Reading risk in online news articles about artificial intelligence: A discourse analysis approach

by
Sean Jones

Submitted to the Faculty of Extension
University of Alberta
In partial fulfillment for the degree of
Master of Arts in Communications and Technology
June 30, 2015

Acknowledgements

It would not have been possible to complete this paper without the support and encouragement of my friends and family. This is especially with thanks to my wife who has patiently engaged in hours of discussion and given me the opportunity and time needed to grapple with the material. Equally important has been the guidance, discussion, and timely suggestions provided by my project supervisor Dr. Thomas Barker. Participating in the MACT program has provided a wonderful opportunity to broaden the scope of my knowledge and dive headlong into the world of communications and technology. For this I am most grateful to the faculty and staff of the program.

Abstract

Artificial intelligence has captured the imagination of many since the term was coined almost fifty years ago. The potential for this technology to one day reach and succeed human intelligence has been identified as an existential risk and is often discussed in media accounts. However, despite an expanding history and much general interest, there has not been very much consideration of how we are communicating about this technology. Discourse analysis is a relatively new field of inquiry and can be used to understand the sociocultural determinants of how communication about a specific subject is proceeding. This study applies discourse analysis methods to online news accounts concerning artificial intelligence and draws conclusions based on sociocultural perspectives of risk. This approach seeks to identify the frames being used in these accounts and draws heavily on the risk discourse work of Deborah Lupton in identifying how the risk of general artificial intelligence may be understood by the public. The results provide a detailed examination of major frames at work and discuss how risk is identified within the present discourse. This exploratory study is not intended to provide answers to the question about how we can avoid the negative risk associated with artificial intelligence but rather how this risk can be understood and how it can begin to be demystified for greater understanding and improved discussion.

Keywords: Artificial Intelligence, Risk, Framing, Discourse Analysis, Competition, Nature, Artifice

Table of Contents

> "In some societies at some times, certain phenomena are selected as the focus for anxieties." (Lupton, 2013, p. 21)

Introduction

The field of artificial intelligence is complex and ever expanding. This study has been designed to survey current mainstream online media articles about artificial intelligence development and discuss how framing of this issue informs public perceptions through the lens of sociocultural perspectives of risk. Improvements in machine learning, access to big data, increasing processing speeds, and a rise in the number of companies focusing on artificial intelligence research all point to the continuing and increasing importance of this technology. However, past and current use of artificial intelligence systems and their subsequent development have not been the focus of recent media reporting. Instead, reporting has turned toward discussions of future eventualities, such as the ability for artificial intelligence to eclipse human intelligence with the potential emergence of a "general artificial intelligence", one that can apply itself to any task with greater-than-human efficiency. If recent media reports are to be believed, humanity may be on the cusp of what has been termed a technological singularity, where machine intelligence will exceed human intelligence, and this point may be reached as soon as the next quarter century. The subject of the technological singularity has been a staple in science fiction for decades and the idea of self-aware machines of human design appears in the mythology of many cultures.

Current discourse surrounding the future of artificial intelligence is rich ground for study in the field of communications and technology. A major influence for this paper are the discourse and sociocultural perspectives on risk as identified in Deborah Lupton's 2013 book, *Risk*. News

discourse concerning artificial intelligence also presents a unique opportunity to consider the sociocultural aspects of communication between individuals (scientists, journalists, and the public) and also casts light on the current sociocultural landscape.

Literature Review

The sociocultural landscape of artificial intelligence research

Artificial intelligence is currently in use in various fields, such as computer science and engineering and continues to be adapted for more diverse applications (Maglogiannis, 2007). There are many who believe that the development of fully autonomous, self-aware, or general artificial intelligence is an eventuality that will happen sooner rather than later (Bostrom, 2013; Kurzweil, 2005; Vinge, 1993). Some, such as Kurzweil (2005) believe that this will hail a time of extraordinary, positive growth for humankind, while others, such as Bostrom (2013) caution that the development of such an entity could present an existential risk to humanity. With these extreme views present, what is the public to make of the current state of artificial intelligence development?

In the sociocultural tradition, it is the way in which individuals and groups communicate that assists them in developing "social structures, identities, norms, rituals, and collective belief systems" (Craig & Muller, 2007, p. 365). By looking at research in the field of artificial intelligence to do with communication, we can easily identify how sociocultural themes arise and follow this progress as it is discussed in media accounts. Studies that focus on forming artificial intelligence behaviour after human social and cultural behaviour (Alissandrakis, Nehaniv, & Dautenhahn, 2004; Azam, 2011; Song & Kim, 2012) show several ways that this technology is developing and posit that imitating human behaviour will provide an opportunity for machines

exhibiting this behaviour to be more socially accepted. Through a series of simulations, Alissandrakis, Nehaniv, and Dautenhahn show that imitation and learned behaviour is developmentally acceptable among artificial robot agents (2004, p. 28). However, questions arise about whether cultural replication and variability is necessary in order to be globally acceptable (Alissandrakis et al., 2004, p. 29). This speaks directly to vast differentiation between the human and machine models being considered. Song and Kim (2012) study models of human behaviour in video game players to provide more realistic representation of these structures of human action. The intended aim of this study is to generate artificially intelligent models that will behave in a more human way. The players in this study are observed playing video games, their playing styles are codified, and then these styles are grouped into specific archetypes. Eventually, these archetypes can be added to the game's artificial intelligence system to create a computer managed character who acts more like a human player (Song & Kim, 2012). Additionally, Azam's research into Natural Language Processing (NLP) indicates that sociocultural divides between human and machine may be crossed by means of a common and human-like language process and ultimately "'creative' utterances" (2011, p. 129). So the basis of this type of artificial intelligence research is to model machine intelligence after human intelligence in order to ease transition between the two.

In the same way that humans are the primary sociocultural models for the development of artificial intelligence, people are also the measure used to determine whether these systems are effective. In some cases the artificial intelligence communication challenge is taken up in sterile environments created for expressly this purpose but they also take place in live environments (often referred to as 'in the wild'). The "Turing test" is a method used in a sterile environment where humans attempt to determine whether they are communicating with another person or

with a "chatbot," a computer programmed to respond in a way that mimics human written communication. This is an adaptation of Alan Turing's (1950) musings on how machine intelligence might eventually be identified. In his book *The Most Human Human* (2011), author Brian Christian takes part in the Loebner Prize, possibly the most recognized of these Turing tests, where human judges try to determine whether an entity they are corresponding with through text messages are other humans or specially designed "chatbots." Christian's attempt to become the "most human human" involves a complex and uncanny attempt to understand the difference between what is human and what is not. The mirror-like properties of this type of test is carried through various strains of artificial intelligence research but are much more difficult in non-sterile environments where one is not necessarily aware that they are interacting with a machine.

In video game environments, there is very little one can use to judge the veracity of other players. Hingston (2009) discusses a method for applying a Turing-style test to the video game environment. Hingston's test is practically the reverse of Song and Kim's (2012) separation of human playing archetypes, where various types of extant artificial intelligence are classified for easier human detection. Hingston provides a list of tactics used by bot programmers to avoid detection or to make the chatbot appear more "intelligent" or "human" (Song & Kim, 2012).This also brings into the discussion a metaphysical conversation about whether appearing to be intelligent equates to intelligence itself and perceived humanity (Hingston, 2009, p. 169). Other definitions of what the term 'intelligent' may refer to in the machine environment is outlined in Console, Lombardi, Picardi, and Simeoni's (2012) research into the Social Web of Intelligent Things (SWIT). In their research, Console et al. propose that inanimate objects in the real world can convey a sense of intelligence, "including the ability to support natural and personalized

interaction" (2012, p. 265). Where this differs from Hingston's in-game approach to defining artificial intelligence, is in a person's ability to interact and consider 'intelligent' something that acts and reacts to stimulus but carries a prior inanimate sensibility, like a park bench or a monument (Console et al., 2012, p. 266). It is one thing to converse with an entity that occurs in an entirely artificial environment, like a chatbot, but another to interact with a seemingly intelligent agent in a natural environment. A machine's potential to occupy a non-human form causes us to question whether a "body" is required to convey "intelligence."

Lee (2010) shows individuals who receive flattering messages from computers are more likely to react positively (p. 2). What this has in common with Console et al. is that Lee is identifying one potential reaction to the Console et al. SWIT model. Lee's discussion of the concept that "computers are social actors (CASA)" (2010, p. 2) fills in the gaps in the earlier work of Alissandrakis et al. (2004) and the potential for artificial intelligence to be more socially accepted. However, Lee (2010) also concludes with the assertion that we should "move beyond mere descriptions of interesting observations and get to the real business of predicting when and explaining why computers are treated as such" (p. 24). This is precisely where Chu, Gianvecchio, Wang, and Jajodia (2012) begin when they start to categorize and assess the automation of Twitter accounts. By classifying 6,000 sample accounts and 8,350,095 tweets Chu et al. are able to determine with a high level of accuracy which accounts are human, which are fully automated 'bots' (machines only), and which are cyborgs (human-assisted bots or bot-assisted humans) (2012, p. 821).

These studies indicate that not only is differentiation between a 'real' entity and an artificially intelligent entity still possible but that the ability to differentiate is becoming more useful and necessary. They also indicate that there is a case to be made that, as this importance

grows, a greater variety of testing tools will be necessary. The ability for a machine to occupy any object, where humans are restricted to their bodies, leads to more questions about how we may struggle to identify machine intelligence in the future. Although this is just a very small group of studies in artificial intelligence, by focusing on research into the sociocultural aspects of this technology we start to understand how interaction, communication, and acceptance are featuring. How these examples of recent research into artificial intelligence development and the end-result of creating a human-like or general artificial intelligence are presented to the general public is often handled by mainstream media outlets.

How is artificial intelligence handled by the media?

The relationship between science (technology-related or otherwise) and news has been the subject of a number of studies, enough so that there is a journal entitled *Public Understanding of Science* (http://pus.sagepub.com/), which focuses specifically on this area. Since the birth of modern printing allowed for the broad dissemination of information and a rise in literacy, what Marshall McLuhan termed a "disturbance" (1962, p. 16) in traditional communication, followed by the increasing popularity of printed leaflets, journals and newspapers, these media have been a "domain in which the news discourse operates [which] consists of shared beliefs about society" (Pan & Kosicki, 1993, p. 57). As traditional news outlets move online and audiences follow (Pew Research Center, 2008, p. 2), consideration of online news, its content, and the surrounding discourse has become even more important.

There have been several calls from academics for a greater scrutiny of news sources in terms of scientific communication, not as a criticism of the journalists' bias or inability to communicate but simply because the news discourse is key to our understanding of major

scientific advancements (Dahl, 2015; Dor, 2003; Levesque, 2014; Nelkin, 1987; Wilson, 1995). The way that advances in artificial intelligence are presented to the public is the topic of Hector Levesque's 2014 paper. The University of Toronto professor states, "The general public could be forgiven for thinking that AI is just about all those whiz-bang applications, smart this and autonomous that" (Levesque, 2014, p. 1). This comment is echoed by other authors, such as Jeff Hawkins in his book *On Intelligence* (2004), who states, "The public [is] impressed by a stream of seeming successes and news stories about AI technology" (p. 17). This speaks directly to the intent of this study about how and why the general public is presented with only the most interesting messages through the media, which is their primary source of this information (Dahl, 2015; Dor, 2003; Nelkin, 1987; Wilson, 1995). Levesque goes on to argue that "the question, in the end is really about us, how much perseverance and inventiveness we will bring to the task" (2014, p. 6). Levesque moves from here through a purposefully critical analysis of artificial intelligence testing, from Turing's test through to the latest demonstrations of artificial intelligence surpassing human rivals, such as IBM's Watson defeating Jeopardy! champions (Rao, 2014). By asking more nuanced questions based on the Winograd schema (see Winograd, 1972), Levesque proposes a deeper test of real understanding, rather than just data searching and processing (2014, p. 3). Levesque's conclusion states "We should avoid being overly swayed by what appears to be the most promising approach of the day" (2014, p. 6).

Organizations that have been specifically created to discuss the potential of artificial intelligence development present similar views. Muehlhauser and Salmon (2012) discuss the potential 'Intelligence Explosion' that could be brought on by artificial intelligence. Primarily, Muehlhauser and Salmon's (2012) focus is on the various predictions that have been made as to when this might happen and conclude that, in general, most predictions are highly inaccurate in

their timing but have the potential to prove true eventually. They go on to present the reasons why this happens and why human predictions are often incorrect (Muehlhauser and Salmon, 2012, p. 4). These and other studies such as *Intelligence Explosion and Machine Ethics* (Muelhlhauser and Helm, 2012) are examples of research being developed at the Machine Intelligence Research Institute, an organization dedicated in part to a focus on avoiding negative outcomes for artificial intelligence research. The subjects of Muelhlhauser and Helm's research are the forebears of artificial intelligence research and accompanying discussion of the risk/reward positions they occupy. Their research has a companion in an article by Gary Marcus (2014) writing for the *New Yorker* online magazine, wherein he discusses the ebbs and flows of artificial intelligence discussion, dependent on how much hype has been associated with various discoveries and postulations.

As the models, use and importance of artificial intelligence research increase, it is the dissemination of this information through the media that is most accessible to the general public. Instead of focusing only on the successes of the technology there should be a balance of reporting about the setbacks along the way. By doing so, the public would be presented with a much more rounded and detailed assessment of the technology, including both the positive and negative risk factors. As such, it is important that information provided to the public by the media be scrutinized in order to understand what is being communicated and how that communication is being affected by the various groups involved.

How do journalists and scientists communicate with the public?

The importance of providing appropriate context about the latest scientific discoveries to the public by the news is a common theme for study (Dahl, 2015; Evans and Priest, 1995; Kling

& McKim, 2000; Nelkin, 1987). Nelkin (1987) focuses on the tension of the scientist/journalist/public triangle, which can sometimes be healthy, with each keeping the other in check. However, this series of checks and balances seems weighted in favour of the scientists and journalists, as they control the flow of information to the public (Nelkin, 1987, p. 15). Researchers looking closely at the scientist/journalist/public triangle provide a better understanding of where context is lacking and why.

Research in this area begins with the scrutinizing of news articles for clues as to how these are prepared for public consumption (Lupton, 1992, p. 145). The use of quoted speech in articles is the subject of a 2003 study by Calsamiglia and Ferrero that aims to determine whether these quotes are "a way of absolving journalists from responsibility or a means of orientating their position on the topic of reference" (p. 169) and determines that scientific voices "have a limited role in the press... [and that] advances of science do not give rise to results with immediate answers to social needs" (p. 170). Calsamiglia and Ferrero conclude that the "differing pace of science and daily life… is manifested through the way the press, reacting consciously or unconsciously to a situation of crisis, gives rise to different voices" (2003, p. 170). So there is a clash between what scientists are researching, the fact that there are few immediate conclusions, and the journalists' desire to present a complete and easily understood story (Calsamiglia & Ferrero, 2003).

The difference in communication styles between various scientific disciplines and between individuals within each field makes providing a common approach to context difficult (Kling & McKim, 2000). In Kling and McKim's 2000 study, the authors analyze a vast array of scholarly communication and consider a social shaping of technology (SST) perspective to determine what differences there may be among various fields. This includes whether a

publication focuses on both successes and failures, whether they allow for both refereed and unrefereed papers, as well adopting value-add electronic features, such as supplementary data sets and searchable text (Kling and McKim, 2000, p. 1315). We can consider these communication challenges as they are further exacerbated by a focus on traditional news sources, which can be a bottleneck for information and do not provide enough scope of consideration (Evans & Priest, 1995). Similarly, Wynne (2014) calls for a more searching discussion of the public understanding of science and sees that there is an inherent difficulty in the public's ability to describe the concerns they have about scientific issues, only that they feel uncomfortable about broad areas of inquiry (p. 66). When this happens, Wynne argues, the media presupposes an automatic judgment presented to the public that excludes discussion (2014, p. 66). Since the public is unable to describe scientific issues but make judgments in any case, we need to understand what information these judgments are based on.

Returning to Nelkin's scientist/journalist/public triangle, it may seem simple for journalist to gather information about scientific research and then pass that, along with some added context, to the public. However, as we've seen above, there are several factors at play that make this exceedingly difficult. The overbalancing of information in the scientific and journalistic realms puts the public in a weakened state while the inherent differences between scientific reporting and journalistic reporting, specifically in the open-ended nature of the former and the stylistic focus of the later, makes reconciling the two a challenge. So, while there is more research being completed than can possibly be reported, that research is ongoing, and as a news article traditionally seeks a satisfying storyline and conclusion, the public becomes poorly informed about scientific progress. It seems to be far easier for the journalist to turn to popular

fictitious representations of the technology in their stories than for them to try and fit the scientist's research reporting into this mold.

Can the public separate fact from fiction?

Regardless of whether such a thing as science fact actually exists, the public is still presented with information about science and technology as such in news media, even when based wholly or in part on fictitious representations. By relying on fictional representations of science, journalists tend to obscure rather than illuminate the progress being made.

In a 2005 study entitled *Science fiction/science fact*, Petersen, Anderson, and Allan discuss the public's ability to understand current advances in medical genetics based on news stories and state "just as science fiction can be an important resource for people to draw upon, it can sometimes make an informed awareness of precisely what is at stake more difficult" (p. 337), a sentiment that is echoed in other research along the same lines (Kirby, 2005; Lowe et al., 2006). The relationship between fact and fiction touches upon various themes such as the use of science fiction as an explanatory tool (Petersen, Anderson, & Allan, 2005; Lowe et al., 2006; Raupp, 2014), magic as a stand-in to allow for concepts that the public does not understand (Moscovici, 2014), faith in science and technology as a focal point of our hopes and fears (Evans, 2014), and represents an oversimplification of the motivation of scientists and technologists (Haynes, 2003).

Petersen et al., examine how metaphors, imagery, and motifs are relayed in the British press surrounding issues of biotechnology, especially in the wake of scientific advances such as the cloning of Dolly the sheep in the year 2000 (2005, p. 338). Fiction and scientific inquiry should be, they argue, "mutually constitutive to the extent that they share certain imagery,

metaphors, and motifs (Petersen et al., 2005, p. 349). However, when fiction is provided as the lead sense-making tool for scientific research, this blurs these boundaries and does not present the public with a fair an unbiased opinion of progress (Petersen et al, 2005, p 350). Instead, the use of fiction obscures the progress being made, since it relies on representations of imagination rather than the results of "dispassionate enquiry" (Petersen t al, 2005, p. 350).

Moscovici discusses the substitution of magic for science in the modern mind, where the concept of magic has traditionally been used to encapsulate concepts that are beyond the reasoning of a mind unfamiliar with a specific cause and effect (2004, p. 759). This, Moscovici argues, is a space that is now occupied by science, and science's seeming ability to succeed where traditionally there has been failure (2004, p. 762). In parallel to Petersen et al. (2005), who suggest that fiction is used by journalists to present an oversimplified version of scientific progress, Moscovici (2014) suggests that magic is used to present concepts that require no explanation to the public at all. Rather, science simply provides answers without need of context or definition and relies on its audience not knowing what is happening behind the scenes.

Evans' (2014) study of faith in the context of scientific study and dissemination follows a similar vein. In order to examine his hypothesis, Evans uses international surveys to present an analysis of "faith in science" (2014, p. 819). Evans determines that the higher a country's GDP, the higher their "faith in science" (2014, p. 822) and that wealthier countries are "more amenable to looking to science for meaning" (2014, p. 822). By Evans' definition, faith is defined as a "firm belief for which there is no proof" (2014, p. 814). Again, by presenting scientific advancement as an act of faith, where the public should simply accept that it will provide a path forward, information about how achievements are being made is purposefully obscured.

Through these studies we can see how journalists, whether consciously or unconsciously, rely on methods that obscure the truth in order to report on scientific and technological progress. By relying heavily on fictitious accounts rather than presenting the actual results of scientific enquiry, they present the results of imaginative speculation. When a journalist relates the outcome of research in science and technology to a magical result, they are presenting the public with a result that requires no further explanation. Similarly, when the public is presented with a result that relies on faith, the public is expected not to require any further proof for support. Each of these tools meant to present science and technology in easily understandable and relatable terms actually obscures the situation rather than supporting a greater understanding of any progress being made.

What tools can we use to interpret what we find in media accounts?

The complexity of science and technology is often "characterized by risk and uncertainty" (Dahl, 2015, p. 40). When we discuss risk and its surrounding discourse, we must appreciate that there are many differences in the perception of risk and in the responses we have to risk (Henwood, Pidgeon, Sarre, Simmons, & Smith, 2008). Several studies spend considerable time arranging and defining the terminology used (Barth, Hatem, & Yang, 2004; Christensen, Andersen, Duijim, & Harremoës, 2003). Others contribute to various theories such as rational actor perspectives, as presented by Jaeger, Renn, Rosa, and Webler (2001), where objective choices are made by individuals on account of their preferences and in accordance with social norms. Risk society theory, as the term has been coined by Beck (1992, 2009), states society is defined by risk, which cannot be detached from individual actions. Henwood et al. (2008) contrast these two theories with "a socio-cultural perspective that also deals with perceptions of

risk" (p. 423). Here, the authors introduce the concept of framing risk including the reflection of assumptions presented by the media (Henwood et al, 2008, p. 424). This is echoed by Lupton (2013) who states that "'Expert' knowledges… embedded within organizational contexts and often mediated through the mass media, are central to the construction and publicizing of risk" (p. 46). As this is the case, dissemination and discussion of risk is inextricably linked to media coverage.

That there is a stated "existential risk" surrounding the development of artificial intelligence (per Bostrom & Ćirković, 2008), and as we often choose to determine the risk associated with a new technology by comparing it with an existing technology (Roth, Morgan, Fischhoff, Lave, & Bostrom, 1990), we must identify how that risk is currently being framed. Similar efforts at understanding media framing of risk discourse have been made with regard to other scientific efforts such as biotechnology (Howarth, 2013; Petersen et al., 2005), nanotechnology (Allan, Petersen, & Anderson, 2010; Cobb, 2005; Veltri & Crescentini, 2011), and nuclear waste (Skarlatidou, Cheng, & Haklay, 2012). These are technologies that have already had a significant and visible impact on human society and the environment. However, the presence of artificial intelligence in small, discrete quantities in several fields has yet to impress itself on society in the same way. Veltri and Crescentini identify a pattern that has begun to develop where discourse relating to these technological risks begins to appear stating, "it started with low levels of attention, which then rose sharply as the issue spread from elite media to general outlets (2011, p. 127).

The use of framing theory to determine the effects of news on the public's perception of events and ideas is a popular sociocultural approach with adherents in many fields. According to Brüggemann, "frames are *patterns of interpretation* rooted in culture and articulated by the

individual" (2014, p. 61) and have been discussed and refined over the past several decades (e.g., Entman, 1993; Gamson, Croteau, Hoynes, & Sasson, 1992; Pan & Kosicki, 1993). Entman writes, "analysis of frames illuminates the precise way in which influence over a human consciousness is exerted by the transfer (or communication) of information" (1993, p. 51). Recent studies that specifically focus on framing effects in the news show that this can be an effective tool to determine the direction of an issue, as opposed to a positive or negative assessment of the journalist's conscious efforts to steer a discussion (Allan et al., 2010, p. 35), and provides an opportunity for the researcher to focus on the discourse at hand (see for example Brüggemann, 2014; Cobb, 2005; de Vreese, 2005; Olausson, 2009). The cyclical nature of framing, where shared culture influences the journalist's production of the news, which in turn informs the shared culture, is also a common thread through many of these studies (Edelman, 1993).

Research Questions

As is evident from the fragmentary nature of the literature reviewed above, the challenges inherent in defining what artificial intelligence 'looks' like and a focus on how to detect artificial intelligence in use point to continuing and growing ambiguity between human and machine operators. The increasing ability of programmers to create programs that operate in a fashion that can blur the lines between human and machine does beg the question of when this line will be crossed and what it will mean to the greater population.

This discussion has been taken up by the media, which has a tenuous relationship with the scientists creating these systems. Unfortunately, the context and development of this discourse does not seem to be a particular focus for study at present, since this literature review

did not unearth anything along these lines. The aim of this study is to answer the following two research questions in order to tie together the issue of artificial intelligence with existing methods of sociocultural study:

1) What are the primary frames used in online news articles about general artificial intelligence?
2) How can we make sense of these frames in light of current sociocultural risk theories?

Methodology and Approach

This exploratory analysis employs a combination of content, case, and discourse analysis procedures used to shed light on the topic of artificial intelligence in popular online news articles published in 2014. Through the design of this study, the intent is to create a list of frames that exist within news articles in major online news outlets and to make sense of these frames in light of sociocultural risk perspectives. For the purposes of this study, articles published online by the top circulating English-speaking outlets from Australia, Canada, United Kingdom (UK), and the United States of America (USA), published between January 1, 2014 and December 31, 2014, that contain the specific term "Artificial Intelligence" have been collected, archived, and coded using NVivo, a popular tool for this type of research. What follows is a detailed explanation of the way in which this research has been carried out, complete with comments about the benefits and drawbacks of this type of study.

Through this data-gathering design, the intention is to mimic the results that a person (or machine) would have been presented with had they searched for the complete term "Artificial Intelligence" in these popular sources during the 2014 calendar year. The intended focus of this

study is to carry out this exploratory research along the lines of the interpretive paradigm of communication research as outlined by Merrigan, Houston, and Johnston (2012, pp. 37-38). The use of online news has been chosen for both its ease of access and as it continues to take a larger role in news coverage (Pew Research Center, 2013, p. 4).

Sampling

For this study, a stratified sampling process has been used (Krippendorff, 2013, p. 116) with the following strata determining the articles gathered:

1) Online news sites with the highest distribution in Australia, Canada, the United Kingdom (UK), and the United States of America (USA),
2) News articles that contain the complete term "Artificial Intelligence," and
3) News articles published between January 1, 2014 and December 31, 2014.

Search responses were not included for the acronym "AI" as the resulting query would have returned too many results since this is a letter combination appears frequently in the English language. There may be an argument here that the sampling technique also resembles a relevance sample or even a convenience sample. However, due to the strata used in determining the sample population, it is believed that stratified sampling is the most correct term to use.

The reasons for choosing these specific strata include convenience sample elements such as the fact that it would be impossible to collect all samples of news articles from all news sources, in all countries, in all languages. By selecting only large-scale news outlets, which are primarily conservative in approach, dominant frames should skew toward similar outlooks. The choice of sampling from one calendar year has a companion in the work of Olausson (2009) who led a study of Swedish newspaper content for a "global warming." Choosing the highest

circulating online news sources means that a representative sample has been collected, although not a complete one. Research from the Pew Research Center has shown that online news readership continues to increase (2008, p. 22), thus underlining relevance of choosing this medium to study.

Choosing the top readership for online news sources has been a challenge, as this information is difficult to come by in some countries and is rarely shown across multiple countries. Where this information is available, due to vast differences in a country's population size (i.e. Canada at ~35 million vs. USA at ~318 million vs.), Canadian news sites, for example, do not appear on some lists of top readership ranked internationally (Pew Research Center, 2013). Another challenge is that the source of information about readership is often reported by the news outlets, themselves, with confusing and sensationalized terminology. Therefore, readership was determined to be the defining factor for inclusion in this study.

The top Australian source was determined to be *The Sydney Morning Herald*, as identified in a Roy Morgan Research study (2014). Roy Morgan Research is a market research company based in Australia (Roy Morgan Research, About the company, n.d.).

BBC News was originally identified as the top news source in Europe (and thus the UK) in a press release citing comScore rankings (BBC, 2013). However, this led to questions about how an online news outlet differed from an outlet that originated as a newspaper (as the other three examples do) and whether this might cause unanticipated skewing of the research. After careful consideration, it was determined that, in order to attempt to avoid such a situation, an additional criteria should be added in the case of the United Kingdom. Therefore, only newspapers with an online news presence were to be considered for this research. As this is the case, *The Guardian UK* has been identified as having the top circulation for its online news,

based on a comScore figure reported in the *Press Gazette* (Hollander, 2013). The source, comScore, is an internet analytics company that captures interactions on websites (comScore, About us, n.d.).

At first, *The Globe and Mail* was identified as the top circulating online news site for Canada, based on a NADbank report (Ladurantaye, 2013). However, as Ladurantaye's article was found on *The Globe and Mail* website, source material for the study was sought and it was found that the 'total weekly brand footprint' was actually higher for *The Toronto Star*, nearly twice that of *The Globe and Mail* (NADbank, 2013). So *The Toronto Star* has been chosen for inclusion in this study. NADbank Inc. (NAD stands for Newspaper Audience Databank) is a "research arm of the Canadian newspaper agency" (NADbank, About us, n.d.).

A Pew Research Center survey determined that the highest online readership for online news in the USA was held by *The New York Times* (2013). By choosing a sample of articles from top online news sites from the four largest English speaking countries, an in depth exploration of general discourse over the period of the previous calendar year is ensured.

While gathering online news articles with the identifier "Artificial Intelligence," several were determined as not being necessary for this study. In one example, two *The Sydney Morning Herald* articles were removed as they both referred to an actor's previous role in the Steven Spielberg's 2001 film *Artificial Intelligence* and did not contain any other content that focused on artificial intelligence as a topic (Dale, Nov. 29, 2014). Other exclusions were letters to the editor, video articles, movie listings, and obituaries.

Procedures and Data Collection

With the news sites to be used identified as *The Sydney Morning Herald*, *The Toronto Star*, *The Guardian UK*, and *The New York Times*, work began on locating the relevant news stories on each of these news organization's websites. Each website includes a search function, which was used exclusively to search for articles that contain the exact search term "Artificial Intelligence." If possible, the resulting searches were limited or sorted by date in order to find articles published between January 1, 2014 and December 31, 2014, otherwise, this work was done manually. Careful attention was paid to the date published as opposed to the date updated, as this date was also present on several articles. Once identified, articles were captured using NVivo's NCapture widget. Once captured, these articles were uploaded into the NVivo project database, where they were separated by source and sorted in chronological order. Bibliographic information was also noted at the time of capture and then exported to a separate Microsoft Excel document for cross-referencing and bibliographic data manipulation (i.e. sorting and filtering by date, source, author, etc.). The article search was completed twice for each news site to ensure that all relevant sources had been found. A complete list of all articles captured can be found in Appendix I.

Once the search and capture procedure had been completed, articles were read through once without coding to determine whether any were to be identified as unsuitable, for the reasons listed above. When this was done, these unsuitable articles were not removed, they were simply colour coded and marked as "not included" meaning that they contained no information that would be of interest for this research. This ensured that these articles were not included in the analysis but were also not lost and could be easily identified.

A second round of reading served to narrow down this group of articles to separate those that were considered "not relevant" from those that contained a significant amount of material for consideration. This followed Lupton's (1994) methodology wherein "the issues incurring most attention from the press were noted, and binary oppositions, metaphors, and other stylistic or rhetorical devices occurring frequently in the texts were identified" (p. 310). A third round of reading further narrowed the articles leaving a group that was considered "content rich." These articles contain long-form arguments discussing artificial intelligence and its potential negative or positive outcomes. Using this information, frames coalesced when considered in the terms outlined by Entman (1993):

> Frames, then, *define problems* - determine what a causal agent is doing with what costs and benefits, usually measured in terms of common cultural values; *diagnose causes* - identify the forces creating the problem; *make moral judgments* - evaluate causal agents and their effects; and *suggest remedies* - offer and justify treatments for the problems and predict their likely effects. (p. 52)

Sampling Totals

Articles/Source	The Sydney Morning Herald	The Toronto Star	The Guardian UK	The New York Times	Total
Gathered	114	28	68	130	340
Unsuitable	2	0	1	9	12
Duplicate	13	10	0	1	24
Not relevant	36	7	17	51	111
Relevant but not content rich	29	2	16	41	88
Content rich	34	9	34	28	105

Validity and Reliability Issues

With Krippendorff's statement in mind, about the preserving nature of mass produced messages strengthening stereotypes, prejudices and ideologies (2013, p. 75), and much as this is a study of these effects, every attempt was made to ensure that this study was approached as objectively as possible. Reiter (2013) reminds us that in an exploratory study, it is impossible to remove the researcher from the subject being researched. This leads to a paradox where validity and reliability are concerned. Krippendorff identifies there is always the potential of the researcher's conclusions being at odds with another person's definition or conclusions on the same topic (2013, p. 16). Again, Krippendorff addresses this in discussion of qualitative studies, which is the primary case here, stating that they "tend to be carried out by analysts working alone, and replicability of generally of little concern" (2013, p. 89). It is hoped that by including a detailed reckoning of the study's design and methodology, the reader and subsequent researchers will be provided with enough information to trace the steps taken and determine whether the conclusions presented are consistent and useful.

The sample chosen does not represent the complete lexicon of articles written on this topic during the year. This could mean that these chosen sources have missed important information or that a newly emergent issue in artificial intelligence, which may only have been reported in a niche source rather than a widely circulating and general news source, does not appear. It is the intention of this study to identify the most widely available and read sources, and not the most comprehensive and in-depth sources available. Likewise, articles in other languages may create certain nuances not captured in the English press. This is the challenge of any study completed in only one language.

Results and Discussion

> "… the issue is not one of misguided perception but rather is the result of clashes in political, moral and aesthetic judgements on risk." (Lupton, 2013, p. 55)

Media representation of artificial intelligence frames the development of this technology in such a way as to shut down debate by endorsing both an anti-technology and a techno-determinist point of view. There are several primary themes that illustrate this point: First, by presenting the development of technology in terms of a political conflict between East (primarily Chinese) and West (primarily American), often through a discussion of military implementation and economic degradation through job loss; Second, by positioning technology as a moral barrier to human relationships and identity; Third, by referring primarily to negative outcomes in aesthetic fields such as popular fiction (movies, books, and television) magic (trickery and deception), and faith (focusing on worship and redemption). As we shall see through a discussion of framing and risk in these articles, a dominant conservative ideology is at play in this discourse, thinly veiled by an interest in the newest technology and trends.

The Frame of Competition

> "The public is traditionally described as having become progressively concerned about such risks over the past half century or so and as directing a more critical and challenging eye upon the activities of industry and government." (Lupton, 2013, p. 266)

The most prevalent themes observed in these articles concern risks related to the *frame of competition*. This frame is most obvious in articles about autonomous weapons and online warfare but also includes articles regarding the risk of job loss due to automation. Although at

first it might not be easy to see the relationship between warfare and job loss, it is the political dimension of international competition that ties these together. The increasing international pressure of both war and economy uses similar terms and follows a similar discourse.

It is no surprise when looking at the headlines of many articles concerning artificial intelligence that they are primarily combative and negative:

"Beware killer robots" (*The Sydney Morning Herald*, January 4, 2014)

"Warning, warning! Entering bots mania" (*The Sydney Morning Herald*, February 27, 2014)

"The scientific A-team saving the world from killer viruses, rogue AI and the paperclip apocalypse" (*The Guardian UK*, August 30, 2014)

"Our machine masters" (*The New York Times*, October 30, 2014)

"Is this the way the world ends" (*The Sydney Morning Herald*, December 10, 2014)

From these headlines it is easy to see how the words warning and beware, as well as end of the world rhetoric presses the reader into an appreciation for a distinct threat appearing on the immediate horizon. They also clearly position technology and humans on either side of the dividing line. They almost always elicit at least one reference to James Cameron's *Terminator* (1984), a movie that chronicles a war between humans and sentient machines after they achieve self-awareness.

The advance warning of potential artificial intelligence agency is present in a number of articles regarding workplace safety and risk. An article in the *New York Times* (June 16, 2014) begins by stating "robots have caused at least 33 workplace deaths and injuries in the United States in the last 30 years." Although this number isn't very high, it presents the reader with a statistic that is very obviously meant to elicit an anti-technology response in the reader. An

article in *The Sydney Morning Herald* (June 25, 2014), goes on to say that most of these deaths occurred due to human error in maintaining or approaching the robots. The choice to identify 'killer robots' rather than human error resulting in death is telling. However, this type of one-on-one individual human versus robot is rare and most articles rely on larger-scale warfare as a narrative.

The use of military jargon is prevalent in many articles and not only those dealing specifically with military applications. In particular, an article in *The Sydney Morning Herald* (November 9, 2014) reads, "Rarely, however, do we pause to consider the beachhead artificial intelligence (AI) has already won in our lives," while *The Guardian UK* (November 29, 2014) states "Already, the first casualties are starting to become clear." These foregone conclusions add to a sense of panic within several articles that it may already be too late to avoid the negative impacts of the use of artificial intelligence. However, artificial intelligence has not yet reached the sentient existence speculated upon in science fiction and is still beholden to its human creators. Beneath the initial layer of attention-grabbing headline writing, another set of lines are drawn, which look back to more traditional rivalries.

In a *Sydney Morning Herald* (January 4, 2014) article concerning the use of autonomous weapons entitled "Beware killer robots" discussing how these might be programmed to observe the rules of warfare, we find the following statement: "We don't know whether the Chinese will have the same stringent rules of engagement as Britain and America." The sentiment that China, specifically, occupies the opposite side in these matters is borne out in almost every article in which competition is discussed, whether in regard to military or economic concerns. In *The New York Times* (December 6, 2014) China is specifically identified as the main culprit in the lowering of wages for American workers alongside artificial intelligence. There is also a concern

about 'brain drain' to technology companies in China as they are "caught up in a frantic race to hire the world's best machine-learning talent" (*New York Times*, December 15, 2014).

Although many articles point to an imminent threat from artificial intelligence but house a robust focus on China as a main concern in the discussion, additional headlines point to another perceived source of the problem:

"Google's robot army in action" (*The Guardian UK*, February 10, 2014)

"Are the robots about to rise? Google's new director of engineering thinks so…" (*The Guardian UK*, February 22, 2014)

"Silicon Valley Sharknado" (*New York Times*, July 8, 2014)

Where once concerns about the risk of a 'take over' of society would have been placed directly on a foreign entity, now we see that private industry, specifically technology companies, are another source of this threat. Since the fall of the Soviet Union and the end of the cold war, the threat of a foreign invasion in North America has left a vacuum for this type of rhetoric, which is now being brushed off and reassigned to discussions about artificial intelligence. A good example of this appears in *The Guardian UK* (August 30, 2014) in the phrase "the faster a bad guy can act, the further behind the good guys will end up." This type of logical appeal, one that supports reaching the end goal ahead of the competitor, harkens back to the nuclear proliferation discourse of the past.

Not surprisingly, both the political threat of China and the economic threat of large technology corporations are portrayed as opaque in terms of the layperson's access to information. This concern surrounds the desired goals of new technology or the moral compass behind their intended uses. Lack of access to information about what these parties are specifically focused on is identified through discussions of job loss, which is also couched in the

terminology of warfare. Terms such as ‘annihilate’ and ‘wipe out’ referring to the loss of jobs certainly point to combative expectations in this area and tying warfare and job loss together allows the reader to move back and forth easily between the two paradigms.

As we can see from the military, economic, and political themes used in articles about artificial intelligence, a desire for the best technology before it is acquired by the competitor in order to either prevent or win any future competition is well supported in the media. An environment of fear that the preliminary military-like maneuvers of artificial intelligence, although currently under human control, seeks to persuade the reader to accept without discussion that it is better for this power to reside at home rather than abroad. Whether this power is in the hands of a foreign political power, such as China, or a local economic power, such as the large technology companies (specifically Google), it is presented as a significant risk to the individual. This is well summarized in a statement made in *The New York Times* (October 30, 2014), “If you think this power will be used for entirely benign ends, then you have not read enough history.” This statement discredits any reader who may think that the technology may be used for altruistic purposes.

The *frame of competition* is the most prevalent frame in the artificial intelligence articles and often overlaps with other frames. It relies on defining the risk of artificial intelligence as one of increased harvesting resources (autonomous machines) and depleted physical resources (human or material). By focusing on competition between traditional, nationalistic rivalries, it limits the public’s understanding of the technology in question, since they are at once directed toward historical competitive boundaries. Artificial intelligence is shown to be a new, globally disruptive and existential risk, much like nuclear warfare, for which the only recourse is suggested to be proliferation and improvement of technology, and attaining greater artificial

intelligence before the competitor does is the end goal. In so doing, it ignores the current issues surrounding the same issues of national sovereignty and economic degradation in favour of a techno-determinist attitude about future concerns.

The Frame of Nature

> "Risk-avoiding behaviour, therefore, becomes viewed as a moral enterprise relating to issues of self-control, self-knowledge and self-improvement." (Lupton, 2013, p. 122)

Articles focusing on companionship and interaction question the potential for artificial intelligence to develop appropriate levels of emotional intelligence and are subtly judgmental about artificial intelligence's place in the natural scheme of things. The *frame of nature* questions whether something created by a human exists inside or outside of the natural world. These articles tend to discuss our continuing relationships with current technology, question the direction that this relationship is taking, and are often couched in romantic terms. Anthropomorphism is abundant in this discourse and follows the technology in its journey from accessory to companion as development of this technology becomes more personally tailored.

The accessory to companion transition is well illustrated in articles discussing less contentious, less militarily focused autonomous machines: self-driving cars. These articles coalesce around announcements and demonstrations of Google's self-driving car. The benefit of these vehicles is touted in a *New York Times* (September 14, 2014) article:

> Google and some major auto manufacturers — not averse to change this time — are busily experimenting with autonomous cars, meaning driverless. Robots, the thinking goes, will sense lurking danger and take corrective action. A robot's judgment is not clouded the way a human's can be. It does not have one too many at a favorite bar. It

> does not nod off at the wheel. It does not succumb to road rage, at least not yet as best as anyone can tell.

Here the virtues of the machine are identified as far superior to the risky human driver. The suggestion here, that artificial intelligence can replace the driver as a more efficient and less risky operator of the vehicle, touches a nerve with a reader who may feel that driving is a uniquely human trait and that removing this luxury from human control crosses a certain line of control. The author goes on to ask "will humans, notably of the American variety, happily yield their beloved cars to a robot?" (*The New York Times*, September 14, 2014) The terms 'control', 'taking over' and 'commanding' appear regularly in articles regarding this new technology and further underline this divisive issue.

The identification of manufacturers as previously change-averse brings into question why they are so "busily experimenting" with the new technology. This is further developed in the aside "the thinking goes" and the concluding statement "at least not yet as best as anyone can tell" (*The New York Times*, September 14, 2014). Again, this speaks to a general distrust of large corporations and their motivations, since most of the information about how the technology is advancing hides behind the closed doors of the organization. In the case of traditional automobile manufacturers, these corporations have grown wealthy on what is often nostalgically termed a 'love affair' with the automobile but may now be working on creating a new focus for our affections. In terms of the framing of this argument, we can begin to see the corporation's approach to this risk, where the desire to control the technology is of paramount importance (Lupton, 2013, p. 26).

After the release of Spike Jonze's *Her* in December of 2013, discussions about whether we could possibly fall in love with our technology became abundant. One such article in *The*

Sydney Morning Herald (January 25, 2014) with the headline "Her reality: Could you really fall in love with your computer?" provides professional opinions on claims that some of the precursor technology required for such an eventuality already exists, such as speech recognition, voice processing, and facial expression mapping, but tempers this with a quote from a technology expert who says, "we've got a way to go yet, although the big companies are marching very quickly toward that end." A psychology expert is also quoted as saying:

> …biologically, we're all-too ready for experiences such as the one in the film. "Humans are social animals," she says. "We'll go to any lengths to find company." You can see it from the way we customize our mobile to make it uniquely ours, to our tendency to name animals, objects and yes, even our computers. (*The Sydney Morning Herald*, January 25, 2014.)

This statement identifies these emotional responses, regardless of whether they are directed at technology or other elements in our environment, as natural processes for humans. Identifying what technology is already capable of and suggesting that humans are predisposed to allow for and/or search specifically for connection with other objects leads the reader to assume that the gap between human and machine is narrow and continues to narrow further.

The paradigm of making a list of the current state-of-the-art technology capability is used often at the beginning of these articles. One example is in *The Sydney Morning Herald* (May 10, 2014), which states, "Artificial intelligence programs can already recognize images and translate human speech." However, these statements go no further in their analysis of how the results are achieved, under what circumstances, or in what environments. It is also interesting that in most cases, journalists attribute these advancements to the machines rather than to the researchers who develop these systems. This provides the reader with a sense that the machines are doing all of

the work and make them seem to be developing independently, rather than along a path designed by the researcher (or the corporation). It is this relationship, between the machine and the researcher, which removes any human agency and may draw some readers to the conclusion that the technology is determining its own path. What suffices for counterpoint, and sometimes seems a moral imperative to support the human side of the debate, is usually another list that displays what machines cannot yet achieve:

> On the other hand, machines cannot beat us at things that we do without conscious thinking: developing tastes and affections, mimicking each other and building emotional attachments, experiencing imaginative breakthroughs, forming moral sentiments. (*New York Times*, October 30, 2014)

These lists generally follow the same order. At the beginning of the article is the list of the newest technological feats while nearer the end of the article is the list of those things that the technology is not yet capable of. By presenting the information in this way, the reader is first presented with the suggestion of a rapid growth in the capabilities of the technology and only later in the article, perhaps to assuage any fears, comes the list of further developments that have not yet been achieved or may never be achieved. By utilizing the structure of the article to present negative outcomes before positive outcomes, a pattern also recognized in the *frame of competition*, artificial intelligence continues to be shown in a primarily negative fashion.

Also present among these articles is a smaller subset that discusses artificial intelligence as a potential surrogate, either for romance or medical care. These articles tend to focus on the ability to bring emotional intelligence to artificial intelligence and the ethical implications that are sure to arise. An article in *The Toronto Star* discusses the use of artificial intelligence in the

field of rehabilitation and identifies the dangers of applying a techno-determinist view to the systems being built:

> 'We've had all these huge advances over the last number of years, that sometimes people think that technology can be the answer to everything,' he says. 'I think one of the challenges is when people don't actually consider a lot of the complexities that come with being an older adult. Then they sometimes are making technology that doesn't make any sense.' As an example, Sinha points out the prevalence of arthritis which renders devices that require self-reporting with a keyboard less than ideal. (May 7, 2014)

Again, we see a situation in which the technology is developed in a vacuum, with the suggestion being that the human user is an afterthought. Rather than considering the human user's needs, systems are built with the expectation that the human will adapt to the technology.

In relation to this discussion is the consideration of surrogacy, or the machine in place of the human, specifically where human-to-human interaction would normally have taken place. An article in *The New York Times* (May 1, 2014) discusses a similar care situation, and makes the point that, "If you could use a remote controlled robot to virtually visit your elderly mother, you could be less likely to get in the car and go over to see her." Logically, it makes sense that if a machine knows exactly what to do in any situation, then a person might be inclined to allow that machine to act in this surrogate fashion and provide this type of care instead.

The *frame of nature* evident in articles on these topics suggests to the public the transition of technology from accessory to companion to master and questions technology's placement in the natural order of things. It illustrates how the gradual and continuous loss of control over devices that Western culture has traditionally embraced (such as the automobile) leads to a decline in the ability to control all aspects of one's life. Again, this frame presents technology

corporations and their technico-scientific perspective as contrary to the more sociocultural perspective of individuals and presents the individual as incapable of maintaining control. It presents expert voices that underline how our human psychology and physiology are well adapted to the changes being made and allows for an easy transition of responsibility away from humans and toward the artificially intelligent systems presented in these articles.

The Frame of Artifice

> "… the Other – that which is conceptualized as radically different from Self – is the subject of anxiety and concern, particularly if it threatens to blur boundaries, to overtake the Self." (Lupton, 2013, p. 173)

The final frame identified within these articles is the *frame of artifice*. We cannot underestimate the impact that popular fiction, particularly science fiction films, has on discourse relating to artificial intelligence. It is difficult to find an article in any news publication that does not make reference to a film, either in the text of the news article or in a photograph attached to the news article. References to James Cameron's *Terminator* (1984) and Spike Jonze's *Her* (2013) have already been identified, above. Others include Stanley Kubrik's *2001: A Space Odyssey* (1968), The Wachowsky Brothers' *Matrix* (1999), Wally Pfister's *Transcendence* (2014), and Fritz Lang's *Metropolis* (1927), though this is not an exhaustive list. What these movies all have in common is the negative and dangerous presence of artificial intelligence. In fact, there is not one positive reference to artificial intelligence in film, television, or literature to appear in the articles found, despite the fact that potential positive examples, such as Big Hero 6, which happened to be released in 2014, are available. In reference to these works of fiction, artificial intelligence seeks to eradicate the humans, enslave humans, or replace humans in some way. Loss of control to artificial intelligence is a running theme through many articles and

coalesces around themes of magic and fantasy, class structure, and the body by identifying artificial intelligence as the 'Other.'

It may seem incongruous to include discussion of magical performance with the discourse on artificial intelligence. However, references to artificial intelligence tend to include many terms and phrases that conjure images of trickery and deceit, especially in articles written about a program that was purported to have passed the Turing test. "With all these tricks… they appear to 'emulate human behavior'" states an article in *The Sydney Morning Herald* (April 21, 2014), while an article in *The Toronto Star* (June 9, 2014) talks about duping judges and that the computer program was "disguised as a 13-year-old boy." In *The Guardian UK* a particularly succinct statement about the Turing test is made:

> When the best way to pretend to be human is to imitate our foibles and weaknesses as much as our strengths, the victors of Turing tests will continue to be the least scary output of artificial intelligence research. (June 9, 2014)

This framing of artificial intelligence as a trick or a ploy further discredits the scientists involved. In *The New York Times*, one expert "describes the future of automation as big-data 'puppetry,' where the actions of humans are replicated once the set of data is big enough." By bringing these themes and concerns into the realm of theatre, a practice that humans have been using to struggle with major existential issues for millennia, journalists can more easily present their subjects to the public with less concern for factuality.

In other places, research into artificial intelligence is discussed in more religious terms, with adherents of this type of research said to espouse "faith in the power of technology and data to solve problems … holds unshakable sway" (*Sydney Morning Herald*, October 8, 2014). Religious iconography also appears in several places, with one expert quoted as saying "we are

summoning the demon" (*The Sydney Morning Herald*, December 10, 2014) and another requesting that research should "proceed serenely with the angels (*The Guardian UK*, December 3, 2014). By identifying those who are working in the field as charlatans or zealots, it is easy to frame the narrative to discredit any progress that is being made and avoid explaining any of this progress to the public. Another angle presented is that of the technological savior who uses technology to perform unimaginable feats: "…those who can harness the abilities of intelligent machines enjoy undreamt-of opportunities, while those without such skills rot in idleness" (*The Sydney Morning Herald*, February 27, 2014). This positions both the technology and the person who can harness its power as the Other: a person and a machine who are to be both respected and feared for what they are capable of.

Even when attempting to espouse a positive view of the technology, references to popular negative imagery seem to be a requirement. Such is the case in an article from *The Sydney Morning Herald* (January 1, 2014), where an expert is quoted as saying that he "wants to build the equivalent of the sentient computer HAL from the film *2001: A Space Odyssey*," which is quickly followed by the addendum "except that it wouldn't kill people." It is possible that the expert is unaware of a positive example that could be used or he is unsure that a positive comparison to point to would not resonate with the listener. Either way, having to point to a negative signifier and then provide this caveat points to the difficulty we have accepting this technology as being potentially positive. There are two additional examples of this type of qualification statement that also happen to appear in *The Sydney Morning Herald* articles. Another expert is quoted in a March 8, 2014 article stating "Robots will become omnipresent in our lives *in a good way* [emphasis added]." Here, the expert seems to be preempting the argument or at least acknowledging that the omnipresence of technology, robots in particular, are

already considered to be a negative factor, while the corporation is working on trying to find the most positive outcome. One final example appears in an October 6, 2014 article in *The Sydney Morning Herald* that discusses the burgeoning presence of automated vehicles, stating "In Australia, robotics are taking over our late-model cars, piece by piece *like a helpful cancer* [emphasis added]." Here, we have the fearful "taking over" of cars mitigated by the term "helpful" but compared to a deadly disease. In all three of these examples either the quoted expert or the journalist struggle with trying to define these technological developments by virtue of their positive impact but use negative imagery to do so. However, in each instance, the audience is met with the negative imagery first.

It is also important to identify the necessity of a container, or body, for artificial intelligence in order to assist in its framing as the Other. It is interesting to note that in many of these articles, the term artificial intelligence is used sparingly, often in the headline or the first several paragraphs of an article, after which it is replaced by some physical device, most often termed as a 'robot' (i.e. *The Sydney Morning Herald*, February 27, 2014; *The Toronto Star*, May 7, 2014; *The Guardian UK*, January 4, 2014; *The New York Times*, April 1, 2014; and others). This seems to be an important spacing device as it sets another barrier between the reader and the developer of the technology and provides a focus for any negative will. It seems far easier for the journalist to focus on a physical being than an abstract concept called artificial intelligence. It also serves to assist in the anthropomorphizing of the technology as it is far easier to draw comparisons between a human body and a robot body.

The *frame of artifice* obscures the progress of artificial intelligence behind the veils of fiction, magic, and faith. What is interesting about this frame is that it almost works to counter the concerns of the *competition* and *nature* frames. These articles tend to rely on fiction to

bolster claims about the direction of progress and present an anti-technology point of view, since all of the examples present negative risk outcomes. By using terminology that associates technology and its adherents in terms of magical abilities, articles fail to provide reasoned examples and context for the outcomes being presented. Faith is used to present new technology and illustrate the characters of scientists and technologists, which removes the burden of proof from either the scientist or the journalist. By using these themes to present new ideas about technology, the journalist fails to provide context to the public. Rather than presenting an unbiased view of this progress and by focusing on negative examples, the reader is forced to adopt an anti-technology view.

Conclusions and Recommendations

The goal of this study has been to answer the following two questions:

1. *What are the primary frames used in online news articles about general artificial intelligence?*
2. *How can we make sense of these frames in light of current sociocultural risk theories?*

There are three distinct frames used in the news articles gathered for this study: the *frame of competition*; the *frame of nature*; and the *frame of artifice*. As is the case with news framing, there is often overlap, where one article may reflect on its subject using more than one frame. This discussion presents evidence that although scientist, journalist, and public are all responsible in part for the development of a sociocultural understanding of artificial intelligence, it is framing of the issue by journalists that contributes most to prevailing anti-technological, techno-determinist, and conservative ideologies. These articles inform the public that technology

is something to be revered and feared, and suggest that it cannot and should not be fully understood by the layperson. The public cannot compete with technology or its creators, must accept that nature is inferior to technology and its creators, and must willingly accept that they will be presented with artifice rather than truth about this technology.

With regard to the *frame of competition*, we have seen how negative headlines create immediate apprehension for the reader. Articles already present artificial intelligence as having individual agency, which is not yet the case. Use of military terminology and combat metaphors present artificial intelligence, and those who are seeking to improve it as traditional enemies of the people. This anti-technology gloss is used in articles to relate to the reader traditional conservative power-structure clashes, such as East versus West, government versus corporation, and corporation versus the individual. Past cold war rhetoric is applied to this risk discourse as it is a narrative that is at once identifiable and understandable, which makes it easier for the reader to accept, rather than question what is actually happening and present new opportunities for discussion. While touting the latest and greatest technology as a necessary requirement in order to keep ahead of the competition and by positioning the technology as both a savior and a threat, there is an anti-technology agenda at play. There is a strong 'technology as savior' versus 'technology as threat' paradox present in much of the artificial intelligence discourse. Since both government and corporate interests are highly competitive, requiring a great deal of secrecy, it is difficult for the layperson to truly identify the course of technology development. The media is an important mediating factor between the individual and these large organizations but relies on conservative and reiterative storytelling rather than providing insight and education on the issue.

Articles utilizing the *frame of nature* revolve around responsibility. Whether this is illustrated with humans actively passing responsibility to an artificial intelligence system or

whether an artificial intelligence system is positioned as taking it by force, this frame questions the natural orders of creation and evolution. Anthropomorphism, which is a well-established human tendency, makes it easy to imagine inanimate objects having human-like features or abilities and technology has a long history of making the transition from accessory to companion. The idea of a virtuous machine, incapable of doing intentional harm, taking over and improving on what are traditionally only human values both concerns and fascinates the reader. However, loss of control, again concern about the corporation's role and motivation, as well as journalists' unease with the explanations they are giving, all cast the increasing role of technology in our lives in a negative light. The listing of breakthroughs and hurdles yet to be run, in that order, presents a negative viewpoint, which permeates these articles with an anti-technology slant. By attributing these advancements to the technology, rather than to the human agent behind its development these articles also create uneasiness in the reader. There is a great desire to allow something 'Other' to bear the brunt of human responsibility. However, concern about building systems that require the human to adapt, rather than having systems that adapt to the human, focuses on the sociocultural challenges presented by this risk.

Perhaps the most challenging is the *frame of artifice*, where the risk of artificial intelligence moves away from easily illustrated concepts like warfare and order. Since these concepts are exceptionally nebulous and change depend on one's point of view, upbringing, or daily experience, identifying how these affect the discourse is challenging. Popular culture, specifically film, presents a primarily negative view of artificial intelligence and both motivate and mirrors media views on the subject. The concept of the Other becomes more easily attributed to artificial intelligence as the visual cues in popular culture bring it closer in line with reality. The leap of faith required to accept that artificial intelligence can reach or exceed human-level

intelligence is again supported by our already stated ability to anthropomorphize inanimate objects. In this way, movie magic is very closely associated with technological magic, a theme that is carried through articles about artificial intelligence. The terminology of magic, faith, and fantasy pervade these articles, with statements about how difficult it is to understand the complex techniques and theories required to understand how to make technology behave in a life-like manner. This suggestion that the technology is simply out of grasp of the layperson leads to a new class structure where the technologist holds all of the power and the layperson can only sit by and appreciate what has been provided for them. Often religious terminology elevates the narrative to even loftier heights. However, the terminology of trickery and deceit is also prevalent and seeks to discredit the scientist behind this technology. Disguise and imitation is presented as theatre at best and a con at worst. In some cases, experts struggle to provide positive examples to illustrate their work, which makes it more difficult to espouse a positive viewpoint. The term artificial intelligence is used sparingly rather than being a well-defined concept that can be discussed freely. In order to present the reader with a concrete term that they can relate to, the word 'robot' is provided as an equivalent and provides a focus for risk concerns about the Other.

As Lupton states, quoting Douglas (1982, p. 58), "individuals do not try to make independent choices," (2013, p. 55) rather they look for information from credible sources with which to form an opinion of the potential for risk. Since the news media is a well-established source of information about technology and provides a primarily negative viewpoint about technology, the public then adopts and impresses into its social and cultural framework a similar view. However, there is also an inherent paradox at play in discussions about technology, where it is at once hailed as potential savior and also potential destroyer in terms of techno-determinist versus anti-technology discourse. The result is a primarily conservative ideology that flows

within the artificial intelligence discourse, where the public is presented with a minimal amount of information and a desire to maintain the status quo is of paramount importance. By utilizing the *frames of competition*, *nature*, and *artifice*, the news media assists in the cultural production of negative bias toward emerging artificial intelligence technology by playing on old fears about global competition, questioning whether the natural order is being toppled, and by obscuring the progress being made.

Recommendations for further research

A secondary goal in a study of this nature is the organization of ideas for further consideration. Entman states, "Analysis of frames illuminates the precise way in which influence over a human consciousness is exerted by the transfer (or communication) of information" (1993, p. 51). By taking the frames outlined in this study and applying them to other forms of media, it is hoped that this illumination will breed further discussion about the challenges facing the development of artificial intelligence technology and its social and cultural acceptance or rejection. As has been illustrated here, the obscuring effect of both journalism and private enterprise tend to disenfranchise the public and lead them toward foregone conclusions regarding new technology. By continuing to study the perceptions of risk in relation to artificial intelligence through the framing of this discourse, it is hoped that future studies will continue to provide additional material and context toward a greater understanding of current technological development.

It may be helpful for the researcher to take the same source material from this study and reconsider it at a later date since the results and conclusions presented here may differ greatly in several years' time, as a historical sociocultural account. Likewise, a similar study could be

completed using articles from the years previous and the years to come. A survey of articles across several years from one or more sources may also present some interesting evidence about the movement of the discourse over time or over a specific source. Taking material from just one source, for example just *The New York Times*, and comparing it from year-to-year in order to determine what specific frames are at work at specific times might also yield some interesting results. One might also want to take these sources and consider what the differences have been between the countries presented. Ideally, building from the research undertaken here, it would also be useful to present a timeline of events through the year and how they affected the discourse. There are several places in this paper where specific events, such as the release of a specific film or the announcement of a program passing the Turing test, made specific elements more or less interesting to journalists. Likewise, if access could be grated to scientific journals or the studies being undertaken in large corporations, these might also shed light on the specific discussions taking place in the media. The lack of discourse analysis regarding artificial intelligence made this study a challenging task but hopefully this begins a fruitful area of study. Perhaps at some point, there will also be the opportunity to perform an analysis of discourse from a self-aware artificial intelligence, should such an entity ever come into being.

References

Alissandrakis, A., Nehaniv, C. L., & Dautenhahn, K. (2004). Towards robot cultures? *Interaction Studies, 5*(1), 3-44.

Allan, S., Anderson, A., & Petersen, A. (2010). Framing risk: Nanotechnologies in the news. *Journal of Risk Research, 13*(1), 29-44.

Azam, M. (2011). Speech generation by artificial intelligent systems: Issues and challenges. *NUML Journal of Critical Inquiry*, *9*(1), 129-158.

Barth, M. M., Halem, J. J., & Yang, B. Z. (2004). A pedagogical note on risk framing. *Risk Management & Insurance Review*, *7*(2), 151. doi:10.1111/j.1098-1616.2004.00042.x

BBC (February 25, 2013) BBC website scores record global traffic of 64 million unique visitors in January 2013. BBC.com. Retrieved from: http://www.bbc.co.uk/mediacentre/worldnews/bbc-website-record-global-traffic

Beck, U. (1992). *Risk society: Towards a new modernity*. Newbury Park, CA: Sage Publications.

Beck U. (2009). *World at risk*. Cambridge, UK: Polity.

Bostrom, N. (2013) 'Existential risk prevention as global priority', *Global Policy, 4*(1). doi: 10.1111/1758-5899.12002. Retrieved from: http://onlinelibrary.wiley.com/doi/10.1111/1758-5899.12002/abstract

Bostrom, N., & Ćirković, M. M. (2008). *Global catastrophic risks.* Oxford, UK: Oxford University Press.

Brüggemann, M. (2014). Between frame setting and frame sending: How journalists contribute to news frames. *Communication Theory, 24*(1), 61-82. doi:10.1111/comt.12027

Calsamiglia, H., & Ferrero, C. (2003). Role and position of scientific voices: Reported speech in the media. *Discourse Studies, 5*(2), 147-173.

Christensen, F. M., Andersen, O., Duijm, N. J., & Harremoës, P. (2003). Risk terminology—a platform for common understanding and better communication. *Journal of Hazardous Materials,* 103181-203. doi:10.1016/S0304-3894(03)00039-6

Christian, B. (2011). The most human human: What artificial intelligence teaches us about being alive. London, UK: Penguin Books.

Chu, Z., Gianvecchio, S., Wang, H., & Jajodia, S. (2012). Detecting automation of twitter accounts: Are you a human, bot, or cyborg? *IEEE Transactions on Dependable and Secure Computing, 9*(6), 811-824. doi: 10.1109/TDSC.2012.75.

Cobb, M. D. (2005). Framing effects on public opinion about nanotechnology. *Science Communication, 27*(2), 221-239. doi:10.1177/1075547005281473

comScore (n.d.). About us. Retrieved from: http://www.comscore.com/About-comScore/comScore-Fact-Sheet

Console, L., Lombardi, I., Picardi, C., & Simeoni, R. (2011). Toward a social web of intelligent things. *AI Communications, 24*(3), 265-279.

Craig, R., & Muller, H. (Eds.). (2007). *Theorizing communication: Readings across traditions*. London, UK: Sage Publications Inc.

Dahl, T. (2015). Contested science in the media: Linguistic traces of news writers' framing activity. *Written Communication, 32*(1), 39-65. doi:10.1177/0741088314557623

Dale, D. (November 29, 2014) Shades of Chamberlain and McCann in The Missing. *Sydney Morning Herald*. Retrieved from: http://www.smh.com.au/entertainment/tv-and-radio/blogs/the-tribal-mind/shades-of-chamberlain-and-mccann-in-the-missing-20141129-3lh07.html

de Vreese, C. H. (2005). News framing: Theory and typology. *Information Design Journal & Document Design, 13*(1), 51-62.

Dor, D. (2003). On newspaper headlines as relevance optimizers. *Journal of Pragmatics*, 35695-721. doi:10.1016/S0378-2166(02)00134-0

Edelman, M. (1993). Contestable categories and public opinion. *Political Communication, 10*(3), 231.

Entman, R. M. (1993). Framing: Toward clarification of a fractured paradigm. *Journal of Communication, 43*(4), 51-58.

Evans, J. H. (2014). Faith in science in global perspective: Implications for transhumanism. *Public Understanding of Science, 23*(7), 814-832. doi:10.1177/0963662514523712

Evans, W., & Priest, S. H. (1995). Science content and social context. *Public Understanding of Science, 4*(4), 327. doi:10.1088/0963-6625/4/4/001

Gamson, W. A., Croteau, D., Hoynes, W., & Sasson, T. (1992). Media images and the social construction of reality. *Annual Review of Sociology, 18*, 373–393. doi:10.1146/annurev.soc.18.1.373.

Hawkins, J., & Blakeslee, S. (2004). *On intelligence*. New York, NY: St. Martin's Griffin.

Haynes, R. (2003). From alchemy to artificial intelligence: Stereotypes of the scientist in Western literature. *Public Understanding of Science, 12*(3), 243-253.

Henwood, K., Pidgeon, N., Sarre, S., Simmons, P., & Smith, N. (2008). Risk, framing and everyday life: epistemological and methodological reflections from three socio-cultural projects. *Health, Risk & Society, 10*(5), 421-438.

Hingston, P. (2009). A Turing test for computer game bots. *IEEE Transactions on Computational Intelligence and AI in Games, 1*(3). DOI: 10.1109/TCIAIG.2009.2032534. Retrieved from: http://www.cs.ucf.edu/~gitars/cap6671-2010/Presentations/turing.pdf

Hollander, G. (2013) UK newspapers ranked by total readership (print and online). *Press Gazette*. Retrieved from: http://www.pressgazette.co.uk/uk-newspapers-ranked-total-readership-print-and-online

Howarth, A. (2013). A 'superstorm': When moral panic and new risk discourses converge in the media. *Health, Risk & Society, 15*(8), 681–698. doi:10.1080/13698575.2013.851180

Jaeger, C. C., Renn, D., Rosa, E., & Webler, T. (2001). Risk, uncertainty, and rational action. London, UK: Earthscan.

Kirby, D. A. (2003). Scientists on the set: Science consultants and the communication of science in visual fiction, *Public Understanding of Science 12*(3): 261–78.

Kling, R., & McKim, G. (2000). Not just a matter of time: Field differences and the shaping of electronic media in supporting scientific communication. *Journal of The American Society for Information Science, 51*(14), 1306-1320

Krippendorff, K. (2013). Content analysis: An introduction to its methodology. Los Angeles, CA: SAGE.

Kurzweil, R. (2005). The singularity is near: When humans transcend biology. New York, NY: Viking.

Ladurantaye, S. (Mar 27, 2013). Canadians increasingly going online for written news. *The Globe and Mail*. Retrieved from: http://www.theglobeandmail.com/report-on-business/canadians-increasingly-going-online-for-written-news/article10430825/

Lee, E. (2010, February 10). What triggers social responses to flattering computers? Experimental tests of anthropomorphism and mindlessness explanations. *Communication Research*. doi: 10.1177/0093650209356389.

Levesque, H. J. (2014). On our best behaviour. *Artificial Intelligence, 27*. doi:10.1016/j.artint.2014.03.007. Retrieved from: http://ijcai13.org/files/summary/hlevesque.pdf

Lowe, T., Brown, K., Dessai, S., de França Doria, M., Haynes, K., & Vincent, K. (2006). Does tomorrow ever come? Disaster narrative and public perceptions of climate change. *Public Understanding of Science, 15*. 435-457. doi: 10.1177/0963662506063796

Lupton, D. (1992). Discourse analysis: A new methodology for understanding the ideologies of health and illness. *Australian Journal of Public Health, 16*(2).

Lupton, D. (1994). The condom in the age of AIDS: Newly respectable or still a dirty word? A discourse analysis. *Qualitative Health Research, 4*(3). 304-320.

Lupton, D. (2013). *Risk: Second edition*. New York, NY: Routledge

Maglogiannis, I. G. (2007). Emerging artificial intelligence applications in computer engineering: Real word AI systems with applications in eHealth, HCI, Information Retrieval and Pervasive Technologies. Amsterdam, ND: IOS Press.

Marcus, G. (2014, January 1). Hyping artificial intelligence, yet again. *The New Yorker*. Retrieved from: http://www.newyorker.com/online/blogs/elements/2014/01/the-new-york-times-artificial-intelligence-hype-machine.html

McLuhan, M. (1962). *The Gutenberg galaxy: The making of typographic man*. Toronto, ON: University of Toronto Press.

Merrigan, G., Huston, C., & Johnston, R. (2012). *Communication research methods: Canadian edition*. Don Mills, ON: Oxford University Press.

Moscovici, S. (2014). The new magical thinking. *Public Understanding of Science, 23*(7), 759-779. doi:10.1177/0963662514537584

Muehlhauser, L., & Salamon, A. (2012). Intelligence explosion: Evidence and import. *Singularity Hypotheses, 15*. doi:10.1007/978-3-642-32560-1_2. Retrieved from: http://intelligence.org/files/IE-EI.pdf

NADbank Inc. (n.d.). About us. Retrieved from: http://www.nadbank.com/en/about

NADbank readership results - 2013 study (2013). Retrieved from: http://www.nadbank.com/en/system/files/PressReleaseTables-2013%20Study.pdf

Nelkin, D. (1987). *Selling science: How the press covers science and technology*. New York, NY: W.H. Freeman and Company.

Olausson, U. (2009). Global warming-global responsibility? Media frames of collective action and scientific certainty. *Public Understanding of Science, 18*(4), 421-436.

Pan, Z., & Kosicki, G. M. (1993). Framing analysis: An approach to news discourse. *Political Communication*, (1), 55.

Pew Research Center (2008). Pew Research Center Biennial News Consumption Survey: Audience Segments in a Changing News Environment.

Pew Research Center (2013). Pew Research Center: The State of the News Media 2013. Retrieved from: http://www.stateofthemedia.org/2013/newspapers-stabilizing-but-still-threatened/newspapers-by-the-numbers/

Petersen, A., Anderson, A., & Allan, S. (2005). Science fiction/science fact: Medical genetics in news stories. *New Genetics and Society*, *24*(3), 337-353

Rao, L. (2014, May 19). IBM Watson acquires artificial intelligence startup Cognea. *Techcrunch*. Retrieved from: http://techcrunch.com/2014/05/19/ibm-watson-acquires-artificial-intelligence-startup-cognea/?ncid=twittersocialshare

Raupp, J. (2014). Social agents and news media as risk amplifiers: A case study on the public debate about the E. coli outbreak in Germany 2011. *Health, Risk & Society, 16*(6), 565-579. doi:10.1080/13698575.2014.950203

Reiter, B. (2013). Chapter 1. The epistemology and methodology of exploratory social science research: Crossing Popper with Marcuse. In, *The dialectics of citizenship: Exploring privilege, Exclusion and Racialization* (p. 1). East Lansing, MI: Michigan State University Press.

Roth, E., Morgan, M. G., Fischhoff, B., Lave, L., & Bostrom, A. (1990). What do we know about making risk comparisons? *Risk Analysis: An International Journal, 10*(3), 375. doi:10.1111/j.1539-6924.1990.tb00520.x

Roy Morgan Research (n.d.). About the company. Retrieved from: http://www.roymorgan.com/about

Skarlatidou, A., Cheng, T., & Haklay, M. (2012). What do lay people want to know about the disposal of nuclear waste? A mental model approach to the design and development of an online risk communication. *Risk Analysis: An International Journal, 32*(9), 1496-1511.

Song, S., & Kim, M. (2012). Five models of players' rule behavior for game balance. *Cyberpsychology, Behavior & Social Networking*, *15*(9), 498-502. doi:10.1089/cyber.2011.0504.

Turing, A. M. (1950). Computing machinery and intelligence. *Mind, 59*, 433-460.

Veltri, G. A., & Crescentini, A. (2011). The anchoring of nanotechnology in the Spanish national press. *International Journal of Science in Society, 2*(2), 127-138.

Vinge, V. (1993). The coming technological singularity. *Digital Rapture*, 56-71.

Wilson, K. M. (1995). Mass media and sources of global warming knowledge, *Mass Communications Review*, *22*(1&2): 75–89.

Winograd, T. (1972). *Understanding natural language*. New York, NY: Academic Press.

Wynne, B. (2014). Further disorientation in the hall of mirrors. *Public Understanding of Science, 23*(1), 60-70.

Appendix I: Online Article Lists

This appendix contains a complete list of all articles retrieved from all four sources. Articles have been grouped by source and are sorted by date. Duplicate articles, those with exact duplicate wording from an individual source are not included. An asterisk (*) identifies those articles that were reviewed in detail for this study.

New York Times

* Gloomy Americans Foresee a Downhill Slide to 2050 (*New York Times*, January 3, 2014)

IBM to Invest $1 Billion to Create New Business Unit for Watson (*New York Times*, January 9, 2014)

10 Things to Look For in 2014 at the Movies (*New York Times*, January 9, 2014)

‘Orfeo,’ by Richard Powers (*New York Times*, January 10, 2014)

* Over the Side With Old Scientific Tenets (*New York Times*, January 14, 2014)

Luxury Watch World Ponders Digital Innovation (*New York Times*, January 20, 2014)

Google to Buy Artificial Intelligence Company DeepMind (*New York Times*, January 26, 2014)

Business Highlights (*New York Times*, January 27, 2014)

Google Buys Artificial Intelligence Startup in UK (*New York Times*, January 27, 2014)

US Looks at Ways to Prevent Spying on Its Spying (*New York Times*, January 27, 2014)

US Looks at Ways to Prevent Spying on NSA Spying (*New York Times*, January 28, 2014)

Paul Allen, the Seahawks’ Man in the Shadows, Shows Them the Light (*New York Times*, January 31, 2014)

IBM Starts Rolling Out Watson Supercomputer in Africa (*New York Times*, February 6, 2014)

* Innovation, Optimism and Jobs (*New York Times*, February 14, 2014)

Apple Looking at Cars, Medical Devices for Growth: Report (*New York Times*, February 18, 2014)

Review: 'Thief' Delivers Some Unpolished Gems (*New York Times*, February 27, 2014)

* The Rolling Robot Will Connect You Now (*New York Times*, March 1, 2014)

SHOW BITS: Stars Kick Back After Hard Night's Work (*New York Times*, March 3, 2014)

Michio Kaku's 'Future of the Mind' (*New York Times*, March 7, 2014)

High-Tech Solutions for House and Apartment (*New York Times*, March 7, 2014)

* Billionaires With Big Ideas Are Privatizing American Science (*New York Times*, March 15, 2014)

Game Makers to Explore Social Issues at Conference (*New York Times*, March 17, 2014)

Reviews: Smash Hit, Castlevania, Calculords and Threes! (*New York Times*, March 18, 2014)

Start-Up Success Isn't Enough to Found a Museum (*New York Times*, March 19, 2014)

* If You Want to Fake It, Don't Do It Around This Computer (*New York Times*, March 21, 2014)

Facebook Takes Page Out of Google Playbook With Oculus Deal (*New York Times*, March 26, 2014)

Enlisting a Computer to Battle Cancers, One by One (*New York Times*, March 27, 2014)

'The Blazing World,' by Siri Hustvedt (*New York Times*, March 28, 2014)

Engaged Johnny Depp Shows Off 'Chick's Ring' (*New York Times*, March 31, 2014)

* Hey, Robot: Which Cat Is Cuter? (*New York Times*, April 1, 2014)

Microsoft Reveals Siri-Like Windows Phone Feature (*New York Times*, April 2, 2014)

Chorus Director Who Helped Score Films Dies (*New York Times*, April 4, 2014)

* Eight (No, Nine!) Problems With Big Data (*New York Times*, April 6, 2014)

Review: Siri-Like Cortana Fills Windows Phone Gap (*New York Times*, April 14, 2014)

Profit and Revenue Slip at IBM as Hardware Sales Fall and Layoff Costs Rise (*New York Times*, April 16, 2014)

Earnings and Sales From Google Disappoint (*New York Times*, April 16, 2014)

Review: 'Transcendence' Like a Clunky TED Talk (*New York Times*, April 16, 2014)

Johnny Depp Stars in 'Transcendence' (*New York Times*, April 17, 2014)

Captain America' Soars Again, Tops 'Rio 2' to Win U.S. Box Office (*New York Times*, April 20, 2014)

Apple Resets the Clock as Investors Await Next Big Thing (*New York Times*, April 23, 2014)

Windows Phone 8.1 Finally Catches Up to Its Rivals (*New York Times*, April 23, 2014)

Moogfest 2014 Unfolds in Asheville, N.C. (*New York Times*, April 28, 2014)

IBM Partners With Universities on Watson Projects (*New York Times*, May 6, 2014)

IBM Poised for Growth, Chief Says (*New York Times*, May 11, 2014)

A Discussion of the Danger and Promise of Tech (*New York Times*, May 11, 2014)

Review: 'Kraken Project' Is Compelling Thriller (*New York Times*, May 13, 2014)

Smithsonian to Fly Drones for 'Future' Festival (*New York Times*, May 14, 2014)

Anne Doran: ‘Photo-works (1985-1991)’ (*New York Times*, May 15, 2014)

* Baidu Hires Former Google Artificial Intelligence Chief (*New York Times*, May 16, 2014)

The Computerized Voice That Wasn’t (*New York Times*, May 24, 2014)

Delay Tests Video Game Developer (*New York Times*, May 25, 2014)

Office Help Is On the Way, Virtually Speaking (*New York Times*, May 30, 2014)

Rich Man's Accusers Press to Reopen Sex Abuse Case (*New York Times*, June 3, 2014)

Microsoft to Cooperate With Qihoo 360 Amid Security Concerns in China: Xinhua (*New York Times*, June 10, 2014)

A Smartphone Keyboard App That Anticipates What You Want to Type (*New York Times*, June 15, 2014)

As Robotics Advances, Worries of Killer Robots Rise (*New York Times*, June 16, 2014)

EA Sports UFC' a Respectable First Round for EA (*New York Times*, June 18, 2014)

Microsoft Makes Bet Quantum Computing Is Next Breakthrough (*New York Times*, June 23, 2014)

New Show Opens at the Barbican Center in London (*New York Times*, July 3, 2014)

Text Games in a New Era of Stories (*New York Times*, July 6, 2014)

* Silicon Valley Sharknado (*New York Times,* July 8, 2014)

'Extant' Stars Halle Berry as a Space Traveler With a Secret (*New York Times*, July 8, 2014)

IBM to Bet $3 Bln Over 5 Years Hoping for Breakthrough in Chips (*New York Times*, July 9, 2014)

Where's the Oval Avatar? (*New York Times*, July 18, 2014)

Avengers' Unleash 'Ultron' Footage at Comic-Con (*New York Times*, July 27, 2014)

* Will You Lose Your Job to a Robot? Silicon Valley Is Split (*New York Times,* August 6, 2014)

* Pew: Split Views on Robots' Employment Benefits (*New York Times,* August 6, 2014)

IBM Develops a New Chip That Functions Like a Brain (*New York Times,* August 7, 2014)

* Aloft Hotel to Begin Testing 'Botlr,' a Robotic Bellhop (*New York Times,* August 11, 2014)

Need a Personal Time Assistant? Apps Aim to Improve Productivity (*New York Times*, August 12, 2014)

Smartphones Overstate Their Social Intelligence (*New York Times,* August 13, 2014)

Traders Profit as Power Grid Is Overworked (*New York Times,* August 14, 2014)

Review: 'Madden NFL 15' Scores on New Consoles (*New York Times,* August 28, 2014)

* Building a Robot With Human Touch (*New York Times,* September 1, 2014)

Google Starts Quantum Computing Research Project (*New York Times*, September 2, 2014)

Exclusive : Microsoft Co-Founder Allen to Give $9 Million for Ebola Fight (*New York Times,* September 11, 2014)

* Lessons From the Past for a Future in Smart Cars (*New York Times*, September 14, 2014)

* IBM Launches Watson Tool for Business Clients (*New York Times*, September 16, 2014)

Science Fiction Writers Take a Rosier View (*New York Times*, September 17, 2014)

* Why Is Our Sci-Fi So Glum About A.I.? (*New York Times*, September 19, 2014)

Can a Computer Replace Your Doctor? (*New York Times,* September 20, 2014)

In ‘Person of Interest,’ Scattered Protagonists Return (*New York Times*, September 22, 2014)

New Smartphone App Gives Sight to the Blind (*New York Times*, September 22, 2014)

‘The Innovators’ by Walter Isaacson: How Women Shaped Technology (*New York Times*, October 1, 2014)

‘Spark,’ the Latest Dystopian Novel From John Twelve Hawks (*New York Times*, October 5, 2014)

‘Autómata’ Stars Antonio Banderas in a Devastated World (*New York Times*, October 9, 2014)

Sesame Workshop Tackles Literacy With Technology (*New York Times*, October 19, 2014)

At Ogilvy, New Unit Will Mine Data (*New York Times*, October 20, 2014)

Weak Results at IBM as Its Strategy Shifts (*New York Times*, October 20, 2014)

The Met and Other Museums Adapt to the Digital Age (*New York Times*, October 23, 2014)

* Google Bolsters Artificial Intelligence Efforts, Partners With Oxford (*New York Times*, October 23, 2014)

Paul Allen to Give $100 Million to Tackle Ebola Crisis (*New York Times*, October 23, 2014)

Robert Jackson Bennett’s 'City of Stairs,' and More (*New York Times*, October 24, 2014)

How Facebook Is Changing the Way Its Users Consume Journalism (*New York Times*, October 26, 2014)

Demystifying the MOOC (*New York Times*, October 29, 2014)

* Our Machine Masters (*New York Times*, October 30, 2014)

Q&A: 'Interstellar' Filmmaker Nolan on His Robots (*New York Times*, October 31, 2014)

Unexpected Complexity in a Spider’s Tiny Brain (*New York Times*, November 3, 2014)

India's Infosys to Hire 2,100 People in U.S. (*New York Times*, November 5, 2014)

* Artificial Intelligence as a Threat (*New York Times*, November 5, 2014)

* Fearing Bombs That Can Pick Whom to Kill (*New York Times*, November 11, 2014)

Latest News: Comet Watch, Ebola Treatments, World Cup Inquiry (*New York Times*, November 13, 2014)

Google to Quadruple Computer Science Prize Winnings to $1 Million (*New York Times*, November 13, 2014)

Movie Cram II at the Upright Citizens Brigade Theater (*New York Times*, November 16, 2014)

* Researchers Announce Advance in Image-Recognition Software (*New York Times*, November 17, 2014)

Hawking: Artificial Intelligence Could End Mankind (*New York Times*, December 3, 2014)

* Margaret Atwood on Our Robotic Future (*New York Times*, December 4, 2014)

* How Technology Could Help Fight Income Inequality (*New York Times*, December 6, 2014)

Demis Hassabis (*New York Times*, December 6, 2014)

Cemetery Plan Clashes With Neighbors' Culture (*New York Times*, December 8, 2014)

* Innovators of Intelligence Look to Past (*New York Times*, December 15, 2014)

* Study to Examine Effects of Artificial Intelligence (*New York Times*, December 15, 2014)

* As Robots Grow Smarter, American Workers Struggle to Keep Up (*New York Times*, December 15, 2014)

Siri Meets Dr. Phil (*New York Times*, December 17, 2014)

* Google: Europe's Favorite Villain (*New York Times*, December 19, 2014)

Knock Knock. Who's There? Amazon's Best-Selling Holiday Author (*New York Times*, December 19, 2014)

Review: 2015 Lexus RC and RC F (*New York Times*, December 19, 2014)

How Possibilities of Life Elsewhere Might Alter Held Notions of Faith (*New York Times*, December 22, 2014)

The Guardian UK

* The robots are coming. Will they bring wealth or a divided society? (*The Guardian UK*, January 4, 2014)

Forget artificial intelligence. It's artificial idiocy we need to worry about (*The Guardian UK*, January 6, 2014)

The apps that can write you a love letter, sext and more (*The Guardian UK*, January 19, 2014)

DeepMind Technologies: where it fits in Google's acquisitions (*The Guardian UK*, January 27, 2014)

Google buys UK artificial intelligence startup Deepmind for £400m (*The Guardian UK*, January 27, 2014)

Demis Hassabis: 15 facts about the DeepMind Technologies founder (*The Guardian UK*, January 28, 2014)

* Google's robot army in action (*The Guardian UK*, February 10, 2014)

In Transcendence, artificial intelligence is viewed with suspicion (*The Guardian UK*, February 14, 2014)

* Computer dating: coming soon to an operating system near you? (*The Guardian UK*, February 20, 2014)

* Are the robots about to rise? Google's new director of engineering thinks so… (*The Guardian UK*, February 22, 2014)

* 2029: the year when robots will have the power to outsmart their makers (*The Guardian UK*, February 22, 2014)

* Will we ever have love affairs with video game characters? (*The Guardian UK*, February 28, 2014)

Zuckerberg and Musk back software startup that mimics human learning (*The Guardian UK*, March 21, 2014)

* By turning security into a data problem, we can turn the tables on the bad guys (*The Guardian UK*, April 3, 2014)

Transcendence: 'A sleek but insubstantial thriller' – first look review (*The Guardian UK*, April 17, 2014)

* Google, Facebook and Amazon race to blur lines between man and machine (*The Guardian UK*, April 28, 2014)

* Facial recognition: is the technology taking away your identity? (*The Guardian UK*, May 4, 2014)

13-year-old boy passes the Turing test (*The Guardian UK*, June 9, 2014)

Mario Kart gets real: robotic Anki race cars powered by artificial intelligence (*The Guardian UK*, June 9, 2014)

* What is the Turing test? And are we all doomed now? (*The Guardian UK*, June 9, 2014)

Turing test: this little Eugene Goostman fellow was much brighter than I imagined (*The Guardian UK*, June 9, 2014)

Eugene Goostman is a real boy – the Turing Test says so (*The Guardian UK*, June 9, 2014)

Eugene the Turing test-beating 'human computer' – in 'his' own words (*The Guardian UK*, June 9, 2014)

* Computer simulating 13-year-old boy becomes first to pass Turing test (*The Guardian UK*, June 9, 2014)

* Scientists dispute whether computer 'Eugene Goostman' passed Turing test (*The Guardian UK*, June 9, 2014)

Claims that the Turing test has been passed are nonsense (*The Guardian UK*, June 11, 2014)

* Don't believe the science hype – we haven't created true AI yet (*The Guardian UK*, June 11, 2014)

* A computer has passed the Turing test for humanity – should we be worried? (*The Guardian UK*, June 13, 2014)

Five fascinating science books to read (*The Guardian UK*, June 18, 2014)

* Elon Musk says he invested in DeepMind over 'Terminator' fears (*The Guardian UK*, June 18, 2014)

* Hi-tech dealing: the connections that led to Google buying DeepMind (*The Guardian UK*, June 23, 2014)

Six ways technology is changing the way we shop (*The Guardian UK*, June 25, 2014)

Role-playing games: all human life is there … or so it sometimes seems (*The Guardian UK*, July 14, 2014)

Artificial intelligence powers Anki Drive to pole position on the indoor racetrack (*The Guardian UK*, July 14, 2014)

Driverless cars get green light for testing on public roads in UK (*The Guardian UK*, July 30, 2014)

Does OKCupid need our consent? (*The Guardian UK*, July 30, 2014)

Driverless cars will ruin the thrill of driving (*The Guardian UK*, July 31, 2014)

Wikipedia: meet the man who has edited 3m articles (*The Guardian UK*, August 5, 2014)

* Computer programmed to write its own fables (*The Guardian UK*, August 6, 2014)

* Will robots take our jobs? Experts can't decide (*The Guardian UK*, August 6, 2014)

* Artificial Intelligence will not turn into a Frankenstein monster (*The Guardian UK*, August 10, 2014)

Suspected child abuse fugitive caught by facial recognition after 14 years (*The Guardian UK*, August 13, 2014)

* Harvard's 1,000 Kilobot swarm demonstrates the future of robotics (*The Guardian UK*, August 15, 2014)

* RoboThespian: the first commercial robot that behaves like a person (*The Guardian UK*, August 17, 2014)

Google buys neural network city guide creator Jetpac (*The Guardian UK*, August 18, 2014)

Show us your robot designs (*The Guardian UK*, August 19, 2014)

Can Automata's rise of the robots bring science fiction to life? (*The Guardian UK*, August 26, 2014)

* The scientific A-Team saving the world from killer viruses, rogue AI and the paperclip apocalypse (*The Guardian UK*, August 30, 2014)

Dyson vacuums enter robotic age with 360 Eye – and a smartphone app (*The Guardian UK*, September 4, 2014)

* When fridges attack: the new ethics of the Internet of Things (*The Guardian UK*, September 8, 2014)

The journalists who never sleep (*The Guardian UK*, September 12, 2014)

* US needs a Federal Robotics Commission, says think tank (*The Guardian UK*, September 17, 2014)

From online dating to driverless cars, machine learning is everywhere (*The Guardian UK*, September 18, 2014)

* Ghosts in the machine: how AI research is bringing game characters to life (*The Guardian UK*, October 14, 2014)

* Google buys two more UK artificial intelligence startups (*The Guardian UK*, October 23, 2014)

* Japanese science fiction award opens entries to aliens and computers | Books (*The Guardian UK*, October 24, 2014)

* Elon Musk: artificial intelligence is our biggest existential threat (*The Guardian UK*, October 27, 2014)

Can Chappie rescue intelligent-robot movies? (*The Guardian UK*, November 7, 2014)

* Once upon a bot: can we teach computers to write fiction? (*The Guardian UK*, November 11, 2014)

The Imitation Game: Alan Turing's outsider status fuelled his genius (*The Guardian UK*, November 14, 2014)

How did the Enigma machine work? (*The Guardian UK*, November 14, 2014)

Alan Turing's name restored with film about his work, life and identity (*The Guardian UK*, November 14, 2014)

Hidden heroes of codebreaking history (*The Guardian UK*, November 18, 2014)

* Artificial intelligence: how clever do we want our machines to be? (*The Guardian UK*, November 29, 2014)

* Why we must not stall technological progress, despite its threat to humanity (*The Guardian UK*, December 3, 2014)

* Google's Eric Schmidt says AI concerns are normal but 'misguided' (*The Guardian UK*, December 10, 2014)

* Computer says no? Facebook's plan to scrap the drunken selfie (*The Guardian UK*, December 10, 2014)

Dear Facebook, stop our smug posts – not the drunken ones (*The Guardian UK*, December 11, 2014)

The Sydney Morning Herald

Spike Jonze taps into love in a virtual world in Her (*The Sydney Morning Herald*, January 2, 2014)

NSA researching quantum computer that could crack most types of encryption (*The Sydney Morning Herald*, January 3, 2014)

* Beware killer robots (*The Sydney Morning Herald*, January 4, 2014)

Terminators or protectors: Rise of the robot soldiers may be closer than you think (*The Sydney Morning Herald*, January 5, 2014)

Movie review: Spike Jonze's Her (*The Sydney Morning Herald*, January 12, 2014)

* Why an algorithm wants your highly skilled job (*The Sydney Morning Herald*, January 20, 2014)

Markets live: Chinese data cheers (for a bit) (*The Sydney Morning Herald*, January 20, 2014)

* Why robot sex could be the future of life on Earth (*The Sydney Morning Herald*, January 22, 2014)

* The rise of artificial intelligence (*The Sydney Morning Herald*, January 23, 2014)

* Her reality: Could you really fall in love with your computer (*The Sydney Morning Herald*, January 25, 2014)

Google, Samsung announce global patent agreement (*The Sydney Morning Herald*, January 27, 2014)

Google purchases DeepMind, expanding its reach in artificial intelligence (*The Sydney Morning Herald*, January 28, 2014)

Demis Hassabis: The secretive computer genius with the $750 million brain (*The Sydney Morning Herald*, January 30, 2014)

Aaron Swartz: A beautiful mind (*The Sydney Morning Herald*, February 1, 2014)

Stop filming with your smart phone and start living (*The Sydney Morning Herald*, February 7, 2014)

Apple looking at cars, medical devices for future growth (*The Sydney Morning Herald*, February 19, 2014)

* Warning, warning! Entering bots mania (*The Sydney Morning Herald*, February 27, 2014)

* Google's Eric Schmidt sees robots everywhere (*The Sydney Morning Herald*, March 8, 2014)

Pole-dancing robots and hands-free wizardry wow at CeBIT tech fair (*The Sydney Morning Herald*, March 12, 2014)

Robot vacuums: Test drive with four on the floor (*The Sydney Morning Herald*, March 13, 2014)

Image, identity and sex (*The Sydney Morning Herald*, March 15, 2014)

Facebook facial recognition takes a giant, scary leap forward (*The Sydney Morning Herald*, March 20, 2014)

* You can't fake it with this computer (*The Sydney Morning Herald*, March 24, 2014)

Actor Gary Lockwood knew 2001: A Space Odyssey was sci-fi for the ages (*The Sydney Morning Herald*, March 27, 2014)

Microsoft unveils Cortana digital assistant, reinstates Start menu (*The Sydney Morning Herald*, April 3, 2014)

Could this Australian-made auto-complete tool save you loads of time composing emails (*The Sydney Morning Herald*, April 4, 2014)

The real Pinocchio: Sweet-faced puppet or a very naughty boy (*The Sydney Morning Herald*, April 12, 2014)

The future of travelling is... not travelling at all (*The Sydney Morning Herald*, April 14, 2014)

Siri-like Cortana fills Windows Phone gap (*The Sydney Morning Herald*, April 16, 2014)

Transcendence: Shooter changes focus (*The Sydney Morning Herald*, April 19, 2014)

Johnny Depp's brave new world (*The Sydney Morning Herald*, April 20, 2014)

* Friends and influence for sale online (*The Sydney Morning Herald*, April 21, 2014)

Man and bird brought back to life (*The Sydney Morning Herald*, April 27, 2014)

Science behind Transcendence not so far-fetched (*The Sydney Morning Herald*, April 27, 2014)

Google's influence balloons thanks to maps and drones (*The Sydney Morning Herald*, April 28, 2014)

The return of Orpheus with a dash of music, terror and genetics (*The Sydney Morning Herald*, May 3, 2014)

George Heilmeier, whose LCDs ushered in flat screens, dies at 77 (*The Sydney Morning Herald*, May 5, 2014)

* Tech giants pour resources into artificial intelligence (*The Sydney Morning Herald*, May 10, 2014)

IBM facing 'rocky time', but poised for change (*The Sydney Morning Herald*, May 12, 2014)

The rise of the citizen scientists (*The Sydney Morning Herald*, May 17, 2014)

Google overtakes Apple as the world's top brand (*The Sydney Morning Herald*, May 21, 2014)

Google replaces Apple as world's top brand (*The Sydney Morning Herald*, May 21, 2014)

Markets live: Telstra extends rally (*The Sydney Morning Herald*, May 21, 2014)

Aussie bank brands trump Twitter and eBay (*The Sydney Morning Herald*, May 21, 2014)

Michael Jackson not a hologram at Billboard Music Awards 2014 (*The Sydney Morning Herald*, May 22, 2014)

Replace, discard and forget to wipe: Gen Y's smartphone habits (*The Sydney Morning Herald*, June 2, 2014)

* Forget self-driving cars: I want a cyborg (*The Sydney Morning Herald*, June 2, 2014)

Markets live: Investors sour on banks (*The Sydney Morning Herald*, June 5, 2014)

Australia poised to lead world into future: Physicist (*The Sydney Morning Herald*, June 5, 2014)

A live wire with boardrooms nous (*The Sydney Morning Herald*, June 6, 2014)

Together as one: The blokes trying to bring Microsoft together (*The Sydney Morning Herald*, June 6, 2014)

* 'Super computer' first to pass Turing test, convince judges it's alive (*The Sydney Morning Herald*, June 9, 2014)

Morning Express: Tuesday, June 10 (*The Sydney Morning Herald*, June 10, 2014)

* A computer passed the Turing Test - but does it matter? (*The Sydney Morning Herald*, June 10, 2014)

* Turing test: What Eugene said, and why it fooled the judges (*The Sydney Morning Herald*, June 11, 2014)

* See, sense, think, react: The robots are coming (*The Sydney Morning Herald*, June 13, 2014)

* Passing the Turing Test: Why we are a step closer to thinking machines (*The Sydney Morning Herald*, June 14, 2014)

* Rise of the robots increases concerns about industrial safety (*The Sydney Morning Herald*, June 25, 2014)

In Short: July 12 (*The Sydney Morning Herald*, July 4, 2014)

* What will work look like in 2025? (*The Sydney Morning Herald*, July 7, 2014)

The return of interactive fiction (*The Sydney Morning Herald*, July 8, 2014)

How free will the internet be in 2025? (*The Sydney Morning Herald*, July 8, 2014)

Drone flying takes off as a popular hobby (*The Sydney Morning Herald*, July 9, 2014)

Can a chatbot computer really deceive people into thinking it's a 13-year-old boy? (*The Sydney Morning Herald*, July 14, 2014)

* Artificial intelligence: The next step in evolution? (*The Sydney Morning Herald*, July 21, 2014)

Tuned in: The future of music (*The Sydney Morning Herald*, July 31, 2014)

* Meet the next bestselling authors: Computers (*The Sydney Morning Herald*, August 1, 2014)

Tom Petty still sets a high bar (*The Sydney Morning Herald*, August 3, 2014)

Microsoft's digital assistant Cortana takes on Apple's Siri (*The Sydney Morning Herald*, August 6, 2014)

What sport will look like in 2032 (*The Sydney Morning Herald*, August 20, 2014)

* Power couple (*The Sydney Morning Herald*, August 30, 2014)

We are already living in a science fiction future (*The Sydney Morning Herald*, August 30, 2014)

* Bankers beware: Root revolution set to push humans aside (*The Sydney Morning Herald*, September 1, 2014)

Take three: Star Trek, Dr. Who, Barricade reviews (*The Sydney Morning Herald*, September 11, 2014)

* When a robot takes the wheel, who's in charge? (*The Sydney Morning Herald*, September 14, 2014)

Benedict Cumberbatch's Imitation Game cements its status as an Oscar front-runner (*The Sydney Morning Herald*, September 15, 2014)

Facebook's soul-searching after controversial study will change the way it does research (*The Sydney Morning Herald*, October 3, 2014)

* The threat posed by Artificial Intelligence: Is it real? (*The Sydney Morning Herald*, October 6, 2014)

* Experts question the value of some new medical technologies (*The Sydney Morning Herald*, October 8, 2014)

* Are robots the future face of financial advice? (*The Sydney Morning Herald*, October 8, 2014)

Is this the future face of financial advice? (*The Sydney Morning Herald*, October 8, 2014)

* 'Skynet has already won': Terminator director James Cameron on why he won't use an iPhone (*The Sydney Morning Herald*, October 20, 2014)

For Peter Car3ey the Whitlam dismissal is more than a memory (*The Sydney Morning Herald*, October 20, 2014)

Apple co-founder Steve Wozniak joins UTS (*The Sydney Morning Herald*, October 22, 2014)

Apple co-founder Steve Wozniak joins UTS as adjunct professor (*The Sydney Morning Herald*, October 22, 2014)

Six degrees: From Bronwyn Bishop to Barry Humphries (*The Sydney Morning Herald*, October 24, 2014)

* We are 'summoning the demon' with AI: Technologist Elon Musk (*The Sydney Morning Herald*, October 27, 2014)

Craig Gample column: Doxxing part of the dark side of the web (*The Sydney Morning Herald*, October 31, 2014)

Chappie trailer: Hugh Jackman sports a mullet in unpredictable adventure (*The Sydney Morning Herald*, November 5, 2014)

* Artificial malevolence: Watch out for smart machines (*The Sydney Morning Herald*, November 8, 2014)

* The singular problem facing mankind (*The Sydney Morning Herald*, November 9, 2014)

Book reviews: Fiction (*The Sydney Morning Herald*, November 15, 2014)

Australia's wealthiest families investing in entrepreneurs (*The Sydney Morning Herald*, December 2, 2014)

* Stephen Hawking unveils new predictive speech platform, says AI 'could spell the end of the human race' (*The Sydney Morning Herald*, December 3, 2014)

* Google's new CAPTCHA test to see if you're a robot simply asks if you're a robot (*The Sydney Morning Herald*, December 5, 2014)

Markets live: CBA best of Big 4 (*The Sydney Morning Herald*, December 10, 2014)

* Automation could be the real zombie invasion (*The Sydney Morning Herald*, December 10, 2014)

* Is this the way the world ends? As Stephen Hawking warns about AI, here are some other scenarios (*The Sydney Morning Herald*, December 10, 2014)

100-year study to examine effects of artificial intelligence (*The Sydney Morning Herald*, December 16, 2014)

Ethan app: Ask him anything. It's free. (*The Sydney Morning Herald*, December 21, 2014)

Summer reading for the tech-minded - Part 1 (*The Sydney Morning Herald*, December 29, 2014)

Frances O'Connor's role in The Missing has echoes of real life (*The Sydney Morning Herald*, November 30, 2014)

The top 10 blockbuster movies we're actually looking forward to seeing in 2015 (*The Sydney Morning Herald*, December 31, 2014)

The Toronto Star

Movies in 2014: 12 good reasons to go (*The Toronto Star*, January 2, 2014)

Oscar 2014: Quebec filmmaker’s Dallas Buyers Club nabs six noms (*The Toronto Star*, January 16, 2014)

Arcade Fire’s Will Butler earns Oscar nomination with Owen Pallett (*The Toronto Star*, January 16, 2014)

Sci-fi: mini reviews of science fiction books (*The Toronto Star*, January 17, 2014)

* Love Sense by Dr. Sue Johnson: review (*The Toronto Star*, February 5, 2014)

Now that the Oscars are done, here's what's coming up (*The Toronto Star*, March 7, 2014)

Transcendence is a techno tale both visionary and myopic: review (*The Toronto Star*, April 17, 2014)

* Technology to help adults age in place just a few years away (*The Toronto Star*, May 7, 2014)

The future of the Internet: experts weigh in (*The Toronto Star*, May 12, 2014)

Sci-fi: mini reviews (*The Toronto Star*, June 6, 2014)

* 'Eugene' becomes first computer to pass the Turing Test (*The Toronto Star*, June 9, 2014)

* Was the Turing Test passed? Not everyone thinks so (*The Toronto Star*, June 13, 2014)

Did politics ruin 'the world's coolest mayor'? (*The Toronto Star*, June 23, 2014)

Google's venture capital arm adds $100M European fund (*The Toronto Star*, July 10, 2014)

DVD reviews: Transcendence, Blue Ruin (*The Toronto Star*, July 17, 2014)

Nissan cars to be self-parking by 2016 (*The Toronto Star*, July 21, 2014)

Sci-fi: mini reviews (*The Toronto Star*, August 1, 2014)

Holograms making first foray into politics (*The Toronto Star*, August 2, 2014)

* Pew finds views split over robots and job losses (*The Toronto Star*, August 6, 2014)

The Next Generation: origami robots that fold up and crawl away (*The Toronto Star*, August 8, 2014)

* HitchBOT completes cross-Canada journey (*The Toronto Star*, August 17, 2014)

Apple finally unveils its smartwatch (*The Toronto Star*, September 9, 2014)

* University of Toronto startup searches for Ebola cure (*The Toronto Star*, November 13, 2014)

When it comes to hi-tech bras, designers' cups runneth over (*The Toronto Star*, November 13, 2014)

* Forget CAPTCHA. Just tell Google you're not a robot (*The Toronto Star*, December 3, 2014)

* Unmanned devices changing everything from war to agriculture (*The Toronto Star*, December 7, 2014)

10 ideas we discovered in 2014 (*The Toronto Star*, December 26, 2014)