pandora's box framing of A.I. This contributes to answering **RQ6a** and **RQ_{6b}**, as framing did not influence participants' perceptions of the safety of A.I. nor participants' concern about A.I.

Table 3.3: Two-Way ANOVA Testing Effects of Frames on Safety and Worry about A.I.

	Safe	Worried
Social progress	*F*= .01 (1, 174)	*F*= .14 (1, 174)
Pandora's box	*F*= .04 (1, 174)	*F*= .36 (1, 174)
Social progress * Pandora's box	*F* = .30 (1, 174)	*F*= .89 (1, 174)
	(N=178)	(N-178)

Note: * $p < .05$

Finally, two-way ANOVAs were run for responses to each of the Likert items that asked participants to rate their agreement with various statements about A.I. Tables 3.4 and 3.5 report the results, which reveal no significant main or interactive effects for the frames on any of the dependent variables. Thus, participants' opinions about A.I. were not significantly impacted by exposure to social progress or Pandora's box framing of the technology. To answer **RQ_7**, framing did not influence participants' opinions about the topic.

Table 3.4: Two-Way ANOVA Testing Effects of Frames on A.I. Opinions

	A.I. Smart Enough to Control Humans	Machines Capable of Thinking	A.I. Replace Humans in Labor Tasks
Social progress	F= .11 (1, 172)	F= .03 (1, 173)	F = 1.92(1, 173)
Pandora's box	F= 1.84 (1, 172)	F= .70 (1, 173)	F= .53 (1, 173)
Social progress * Pandora's box	F= .04 (1, 172)	F= .06 (1, 173)	F= .50 (1, 173)
	(N=177)	(N=177)	(N=177)

Note: * $p < .05$

Table 3.5: Two-Way ANOVA Testing Effects of Frames on A.I. Opinions

	Concerned about A.I. Risks	Excitement About A.I. Developments	Trust in Innovators in A.I. Industry to Minimize Risk
Social progress	F= 1.76 (1, 173)	F= .12 (1, 173)	F = .99 (1, 173)
Pandora's box	F= .67 (1, 173)	F= .04 (1, 173)	F= .19 (1, 173)
Social progress * Pandora's box	F= .43 (1, 173)	F= .39 (1, 173)	F= .59 (1, 173)
	(N=177)	(N=177)	(N=177)

Note: * $p < .05$

The analysis of open-ended responses to the question, "When you hear or read about A.I. what do you think of?" revealed no clear patterns between the type of responses offered and frame assigned—thus answering **RQ**$_{\mathbf{10}}$— but still yielded some interesting results. As illustrated in Table 3.6, most participants responded to the question in a way that indicated concerns over A.I.'s potential threat to humanity, regardless of the frame to which they were assigned, thus answering **RQ$_8$**.

Table 3.6: Common Themes in Open-Ended Responses

Treatment	Concern/Fear	Privacy	Positives & Negatives	Neutral	Benefit Us	"Robots"	Pop Culture
No Frame	14	6	3	10	4	6	6
Pandora's Box	13	7	2	8	7	8	4
Social Progress	15	3	9	11	3	6	1
Both Frames	12	8	6	5	2	11	7

The following responses illustrate such concerns:

> *I often feel frightened by the possibilities of A.I. simply because once these technologies are created, the effort to shut them down, if they do not perform how we hope, can be compromised because of the intelligence behind the creation*
>
> *How they may take over the world someday*
>
> *I think of A.I. possibly becoming too advanced for us humans to control*
>
> *I think about the future and how artificial intelligence could take over our world in the future.*
>
> *I think that we are getting ourselves involved in something that we will one day not be able to control*

The first thing that comes to mind is the danger of A.I. becoming a threat to people in some way

Additionally, participants frequently used the term, “robots,” in the responses, along with references to movies where technology poses a major threat to humans. For example:

Robot monsters

Robot apocalypse

Robot revolution

Robots taking over the world

I think about Hollywood movies where artificial intelligence rises up against humanity

Skynet / The Terminator movies

The Terminator

Such responses reveal that many of the participants think of A.I. not only as an intricate computer system, but as an entity with which it is possible to interact; to them, A.I. is something tangible and, as captured by the popular culture references and expression of concerns about the technology, potentially dangerous.

Discussion

Although no significant main effects emerged and only one interaction was found, this study adds to the existing literature surrounding public opinions of A.I. in that it establishes an interactive relationship between framing and positive emotions toward A.I. technology. Specifically, the results demonstrate that exposure to both frames results in stronger positive emotions than exposure to only social progress framing or only Pandora's box framing. As demonstrated by the predominantly negative associations with A.I. in the short-answer responses, participants often associate A.I. with overpowering humanity or Hollywood depictions of evil robots. These associations may be so ingrained that exposure to social progress framing by itself fails to make audience members experience more positive feelings toward the technology, while Pandora's box framing does not create deeper negative associations because the participants have already considered the dangers of A.I. prior to reading the article. However, exposure to both frames may significantly impact positive emotions about this technology because this two-sided framing addresses the good A.I. can do *along with* the potential threats it poses. The article's open discussion of the threats A.I. poses may make it more credible to participants as it aligns with their preconceived notions, and so when the article discusses the benefits this technology can bring, participants feel more confident that this is in fact true—thus fostering feelings of enthusiasm and hope. Still, further research in the same vein as this study needs to be conducted in order to clarify the results obtained here.

Although the results obtained from the open-ended responses did not indicate any clear relationship between the nature of the response and type of frame, it is still interesting to note how the majority of the responses indicated either explicit feelings of apprehension toward A.I. or implicit feelings of concern through frequent mention of robots and associations with pop culture. As previously mentioned, no effect was found between frame exposure and negative feelings about A.I.; however, it is evident that many of the participants do hold some negative sentiments toward this technology. The open-ended responses served as an intriguing glimpse into what ideas people associate with A.I., but more research needs to be conducted into how and why these associations are formed.

One limitation of this study is its sample. In terms of demographics, the participants were all individuals enrolled in a mid-Atlantic university who were predominately white and female. The sample was not representative of the educational backgrounds, racial/ethnic identities, or gender breakdown of the nation as a whole, and thus the findings of this study cannot be generalized to the public. The results obtained here might have differed among a more representative sample.

The individuals who participated in this study were enrolled in a university, and so possess a higher level of knowledge than the average U.S. citizen, as only 34% of the U.S. population holds a bachelor's degree or higher (U.S. Census Bureau, 2017). Given this fact, the participants may have had expressed more muted reactions in their responses than those who have lower education levels would have simply because the former are more informed on the topic of artificial intelligence. For instance, participants who received the Pandora's box article treatment may have recalled information they previously obtained about artificial intelligence that portrayed it in a positive way, thereby countering any negative emotions, concern, and fear about the technology they experienced. Individuals with lower education levels may not have heard as much about artificial intelligence as the respondents of this study—their only source of information about this technology may, in fact, come solely from movies and television programs—and so it is possible that they could respond differently to the frames examined in the study. Further, Price and Tewksbury (1997) have even argued that the characteristics of an individual's knowledge store can shape how a particular frame is perceived. Thus, the convenience sample used for this study may have swayed the results.

Beyond the sample composition, another limitation was an aspect of the posttest design. There were no manipulation checks to ensure that the participants of the study actually read the article treatment they were assigned. If even a handful of participants skipped reading the article and went straight to the post-test, this could have affected the results regarding how framing shapes (or fails to shape) perceptions of and opinions about A.I.: in such an event, the effects of various frames would not be fully captured. Although this was, hopefully, not the case, it is a possibility that should be considered. If a study in this vein is conducted in the future, researchers may want to consider inserting a short quiz about the article in order to ensure that the participants are actually exposed to the frame before taking the posttest.

A final limitation of this study lies in the article selected to be edited into the four separate treatments. Although it did clearly exhibit social progress and Pandora's box frames, perhaps the way in which they were presented was not powerful enough to elicit a discernible response from participants. While technology monitoring one's mood can be alarming, it may not be as alarming as, say, A.I. implanted into a human-like body such as Sophia the robot. Perhaps if the content of the treatment article had been more controversial, then the social progress and Pandora's box frames might have exerted stronger effects on participants' feelings towards and about A.I.

Chapter 4:

CONCLUSION

The small-scale content analysis conducted by this study contributes to the extant literature on how newspapers and news media sources frame scientific and technological topics. Though past studies have shown that the nature of news coverage may differ substantially across outlets (Hamilton, 2005; Project for Excellence in Journalism, 2005; Feldman et. al. 2011), this study found a more uniform representation of artificial intelligence across sources. Though alarming headlines regarding this technology may stand out to some, it appears that A.I. is typically discussed as an innovation that can impact humanity in a positive way, making the lives of individuals better or easier. Indeed, a majority of articles and news media segments used a social progress frame.

In contrast, only a third used a Pandora's box frame. However, the stories that made pop culture references often included the latter frame. This suggests that although journalists predominantly think of A.I. as beneficial technology in its real life applications, its Hollywood portrayals conjure thoughts of A.I. as potentially spiraling out of control and as a danger to humanity. Hollywood's portrayals of A.I. have clearly resonated with journalists; accordingly future research should study these portrayals, as well as how—and to what degree— they shape individuals' perceptions of A.I.

Nisbet's and Lewenstein's (2002) research regarding biotechnology and media coverage provides one potential explanation for the overall positive framing of A.I. These researchers found a similarly pro-biotechnology tone in media coverage reflecting the "dominance of framing devices that accent elements of scientific progress and economic development" (p. 17), which they attributed to the low level of controversy over this technology. Looking at source influence, they likewise concluded that "scientists, industry, and government actors have dominated coverage" (p. 17). Furthermore, Nisbet and Lewenstein (2002) see this pattern "attributable to journalistic preferences, as the media have relied heavily on these sources for technical information and routine channel news" (p. 8). As with biotechnology, there appears to be little controversy over whether artificial intelligence should be integrated into our daily lives—which may explain the predominantly positive coverage of A.I.—but rather an underlying apprehension that this technology, while inevitable, may spiral out of control much like Hollywood imagined. It is plausible that the lack of controversy in A.I. coverage is a result of the industry leaders' dominance within this coverage and journalists' reliance on these leaders, given that social progress and economic development frames were frequently present in the articles this study examined, as were quotations from industry leaders and scientists. As with biotechnology, industry leaders of A.I. presumably seek to dominate coverage of the subject for professional gain, while journalists seek to quote them as sources to make their stories more credible—a symbiosis that may result in predominantly positive coverage.

The findings of this study provide only limited evidence of framing effects. Cobb's (2005) research found that members of the public maintained a positive view of nanotechnology even in the face of exposure to negative framing. Similarly, this study found that negative framing of A.I. did not have an effect on participants' perceptions, as no main effect was found for exposure to Pandora's box framing on positive or negative emotions. Similarly, exposure to framing produced no significant main effects on perceptions regarding the effects of A.I. on society, perceptions about the safety of A.I., concern about A.I., or opinions about A.I. However, exposure to an article that included both social progress and Pandora's box framing fostered stronger positive emotions toward A.I. This interaction effect may reflect the article's two-sided discussion: acknowledging potential threats from A.I. may have made it more persuasive to participants with preconceived notions about such threats.

Interestingly, the results obtained from the open-ended responses—while not indicating a clear relationship between the nature of responses and frame type—revealed that many respondents held explicit or implicit negative associations with artificial intelligence. Although the framing treatments did not appear to shape these negative associations, it is still important to consider the roots of such associations. It is reasonable to speculate that many of these negative associations arise from past exposure to media messages—particularly given research showing that ideas or feelings with the "highest excitation levels" are "the ideas and feelings most likely used in making evaluations" (Price, Tewksbury, & Powers, 1997, pp. 486). Perhaps the participants of this study were previously exposed to content—either in the news media or pop culture—that depicted A.I. in an exciting, negative manner that persisted in their memories. Thus, while participants may be able to rationalize that A.I. in the real world is probably not dangerous or scary, their first association with the term may lead them back to more dramatic depictions of the technology..

Limitations

As previously discussed, this study possessed limitations that may potentially have shaped the results obtained. To begin, the content analysis only examined four newspaper and television news sources. Thus, the results of the analysis may not be representative of the framing techniques used by other outlets. Furthermore, Fox News and MSNBC—two of the six outlets originally selected—were not examined because the LexisNexis database yielded no search results for them. These two networks tend to feature more ideologically polarized coverage and, accordingly, may have used different framing techniques than the outlets analyzed in this study. Additionally, the tests of intercoder reliability yielded low reliabilities for some of the frames, which may reflect incorrect article coding that misrepresents the prevalence (or lack thereof) of particular frames.

In terms of the experiment, the results may not be generalizable to the public given that the participants of the study were predominantly white and female, and thus not representative of the demographics of the nation as a whole. The participants of the study were also university students and thus possessed higher levels of knowledge than the average U.S. citizen, which may have influenced their responses. An individual's established knowledge store affects what sort of knowledge is activated by a particular frame (Price & Tewksbury, 1997), and so the participants of the present study may not have been as shocked or concerned about A.I. developments as individuals with significantly less knowledge about the technology would have been. Beyond the sample composition, no manipulation checks were employed to ensure that participants actually read the assigned article treatment before completing the posttest. If some individuals did not read their assigned stimuli, then the effects of the various frames would have been attenuated, resulting in skewed or invalid results. Finally, the article that was edited into the four treatments may not have included content dramatic enough to elicit powerful responses from participants. Though it did include social progress and Pandora's box framing, the content related to A.I. may not have been as alarming as, say, an article discussing A.I. implanted into a human-like body. If the "dosage" of framing in the treatment articles had been stronger, clearer effects might have emerged.

Broader limitations of the study include its sole focus on news media sources and audience members from the United States. International newspapers and television outlets may frame A.I. differently from the U.S.; thus, neglecting to examine the framing techniques utilized by international sources may limit our understanding of how A.I. is portrayed around the world. Furthermore, the experiment was only administered among one population: U.S. students. The results obtained may have differed had the survey been administered to students (or non-students) from other nations given that their cultural, social, and political contexts for A.I. may be different than the contexts for those residing in the United States. Additionally, the article used as various treatments in the posttest survey only tested the effects of one exposure to framing at one point in time, in one genre (news), and in one medium (an online version of a print story). Participants might have responded differently if they were exposed to, say, a video clip from a satirical news program discussing A.I. or even a short segment from a film portraying A.I. Such stimuli may elicit a stronger response from audience members, particularly given that may be more entertaining or visually engaging than reading a news article.

Directions for Further Research

Given these limitations, it is imperative to conduct further research that adds to our understanding of how news media frames artificial intelligence, as well as how this framing affects audience members' emotional responses to, perceptions of, and opinions toward this technology. To improve and expand upon the present study, future research should incorporate more politically polarized sources into content analyses of frames, as well as expand the scope of findings here by looking at coverage in nations other than the United States. If researchers conduct future experiments in the same vein as the one in the present study, they should consider implementing manipulation checks in order to ensure that the participants are paying attention and that the responses obtained by the posttest capture the full effects of said treatment. Additionally, future studies could collect experimental data from a more nationally representative population and/or populations from other nations.

Such research should examine not only news media framing of artificial intelligence, but also the satirical framing of this technology given that the power to shape public opinion on scientific issues through framing is not limited to traditional news media. Entertainment-oriented "soft news" media can also play a role in determining public understanding of a topic (Baum, 2003). For instance, satirical television programs such as *The Daily Show* and *The Colbert Report* are designed for comedic purposes but often address current social issues, thereby carrying the potential to shape audience members' beliefs about those issues (Brewer & Marquardt, 2007; Young & Hoffman, 2012; Young & Tisinger, 2006; Polk et al., 2009; Morris, 2009; LaMarre, 2013; Jones, 2010; Hollander, 2005; Cao, 2010). Looking at these two programs, Feldman et al. (2011) found that they frequently discussed scientific topics such as evolution and space exploration. Indeed, a Project for Excellence in Journalism study found that *The Daily Show* devoted 2.6% of its 'news hole' to science and technology—more than twice the percentage for the traditional press (Pew Research Center, 2008). Furthermore, Feldman et al. (2011) concluded that viewing the two aforementioned programs can serve as a gateway to scientific engagement. Similarly, Brewer and McKnight (2015; 2017) found that satirical framing of science on programs such as *The Daily Show, The Colbert Report,* and *Last Week Tonight with John Oliver* influenced audience members' perceptions of climate change. Thus, it would be interesting to investigate how satirical news programs such as *The Daily Show* and *Last Week Tonight* frame artificial intelligence and how this framing influences audience emotions toward, opinions about, and perceptions of this technology. Potential segments to consider include one from the June 15, 2014 episode *Last Week Tonight* where John Oliver interviews Stephen Hawking about his statement that A.I. may be "humanity's greatest invention, but may also be [the] last" and the possibility of a robot war, as well as Trevor Noah's March 9, 2018 segment on *The Daily Show* titled, "Robots Want Our Jobs…and Our Genitals."

Given the prevalence of pop culture references to the *2001: A Space Odyssey, Terminator,* and *The Matrix* films in the articles examined by the content analysis as well as the short answer responses in the survey, it may also be worthwhile to conduct research examining the framing of A.I. in these films, as well as in other relevant television programs such as *Westworld* and *Person of Interest.* The results of this study suggest that pop culture references from the aforementioned films and programs tend to be associated with negative implications of A.I.; thus, it would be useful to explore whether exposure to them not only shapes short-term reactions to this technology but also cultivates deeper impressions of it.

Artificial intelligence, though featured in countless movies and television programs, is not merely a far-fetched invention confined to science fiction; it is a rapidly developing technology that will almost certainly become omnipresent in our daily lives in the near future. As the role of A.I. within society grows and evolves, media coverage of it—along with the effects of such coverage—may grow and evolve as well. Just as this technology has the power to change our lives, the media have the power to influence how we feel about this change. Thus, it is vital that we continue to study news coverage of A.I. to understand whether we will perceive artificial intelligence as a fear-inspiring potential overlord that threatens our humanity and security or a hope-inspiring beneficial innovation designed to improve our quality of life.

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Appendix A

CODING MANUAL

Instrument A: Newspapers

A. Source, Headline, and Date of Article
    a. Provide the source of the article, the article's headline, and the date the article was published

B. Provide the length (total number of words) of the article

C. Article Frame
    a. How is artificial intelligence (A.I.) framed by the article?
        1. **Social Progress:** a means of improving quality of life or solving problems
        2. **Economic Development & Competitiveness:** an economic investment; market benefit or risk
        3. **Morality and ethics:** a matter of right or wrong; of respect or disrespect for limits, thresholds, or boundaries
        4. **Scientific and technical uncertainty:** a matter of expert understanding or consensus; a debate over what is known versus unknown
        5. **Pandora's box/ Frankenstein's monster/runway science:** a need for precaution or action in face of possible catastrophe and out-of-control consequences
        6. **Public accountability & governance:** research or policy either in the public interest or serving special interests; emphasizing issues of control, transparency, participation, responsiveness, or ownership; or debate over proper use of science and expertise in decision-making
        7. **Middle-way/alternative path:** A third way between conflicting or polarized views of options
        8. **Conflict and strategy:** a game among elites, such as who is winning or losing in developing the latest technology/A.I.

D. Reference to Pop Culture

a. Please indicate if the article makes a reference to A.I. within popular culture:
    1) Yes
    2) No
b. If there is a pop culture reference what is it…
    1) HAL (*2001: Space Odyssey*)
    2) Terminator (*Terminator*)
    3) Skynet (*The Matrix*)
    4) *Ex Machina*
    5) Other

Instrument B: Broadcast News Coverage

A. Source, Headline, and Date of Transcript
    a. Provide the source of the transcript, the transcript's headline, and the date the transcript appeared

B. Provide the length (total number of words) of the segment

C. Transcript Frame
    a. How is artificial intelligence (A.I.) framed by the transcript?
        1. **Social Progress:** a means of improving quality of life or solving problems
        2. **Economic Development & Competitiveness:** an economic investment; market benefit or risk
        3. **Morality and ethics:** a matter of right or wrong; of respect or disrespect for limits, thresholds, or boundaries
        4. **Scientific and technical uncertainty:** a matter of expert understanding or consensus; a debate over what is known versus unknown
        5. **Pandora's box/ Frankenstein's monster/runway science:** a need for precaution or action in face of possible catastrophe and out-of-control consequences
        6. **Public accountability & governance:** research or policy either in the public interest or serving special interests; emphasizing issues of control, transparency, participation, responsiveness, or ownership; or debate over proper use of science and expertise in decision-making
        7. **Middle-way/alternative path:** A third way between conflicting or polarized views of options

8. **Conflict and strategy:** a game among elites, such as who is winning or losing in developing the latest technology/A.I.

Appendix B

NO FRAME ARTICLE TREATMENT

The New York Times

If Our Gadgets Could Measure Our Emotions

By JENNA WORTHAM

On a recent family outing, my mother and sister got into a shouting match. But they weren't mad at each other -- they were yelling at the iPhone's turn-by-turn navigation system. I interrupted to say that the phone didn't understand -- or care -- that they were upset.

"Honey, we know," my mom replied. "But it should!"

She had a point. After all, computers and technology are becoming only smarter, faster and more intuitive. Artificial intelligence is creeping into our lives at a steady pace. Devices and apps can anticipate what we need, sometimes even before we realize it ourselves. So why shouldn't they understand our feelings? If emotional reactions were measured, they could be valuable data points for better design and development. Emotional artificial intelligence, also called affective computing, may be on its way.

It sounds like a science-fiction movie, and in some ways it is. Much of this technology is still in its early stages, but it's inching closer to reality.

Companies like Affectiva, a start-up spun out of the M.I.T. Media Lab, are working on software that trains computers to recognize human emotions based on their facial expressions and physiological responses. A company called Beyond Verbal, which has just raised close to $3 million in venture financing, is working on a software tool that can analyze speech and, based on the tone of a person's voice, determine whether it indicates qualities like arrogance or annoyance, or both.

Microsoft's Xbox One includes a Kinect, its motion-tracking device that lets people control games by moving their hands and bodies. One of the Kinect's sensors uses infrared technology to track a player's heartbeats. That could eventually help the company detect when a player's pulse is racing during a fitness contest -- and from excitement after winning a game.

Albert Penello, a senior director of product planning at Microsoft, says the company intends to use that data to give designers insight into how people feel when playing its games.

Eventually, he said, the technology embedded in the Kinect camera could be used for a broader range of applications, including tracking reactions while someone is looking at ads or shopping online, in the hope of understanding what is or isn't capturing the person's interest.

Online media companies like Netflix, Spotify and Amazon already have access to real-time consumer sentiment, knowing which chapters, parts of songs, movies and TV shows people love, hate, skip and like to rewatch.

So it is not much of a leap to imagine Kinect-like sensors, and tools like the ones Affectiva and Beyond Verbal are developing, being used to create new entertainment, Web browsing and search experiences.

Once a phone really does understand our emotions, the possibilities seem to spiral without limit. We're not there yet, but the future starts now.

Appendix C

SOCIAL PROGRESS ARTICLE TREATMENT

The New York Times

If Our Gadgets Could Measure Our Emotions

By JENNA WORTHAM

On a recent family outing, my mother and sister got into a shouting match. But they weren't mad at each other -- they were yelling at the iPhone's turn-by-turn navigation system. I interrupted to say that the phone didn't understand -- or care -- that they were upset.

"Honey, we know," my mom replied. "But it should!"

She had a point. After all, computers and technology are becoming only smarter, faster and more intuitive. Artificial intelligence is creeping into our lives at a steady pace. Devices and apps can anticipate what we need, sometimes even before we realize it ourselves. So why shouldn't they understand our feelings? If emotional reactions were measured, they could be valuable data points for better design and development. Emotional artificial intelligence, also called affective computing, may be on its way.

It sounds like a science-fiction movie, and in some ways it is. Much of this technology is still in its early stages, but it's inching closer to reality.

Companies like Affectiva, a start-up spun out of the M.I.T. Media Lab, are working on software that trains computers to recognize human emotions based on their facial expressions and physiological responses. A company called Beyond Verbal, which has just raised close to $3 million in venture financing, is working on a software tool that can analyze speech and, based on the tone of a person's voice, determine whether it indicates qualities like arrogance or annoyance, or both.

Microsoft's Xbox One includes a Kinect, its motion-tracking device that lets people control games by moving their hands and bodies. One of the Kinect's sensors uses infrared technology to track a player's heartbeats. That could eventually help the company detect when a player's pulse is racing during a fitness contest -- and from excitement after winning a game.

Albert Penello, a senior director of product planning at Microsoft, says the company intends to use that data to give designers insight into how people feel when playing its games.

Eventually, he said, the technology embedded in the Kinect camera could be used for a broader range of applications, including tracking reactions while someone is looking at ads or shopping online, in the hope of understanding what is or isn't capturing the person's interest.

Online media companies like Netflix, Spotify and Amazon already have access to real-time consumer sentiment, knowing which chapters, parts of songs, movies and TV shows people love, hate, skip and like to rewatch.

So it is not much of a leap to imagine Kinect-like sensors, and tools like the ones Affectiva and Beyond Verbal are developing, being used to create new entertainment, Web browsing and search experiences.

The possibilities go far beyond that. Prerna Gupta, chief product officer at Smule, a development studio that makes mobile games, says she thinks industries like health care may be revolutionized by emotionally aware technology -- particularly as we enter a time when laptops, smartphones, smart watches, fitness trackers and home media and game consoles interact with one another.

"Tracking how our bodies are responding throughout the day could allow you to tailor your life according to what's happening to your body throughout the day," she said. It could allow nutritionists to carefully build meal plans for clients, or for doctors to come up with more efficient medical treatments.

But that could be just a start. "When we are wearing five different computers and they can all talk to each other, that sort of input information will cause an exponential increase" in what humans can do, Ms. Gupta said.

Once a phone really does understand our emotions, the possibilities seem to spiral without limit. We're not there yet, but the future starts now.

Appendix D

PANDORA'S BOX ARTICLE TREATMENT

The New York Times

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Of course, the range of ethical and privacy concerns is enormous.

"We are talking about archives of personal data that are really revealing," says Clive Thompson, author of How Technology Is Changing Our Minds. "Not to mention that there is something unsettling about emotion recognition becoming another part of our lives that is archived and scrutinized."

He said an insurance company, for example, might want to know its customers' moods -- so it can raise their fees if they show signs of becoming depressed. And employers might want to know when their staff members are bored, so they can give them more work or reprimand them if their attention wanders. He wondered whether we would all become better at masking our emotions if we knew that we were being watched and analyzed. And could machines use what they know about our emotions to manipulate us into buying things?

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Appendix E

SOCIAL PROGRESS AND PANDORA'S BOX ARTICLE TREATMENT

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Appendix F

IRB EXEMPT LETTER

RESEARCH OFFICE

210 Hullihen Hall
University of Delaware
Newark, Delaware 19716-1551
Ph: 302/831-2136
Fax: 302/831-2828

DATE:	March 16, 2018
TO:	Lucy Obozintsev
FROM:	University of Delaware IRB
STUDY TITLE:	[210659-1] Audience Responses to Media Portrayals of Artificial Intelligence
SUBMISSION TYPE:	New Project
ACTION:	DETERMINATION OF EXEMPT STATUS
DECISION DATE:	March 16, 2018
REVIEW CATEGORY:	Exemption category # (2)

Thank you for your submission of New Project materials for this research study. The University of Delaware IRB has determined this project is EXEMPT FROM IRB REVIEW according to federal regulations.

We will put a copy of this correspondence on file in our office. Please remember to notify us if you make any substantial changes to the project.

If you have any questions, please contact Nicole Farnese-McFarlane at (302) 831-1119 or nicolefm@udel.edu. Please include your study title and reference number in all correspondence with this office.