Chapter 6
The Robot Journalist in the Age of Social Physics: The End of Human Journalism?

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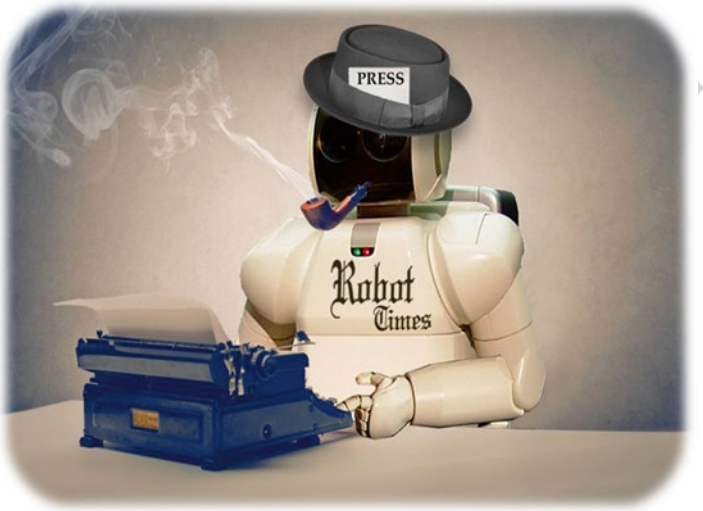

Designed by Michael Latar

Abstract In the age of Big Data, extracting knowledge from unlimited data silos employing Artificial Intelligence algorithms is becoming fundamental for the survival of society. We are living in an age of exponential growth in the complexity of social systems. We are at the dawn of an emergence of a new science some term as "social physics" that will allow to automatically analyse the billions of micro social engagements done continuously through our mobile devices in all fields of human activity (similar to the study of atoms in physics). This analysis of the social dynamics will allow to identify new social trends, social theories, at the "budding" stage.

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Traditional journalists, through the practice of intensive and at times, risky and expensive, investigative journalism, attempt to reveal new facts and social trends and with their narrative talent, experience, their values, creativity and intuition convert these facts into journalistic stories for their audiences.

In parallel to the emergence of the new field of "social physics", narration, the art of telling stories, is also becoming a scientific endeavor employing artificial intelligence algorithms taking advantage of the vast body of knowledge of the field of linguistics and the study of natural language. AI algorithms are being composed that can convert facts into readable stories in a fraction of a second.

This is the birth of Robotic Journalism. Robotic Journalism is based on two pillars: The computer software that automatically extract new knowledge from huge data silos employing the new "social Physics" concept; algorithms that automatically convert this knowledge into readable stories without human involvement. Besides the great potential saving in labor costs, these robot journalists seldom miss facts, if programed correctly, are never tired and if programed objectively-are free of personal bias. Data silo managers of the media organizations and the AI narrative software engineers may become the key employees of the organizations. The human journalists, considering labor and other costs, may become obsolete. In this paper, this new form of robotic journalism and its possible implications will be discussed.

Introduction

We are living in an age of exponential growth in the complexity of social systems. The amount of human digital data stored in data silos is doubled every 40 months. This is called the Age of Big Data. We are at the dawn of the emergence of a new science, the "social physics", that will enable the automatic analysis, employing artificial intelligence algorithms, of the billions of micro social engagements made continuously through our mobile devices and other online platforms (Pentland 2012). These micro engagements are recorded in digital format and stored in unlimited data silos. The recorded data covers all fields of human activity. This novel analysis of social activity will enable a better understanding of human connections and will identify new social and ecological trends at the "budding" stage. The ability to identify these changes at the budding stage will enable human society to anticipate changes that could risk social stability, and make the appropriate policy changes on time. The early identification of social and ecological changes is of great journalistic value.

In parallel to the emergence of the new field of "social physics", narration – the art of telling stories – is also becoming a scientific endeavor employing artificial intelligence algorithms.

Narration is now becoming a new field of research by artificial intelligence software writers taking advantage of the vast body of knowledge regarding linguistics and the study of natural language. AI algorithms are being composed that can convert facts and new insights derived from data silos employing data analytics (data mining) into readable stories in a fraction of a second. This is Robotic Journalism.

There are already commercial companies who have developed AI algorithms that write a huge number of journalistic stories without human involvement. These algorithms can adjust the tone and narrative structure of the stories to the profiles of their audiences. Two such companies will be discussed. It is estimated that that within 5–10 years, the majority of all journalistic stories will be written by robots.

Traditional journalists, through the practice of intensive and, at times, risky and expensive investigative journalism, attempt to reveal new facts and social trends. With their narrative talent, experience, values, creativity and intuition, they convert these facts into journalistic stories for their audiences. The efficient new robot journalist will constitute strong competition for traditional journalists.

This new field of Robotic Journalism is based on two pillars: The computer software that automatically extracts new knowledge from huge data silos employing the new "Social Physics" concept, and the algorithms that automatically convert this knowledge and these insights into readable stories without human involvement. Aside from great potential savings in labor costs, these robot journalists never miss facts, are never tired, and – if programmed objectively – are free of bias. The Japanese even created a three-dimensional humanized robot journalist that can mingle in a crowd of people, conduct interviews, take pictures, and compose a story.

This potential threat to the profession of human journalism is viewed by some optimistic journalists merely as another tool that will free them of the necessity to conduct costly and, at times, dangerous investigations. The robot journalists will provide them, so the optimists hope, with an automated draft for a story that they will edit and enrich with their in-depth analysis, their perspectives and their narrative talents. The more pessimistic journalists view the new robot journalists as a real threat to their livelihood and style of working and living. In the coming age characterized by the introduction of micro data collecting sensors embedded everywhere – in our clothing and all the gadgets that surround us – human journalists will find it hard to compete in this ecosystem of automatic comprehensive data collection and writing.

The data silo managers of the media organizations, and the AI narrative software engineers, may become the key employees of the media organizations and the new leaders of the newsrooms.

Due to some inherent limitations of AI algorithms, the human journalists do have some important advantages in competing with the robot journalists – but they must fully understand those limitations and adapt their mode of operation to take advantage of them. No robot journalist can become a guardian of democracy and human rights. It is therefore extremely important that human journalists should understand the new rules of the game. This will be discussed here.

Big Data: The Age of Social Physics

All forms of human activity are being digitized and stored in data silos. All media content, the context of the content absorption, and the consumer engagement, are digitized and automatically tagged by artificial intelligence algorithms (Lemelshtrich

Latar and Nordfors 2009). People's biometric and health records are being coded and stored. There is exponential growth in the use of mobile devices, and all such activities are being recorded and stored. The amount of human data being stored is doubled every 40 months. Prof. Sandy Pentland of MIT, one of the most influential data scientists in the world and a Big Data expert, calls these billions of human activities "micro engagements" (Pentland 2012). The storing process is random and unstructured. This continuous digitizing and storing of all human activities in huge data silos is called the age of "Big Data".

In parallel to these big data processes, artificial intelligence scientists are developing algorithms which are able to "crawl" through these data silos and extract new hidden knowledge. These algorithms enable the discovery of new social, health, economic and ecological trends at the budding stage. The process of analyzing data stored in data silos employing AI algorithms is called "data mining".

Pentland describes the application of artificial intelligence algorithms to the study of the billions of social engagements we make through our mobile devices or other online platforms as a new science he calls "social physics", which he likens to the study of the atom in physics:

> This sort of big data comes from things like location data off your cell phone or credit card. It's the little data breadcrumbs that you leave behind you as you move around the world that tell us the story of your life. It tells what you've chosen to do. … Big data is increasingly about real behavior, and by analyzing this sort of data, scientists can tell enormous amount about you. … As a consequence analysis of big data is increasingly about finding connections… Big data gives us the possibility of understanding how these systems of people and machines work, and whether they're stable. … Understanding these human-machine systems is what's going to make our future social systems stable and safe. … We're entering a new era of social physics, where it's the details of all the particles – the you and me – that actually determines the outcome (Pentland 2012).

All of our activities will be continuously and dynamically monitored in the Big Data age. The AI algorithms analyzing this data will enable us to understand human behavior and social dynamics like no social science could do before with traditional social science methodologies. Traditional scientific methodologies all depended on small samples and statistical extrapolations and averages. The new AI data-mining processes based on billions of micro engagements will reveal new facts about us that will lead to great dramatic journalistic scoops and stories. Who will be the first to benefit from these insights? The human journalist or the robot journalist?

Computational Journalism or Robotic Journalism

> …we define computational journalism as the combination of algorithms, data, and knowledge from the social sciences to supplement the accountability function of journalism (Hamilton and Turner 2009).

The use of computers by journalists is not a new phenomenon. The use of computers in newsrooms dates back to the early 1950s in parallel to the early developments of the computer industry (Cox 2000). Melisma Cox provides a detailed history

of the use of machines in journalism. This process was also termed "computer assisted reporting" (CAR) (Karlsen and Stavelin 2013). The organization for Investigative Reporters and Editors (IRE) holds an annual CAR conference (*ibid*).

Empirical literature on the use of computers in journalism is very limited what Anderson describes as "relatively scant literature on computational journalism" (Anderson 2011). There were also Luddite journalists in newsrooms (Singer 2004). The research projects that were conducted focused on viewing technology as a means of reinventing journalism (Powers 2012; Karlsen et al. 2013). Most of the researchers viewed computers as tools for investigative journalism and for introducing interactivity with consumers (Flew et al. 2012).

For the most part, computational journalism research concentrated on how computers can be used for information retrieval and data-mining processes to discover new knowledge from data silos of structured and unstructured random data. An extensive summary of the development of computational journalism is provided by Joakim Karlsen and Erik Stavelin (2013). Meyer describes an important advantage of computational journalism: the use of scientific method in the search of the truth which should be free from "prejudices, wishful thinking and perceptual blinders" (Meyer 2002).

"The phrase computational journalism carries for some the suggestion of robotic reporters…" (Hamilton and Turner 2009). The term "robot" is frequently used to describe activities we usually associate with what are traditional human activities.

Robots in journalism assume several tasks according to the literature and practice: Robot agents, robot editors, robot article generators and in recent years – robot story writers. The robot can be just computer software or a three dimensional structure; some assume a human-like appearance.

Robot Agents

The early use of the term "robots" in journalism were the "robot agents" proposed by Lee et al. who created the service "News On Demand" (NOD) in 1998. They proposed a news on demand service system that "gathers daily news information using a robot agent and delivers integrated news to users" (Lee and Kim 1998). The Lee algorithm allowed the users to register their information and receive the stories via email. Information-gathering robots were also used in war zones, such as the "Afghan Explorer" used to survey areas in Afghanistan too dangerous for human journalists.

Robot Editors

One of the early introductions of the term "Robot Journalism" related to a robot editor developed by Google in their "Google News Service". The product manager of the Google news service was proud to say, "There is no human intervention" in the process. Even decisions on what should be the site's lead story, what should be

displayed on the home page… are made by computers… based on a "source credibility measure" (Kurtz 2002).

Google News, launched in 2002, is an aggregation service. The company developed an algorithm that "crawls" through thousands of news sites and determines automatically which stories to publish with the relevant links. Google News aggregates stories from over 4,000 sources for its English edition, and covers over 60 regions in the world in 28 languages from over 25,000 publishers. Kurtz: "No team of human editors can compete with 24/7 robots." (*ibid*)

Mobile Robot Article Generators

The first and most ambitious endeavor to create a three-dimensional robot journalist that can mingle in a crowd in a similar fashion to a human journalist was made by a Japanese team led by Matsumoto of the Department of Mechano-Informatics in the Graduate School of Information Science and Technology at the University of Tokyo in 2007. The algorithm developed by Matsumoto's group was programmed for "(1) autonomous exploration, (2) recording of news, and (3) generation of articles" (Matsumoto et al. 2007).

The algorithm was designed to select the news by ranking the scarcity of the news item ("anomaly") and its "relevance". The robot was designed to explore the real world, take photos, transfer the information to a "news classifier" that calculated a "news score"; if the score was high enough, the "article generator" produced an article.

The Matsumoto robot was constructed on Segway wheels that enabled it to move in a building or on a street. The robot employed mathematical and statistical formulas throughout the news gathering process to determine the news items worth publishing.

Telepresence Mobile Robots

Another mobile robot was developed by Suitable Technologies in Palo Alto, California –the "Beam". The Beam system is designed to enable the remote presence of a human journalist at an event, i.e. without being physically there. The Beam is a motorized stand with a 17-in. flat screen that can be controlled by the user from a distance and enable a person to have telepresence and conduct interviews in a manner similar to a video conference. The Beam basically enables a multi-player mobile video conference. The Beam system consists of a dock that is used to charge the Beam, and client software that connects the Beam to its operator over a network and enables the Beam to be driven to various desired locations. The Beam enables interaction with other Beams in the area that represent other users.

Parmy Olson, a Forbes staff writer, visited the headquarters of Suitable Technologies while remaining at home in San Francisco: "I'm exploring the headquarters of Suitable Technologies in Palo Alto, Calif., passing leather couches, paintings and large indoor plants. Only I'm not really here; I'm on a laptop at my desk in downtown San Francisco, roughly 30 miles away. Using some lightweight software, I'm controlling a Beam… that displays my face." (Olson 2013). Olson interviews ST personnel and writes her journalistic story for Forbes on the telepresence robot producer without being there in person.

Kashmir Hill, another Forbes staff writer, used Beam to visit the CES – Consumer Electronics Show in 2014. "There are fewer than 10 Beams at CES this year… I want 10,000 at CES next year. It's not as good as being there. But we want it to be the next best technology for being there," Scott Hassan, the company CEO told Hill (Kashmir Hill 2014). "All in all, it was a pretty nice way to check out the show without the headache of travelling there," wrote Hill.

Another telepresence robot manufacturer is Double Robotics:

> **Double** is the ultimate tool for telecommuting.. Double is a remotely controlled mobile teleconferencing system, enabling conversations to happen anywhere and anytime (doublerobotics.com).

Another telepresence robot manufacturer is Anybots, which enables an avatar to represent the journalist:

> Short of being face-to-face, Anybots, Inc. offers the most interactive forms of communication available today by providing the user a **personal remote avatar**… With Anybots you can instantly be **immersed** in a distant environment experiencing the forefront of a new class of communication called **mobile telepresence**, allowing you to never miss an important event, meeting, or experience again (anybots.com).

The telepresence robots do not employ AI algorithms for their journalistic work. They only save travel time and expenses. The use of such telepresence tools can be expected to grow, and may affect the travel and tourism businesses. However, the use of machines to replace physical contact will enhance the acceptance of human-like journalist robots replacing human interaction. It won't be long before the AI features of the Japanese robot will be introduced into the next generation of telepresence robots replacing the Olsons and Kashmirs…

Robot Journalist Story Writers

> "Are we looking at the last generation of human journalists?" (Carter 2013)

A major change in the use of robotics in journalism occurred in 2010, when AI algorithms were developed in university computer science and communication labs with the clear objective of replacing the human journalist as a writer of stories, a very human occupation.

Narrative Science

The first serious commercial attempt to convert facts automatically into readable stories was done at Northwestern University in a research project called the "Stats Monkey". The Stats Monkey algorithm was programmed to automatically generate baseball stories when fed game statistics. This research was led by Dr. Kristian Hammond and Dr. Larry Birnbaum, the co-directors of the Intelligent Information Laboratory, the "InfoLab" (narrativescience.com).

The Stats Monkey project led to the start-up Narrative Science in 2010. With a multidisciplinary team of experts, Narrative Science developed and patented a new algorithm, the "Quill", based on artificial intelligence. The team included experts in computer science, communications, and business. The initial major objective of the Quill was to create a "revolutionary approach to business analytics and natural language communication" (Narrativescience.com). "Quill's power lies in the fact that it is a synthesis of data analytics, artificial intelligence and editorial expertise," said Kris Hammond, CTO of Narrative Science (Carter 2013).

The Quill algorithm operates in three stages: data reception, extraction of key facts and insights from the data employing AI algorithms, and transforming these facts and insights into readable stories without human involvement. Quill attempts to deliver insight and predictions. Hammond explains: "…the system uses the results of these analytics to drive a heuristically based inference engine and the central natural language generation. …give it data and Quill can reproduce a bona fide news story in seconds." According to Hammond, Quill is able to create a journalistic "spin" in addition to the stories (Carter 2013).

Quill enables the NS customers to select the tone of the stories. "You can get anything, from something that sounds like a breathless financial reporter screaming from a trading floor to a dry sell-side researcher pedantically walking you through it," says Jonathan Morris, COO of Data Explorers, a NS customer. "It's no more difficult to write an irreverent story than it is to write a straightforward, AP-style story," says Larry Adams, the NS VP of product (Levy 2012).

The Quill algorithm is programmed to learn the language of the domain it covers and write the stories in the appropriate language. An example: Quill is assigned to write stories that cover the restaurant business in a given city. Using a database of restaurant reviews, Quill was taught to learn the relevant components of a restaurant review, such as survey grades, service level, food experience, and citations from customers. In a short time, Quill can develop the narrative structure of the story and be able to write "an endless supply of chirpy little articles like 'The Best Italian Restaurants in Atlanta' or 'Great Sushi in Milwaukee' " (Levy 2012).

Hammond claims that as NS grows, its stories will be able to provide explanatory journalism and, ultimately, long-form articles. "Humans are unbelievably rich and complex, but they are machines. In 20 years, there will be no area in which Narrative Science doesn't write stories" (Levy 2012).

Even the use of metaphors, a very human concept, is going to be integrated into the Narrative Science algorithm. Hammond said that Narrative Science is

working to improve the quality of its articles by creating "deeper and better analytics, more expressiveness, more interesting parallelism and the use of metaphor" (Goldberg 2013).

Quill depends on data, and is therefore limited to writing stories only when data is available and questions are defined. Quill cannot initiate stories on its own without the data and a well-defined question.

Automated Insights

A major competitor of Narrative Science in the automatic conversion of data to journalistic stories is Automated Insights of North Carolina. The Automated Insights slogan is "We Give Data a Voice." They say that their patented AI algorithm is "like having your own personal data scientist, scouring large data sets and writing a story full of key insights for you. Except we do it in real time and at a scale of millions. … We are helping web site owners uncover the hidden insights in their web analytics. … We are publishing hundreds of millions of fully personalized stories … whether it is sports, finance, business intelligence – we can put any data in historical context in real time" (automatedinsights.com).

The automated Insights algorithm enables the writing of stories in any desired journalistic format: summaries, bullets or long-form articles. Its real-time stories can be published on any scale in multiple formats – emails, mobile applications and all types of social media. The customers of Automated Insights include Microsoft, Bloomberg, MSN, USA Today, and many others. Sports Illustrated: "If the writerless story sounds absurd, so did the horseless carriage" (automatedinsights.com).

The Automated Insights algorithms operate in a similar fashion to the NS algorithms: "Our patented technology humanizes data by spotting patterns and key insights, and describes these findings in your native language (English, Spanish, etc.)." The Automated Insights algorithms first analyze the data set, derive and prioritize insights based on the context and uniqueness, then construct a narrative in any required format and publish the story using a cloud-based infrastructure in real time through all new media platforms (automatedinsights.com).

Robot journalists are now also being embedded into electronic games, producing real-time stories based on how the users are performing during the games. Even AP recently announced that it will use Automated Insights algorithms to write some of its financial stories. Andrew Beaujon wrote in the digital journalism web site Poynter that "AP's robot writers have arrived" (Beaujon 2014).

The Los Angeles Times Algorithms

Ben Welsh, the LA Times data base manager, employs algorithms to create stories from the LA Times data base, which is automatically or manually fed by public or government authorities, such as the stock market results, the LAPD reports on crimes, or the US Geological Survey (USGS) reports.

When an earthquake of 3.2 magnitude shook California off the coast of San Simeon on Feb. 1, 2013, the LA Times algorithm published the story within 8 min, complete with a map showing the epicenter of the quake. The journalist Ken Schwencke wrote the code that automatically wrote and published the story (Marshall 2013). Ben Welsh: "The structured data comes in and Ken has an algorithm that says if the earthquake is close to California and over a certain magnitude it is 'news'. That automatically writes a blog post that looks like it was written by a human – well it was written by a human, by Ken – and it instantly creates a map, blog post, headline, and automatically posts it into our blogging platform." Ben Welsh views this auto-writing process as "human assisted reporting".

The LA Times algorithms are programmed to ask relevant questions that an experienced journalist would ask in a given situation. For example, in a crime story such as a homicide, the algorithm will search the data base for who committed the most serious offense by looking at the highest bail amount, or comb through the list of occupations for public service jobs and familiar names (Marshall 2013).

Automatic Newsrooms

Media companies are expected to undergo dramatic changes in the coming decade due to the introduction of automatic AI processes into all aspects of news production and dissemination.

AI algorithms will be employed for automatic content analysis and tagging in all media platforms: text, video, audio and pictures. AI algorithms will be employed for the automatic analysis and tagging of the context of the media consumption: social, location, the mood of the consumer and the mood of the programs. AI algorithms will be employed to analyze the consumer engagement during the content consumption (Lemelshtrich Latar and Nordfors 2009). See Fig. 6.1 for a layout of an automatic newsroom.

AI algorithms are used to create a comprehensive social DNA for consumers to enable automatic behavioral targeting of content and advertising to them based on their comprehensive digital profiles (Lemelshtrich Latar 2004).

The ability to measure accurately how the content affects consumer behavior and the ROI of every journalist can be expected to exert tremendous pressure on journalists to adjust the content according to the ROI of each of their articles. The ability to automatically send content directly to consumers based on their profiles gives robot journalism a significant advantage in the competition for consumer attention and dollars. The great economic saving and the speed of robot journalists put human journalists at very real risk.

Media organizations can be expected to seek efficiency (except perhaps for public media). The efficiency lies in automation, creation of data silos, the construction of AI algorithms that can data-mine new facts and social trends, write the stories, and automatically target the content to the appropriate consumers in the relevant context of media consumption.

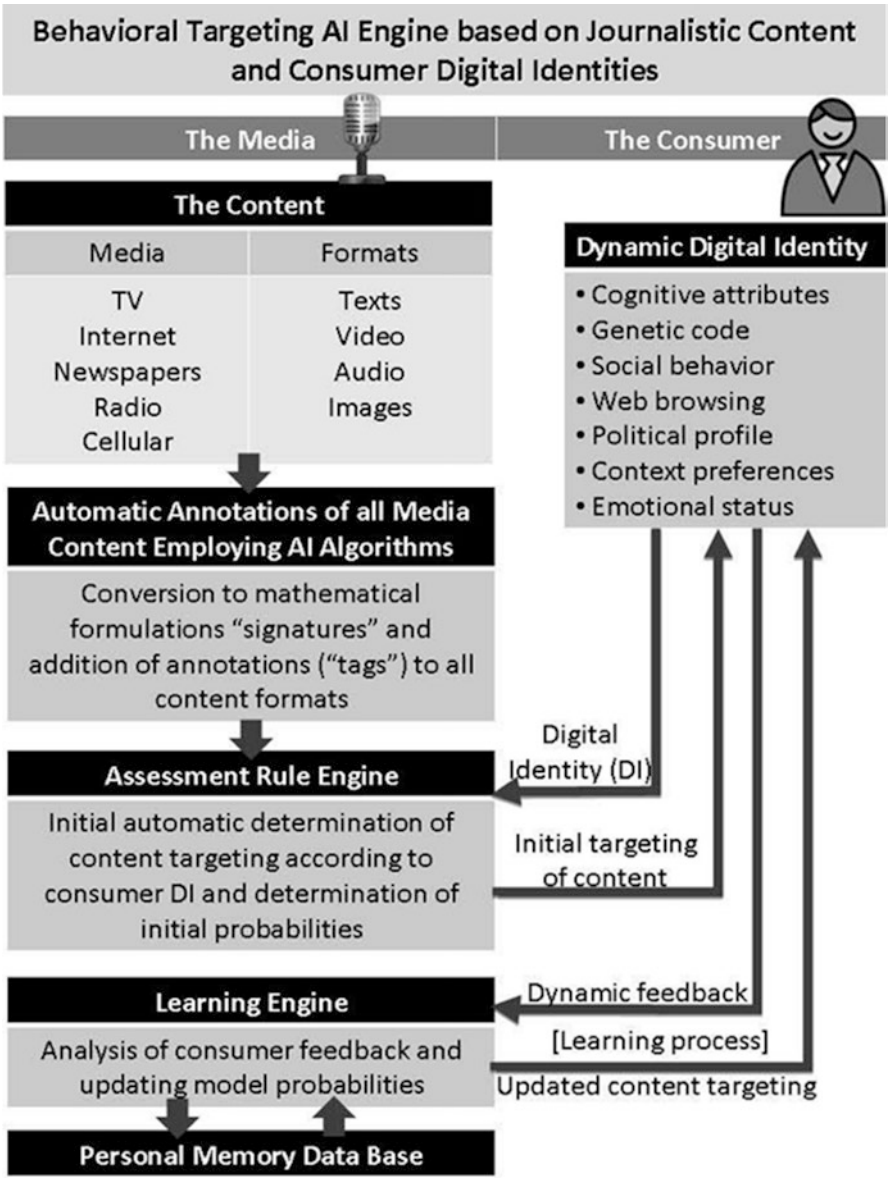

Fig. 6.1 AI engine for automatic news analysis and targeting of content per consumers' digital profiles (Lemelshtrich Latar and Nordfors 2009)

New leaders can be expected to run the newsrooms – they will be the data silo managers and software writing engineers. Arthur Sulzberger, publisher of the NYT, was recently asked what he would do today in his media organization, given his experience:

> Arthur Sulzberger surprised some people recently when asked what he would do differently in the digital transition, given hindsight. Hire more engineers, he said (Doctor 2013).

New Horizons for Human Journalists

Human journalists will find it difficult to compete with story-writing robot journalists who employ social physics and AI to data-mine new facts and write stories automatically, unless they understand the limitations of AI in journalism. These limitations, once understood, offer human journalists many opportunities to preserve their profession and even to use AI algorithms to gain more influence. But they must learn to adapt the nature of their work to the new social physics Big Data era.

The developer of one of the first robot journalist story writers, Kristian Hammond of Narrative Science, predicted that 90 % of the journalistic stories would be written by robots within 5–10 years. Ray Kurtzweil predicted that by the year 2040 computers will outsmart the human brain, at a point known as the "technological singularity". However, recognizing the AI limitations and properly adapting the nature of human journalistic work to take advantage of those limitations, could limit robotic journalism to some segments of the media content and to becoming journalists' aids in other segments. Some of the optimistic journalists do indeed see the AI algorithms and robotic journalism as enhancing their work: "Journalists see 'robotic journalism' as an opportunity to make journalism more human. When routine tasks can be automated, journalists will have more time for in-depth reporting" (van Dalen 2012).

AI algorithms do have some serious limitations. Data-mining algorithms are best at discovering new connections between multiple variables with very high statistical significance due to the huge amount of data being analyzed, but the results can be meaningless and add no real value, and could lead to wrong decisions. False discoveries can be a function of incorrect questions, incorrect data or incorrect AI procedures. The conclusions that can be drawn from these discoveries can be totally incorrect. AI discoveries must be validated by tests, by logic and by reasoning. Extracting knowledge from data followed by a validation process is called "knowledge discovery in databases (KDD)" (Fayyad et al. 1966). The validation process is best done by human analysts or journalists, on condition that they learn to activate the new validation tools that are becoming available (data analytics).

Another serious limitation of AI relates to the ability of AI algorithms to understand human natural language, especially the context of the ideas, metaphors, humor and poetry. There is an ongoing philosophical debate among scholars as to whether machines will ever be able to fully understand the richness and depth of natural language within the cultural and social contexts which are also changing with time. Terry Winograd, a leading researcher in human language processing, knowledge representation and artificial intelligence, and co-author of a book on the limitations of artificial intelligence (Winograd and Flores 1986), claimed that AI understanding of natural language cannot go beyond a bureaucratic level, which Trausan-Matu interprets as "…a person without empathy, that acts according to some strict mechanic rules" (Trausan-Matu 2005). A current and relevant interpretation of Winograd's view would be that a robot journalist will not ever be able to "write" stories whose depth and richness will go beyond the "bureaucratic level", which may give the human journalist, who can be empathic and can understand complex cultural contexts, an important advantage.

Another major limitation of AI is that the algorithms cannot ask questions but can only attempt to answer them. The AI algorithms cannot think out of the AI tool box: data silos and the algorithm instructions set by the human software writers.

Another AI limitation is that algorithms lack the ability to write opinions. They can provide new knowledge (after validation) but they cannot integrate the new knowledge into suggestions for policy or change. This is a very human endeavor.

AI algorithms cannot be innovative, cannot invent new things, whether products or social organizations. Invention requires ingenuity, which gives us humans a great advantage over the AI robots. Human ingenuity led to technological and social inventions. Ingenuity requires complex thought processes usually aimed at asking questions and solving problems. Data mining of digital silos can greatly enhance the process of human ingenuity by enabling the testing of complex ideas and hypotheses. The trigger of invention is the unique human ability to identify needs, recognize threats, and ask the right questions. These questions are usually motivated by the will to survive environmental or man-made threats, or simply out of the desire to constantly improve the quality of life.

The realization that ingenuity processes are important to seeking solutions to the threats posed by robot journalism in the age of Big Data led to the search for and creation of new social experiments to enhance innovation and ingenuity processes. One such experiment is the "Hackathon", which aims to benefit from the "wisdom of the crowds". Hackathons are 1- or 2-day events where people of various backgrounds gather together to discuss and seek new solutions to problems in a judgment-free multidisciplinary environment. Such gatherings include computer programmers, graphic designers, hardware developers, artists, social scientists, psychologists and journalists.

The word "hack" means a playful positive activity with the aim of creating new things or ideas in a restriction-free environment.

Leading journalism schools, aware of the threat to human journalism, adopted "hackathons" to seek new ideas and to find new roles for human journalists. Journalistic hackathons took place in leading journalism schools such as the Columbia School of Journalism, and in other parts of the world. On Feb. 4, 2013, an Australian data journalism team from "The Age" conducted a hackathon in Melbourne. The aim of the hackathon was to "explore the relationship between big data to drive a narrative in the form of data visualization" (Wright 2013). Wright: "It was a fascinating experiment that saw programmers, data crunchers, journalists, graphic designers and open data activists come together to ask the question, at least in my mind, **if data-driven journalism is art or science?**"

Journalism is a combination of art *and* science. The artistic nature of journalistic work is manifested in the search for new creative ideas, new creative angles to cover a story, new thoughts, new solutions to problems, new ways of enriching life. The scientific part of journalistic work is to employ analytical tools to support and validate the ideas proposed based on data silos where human activity is recorded and stored.

A recent example of the use of art to tell a journalistic story is the use of animation in the New York Times to tell a journalistic story. Nicholas Blechman published

an animated story in the Opinion Pages titled "Extra Virgin Suicide: The Adulteration of Italian Olive Oil". Blechman is the art director of the NYT Book Review, and an illustrator. The animation tells a story of how olive oil is being marketed by the Italians as virgin oil "made in Italy" but in reality is a doctored oil product of soy oil and imported olive oil from North Africa. The story is told "like a cartoon combined with an infographic" (Ellis 2014). The use of visuals (pictures, video) to tell a story is becoming important in the new multi-platform media where peoples' attention span for text is getting shorter. This is especially true for mobile devices with small screens.

However, even this NYT attempt to employ art to enrich news items by human animation is becoming under competition from automatic AI algorithms. A new start up company the "Guide", is developing an algorithm for the automatic conversion of news items to animation and video. The company objective is to "quickly create videos from existing online news articles…with our guided publishing online tool you can quickly create a video in just a few minutes…enables you to have a human voice narrate your video replacing…the initially computer generated voice"(http://gui.de). The Guide process: Analyse original data, summarize it, transfer the article elements into video elements, subject it to editorial review and reassemble as video. The economic advantages of the use of algorithms to replace human activities will continue to fuel the competition between human journalists and their robot competitors.

When thinking about the nature of their future work, human journalists must also be aware that the media organizations that are their current employers are also undergoing dramatic organizational changes, and they must employ creative thinking not only vis-à-vis the robot journalists, but also in looking for innovative ways to market and distribute their stories. If they are able to produce stories of high value that will employ AI techniques to discover new insights and validate them, they may find themselves becoming members of new forms of organizations that employ social networks and the internet to market their stories for micro payments. The "long tail" nature of the internet may provide them with a respectable living as practicing human journalists.

Present media journalism ethics call for separation between facts and opinions. Robotic journalism ethics have not yet been written. It is important that publishers should make it transparent which item was written by a human journalist and which by a robot journalist. The current Narrative Science articles published by Forbes adhere to this procedure, but the economic temptation to assign a human name to a robot story can be expected to grow unless clear ethical guidelines are defined and maintained. Due to the AI limitations specified above, it is important to inform the reader as to whether a story was written by a robot or by a human journalist. The human journalists must be the guardians of this important issue.

No robot journalist can become a guardian of democracy and human rights. It is therefore extremely important that human journalists should understand the dramatic developments in their professions and make sure these changes serve them in ways that will preserve and strengthen their very important social function.

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