# The Image of Artificial Intelligence in Dutch Newspapers

Janneke van der Zwaan

Supervisors

| | |
|---|---|
| Karin Rebel | Bert Bredeweg |
| Athena Institute | Faculty of Science |
| Vrije Universiteit | University of Amsterdam |

Amsterdam
June 2008

# The Image of Artificial Intelligence in Dutch Newspapers

## Master's literature study


| | |
|---|---|
| By: | Janneke van der Zwaan |
| Student no.: | 1730460 |
| Address: | Rudolf Dieselstraat 67-hs<br>1097 AV Amsterdam |
| E-mail: | jannekevdzwaan@gmail.com |
| Tel. no.: | 06 24241865 |


## Master's in Artificial Intelligence

| | |
|---|---|
| Programme: | AI and Communication |
| Credits: | 9 ects |
| Date: | June 2008 |

## Supervision

| | |
|---|---|
| 1st supervisor: | Karin Rebel<br>Athena Institute<br>Vrije Universiteit |
| 2nd supervisor: | Bert Bredeweg<br>Faculty of Science<br>University of Amsterdam |

**Abstract**

Artificial intelligence is the academic discipline concerning itself with the automation of tasks that require intelligence, often by building computer programs. Since artificial intelligence is a complex, broad, and abstract field, it is hard to give a precise description. At the moment, artificial intelligence is already applied in many common devices and computer programs, such as traffic lights, medical equipment, video games, and Internet search engines, but the application goes largely unnoticed. However, the impact of artificial intelligence on society will most likely increase in the future.

This study explores the way newspapers write about artificial intelligence by making a content analysis of newspaper reports. Reports are selected from Dutch national newspapers between 2005 and 2007. 52 reports contain substantive information on artificial intelligence, and are analyzed, based on a framework that was constructed from several issues concerning artificial intelligence and newspaper reports about science in general.

The small number of reports discovered, confirm that the subject is unknown and difficult. Also, the reports contain little explanation about artificial intelligence. Explanations found are general, and restricted to specific applications and disciplines.

# Contents

# Chapter 1

# Introduction

At present, many aspects of everyday life depend on information technology. Computer hardware and applications get more powerful and are employed to enhance or support humans when performing intelligent tasks. Sometimes computers even take over these tasks. The academic discipline concerning itself with the automation of tasks that require intelligence is called artificial intelligence (AI).

Intelligence is usually attributed to humans and some animals. Since (human) intelligence is not fully understood, it is unclear what it means for a machine or computer program to be intelligent. Moreover, many different (human) abilities require intelligence, so, the field of artificial intelligence is very broad. In addition, intelligent systems vary widely in abilities, inner working, and appearance. Therefore, giving a precise explanation of artificial intelligence is difficult.

Ever since the emergence of the field, artificial intelligence has been predicted to have a profound impact on society, either in a positive or negative way (Boden, 1990). Currently, the application of artificial intelligence in many computer programs and devices goes largely unnoticed. The field is relatively unknown among the general public. Nevertheless, the impact of artificial intelligence will most likely increase in the future.

Given that artificial intelligence is complex and unknown, the question arises how newspaper reporters treat this subject. Since the image people have of science in general is based on all kinds of images encountered in the media and daily life (Hanssen and van Katwijk, 2007), investigating how newspapers write about artificial intelligence gives insight into what people think of this subject. In addition, a study of the image of artificial intelligence makes it possible to verify and, if necessary, provide suggestions for improving the image in newspapers. It is also a good starting point to draw up recommendations for writing about complex and abstract topics in general.

## 1.1 Research questions

The matter of how artificial intelligence is depicted in newspapers is explored by making a content analysis of newspaper reports. The main research question is formulated as follows:

What image of artificial intelligence is disseminated through newspaper reports?

Relevant sub-questions are:

- What is artificial intelligence?
- What issues concerning science in newspapers and artificial intelligence can be used for the content analysis of newspaper reports?
- How much and what kind of attention is being paid to science in newspapers?
- How much and what kind of attention is being paid to artificial intelligence in newspapers?
- Is the image of artificial intelligence disseminated through newspaper reports correct?

## 1.2 Outline

In chapter 2, a short introduction to artificial intelligence is given. In addition, related work concerning science in newspapers is discussed. Chapter 3 is about the procedure of selecting reports from newspapers and the construction of the framework for analysis. Results of the content analysis are presented in chapter 4. Conclusions and suggestions for future work follow in chapter 5.

# Chapter 2

# Background

## 2.1 Artificial Intelligence

### 2.1.1 What is Artificial Intelligence?

Artificial intelligence is the "science and engineering of making intelligent machines, especially intelligent computer programs" (McCarthy, 2007). Intelligent systems are able to reason, learn, communicate, perceive, move, represent knowledge and/or manipulate objects. An intelligent system has one or more goals and uses its abilities to achieve these goals. Intelligent systems are applied in numerous domains and vary widely in abilities, inner working, and appearance. The field of artificial intelligence is very broad, so any general description is somewhat indefinite.

Artificial intelligence is about intelligence. The term 'intelligence' seems to have many interpretations. It is an ability usually attributed to humans (and some animals) and includes skills like learning from experience, using metacognitive processes to enhance learning, and being able to adapt to changes in the environment (Sternberg, 2003, p. 485). The notion of intelligence is also connected to other typical human qualities such as consciousness and the ability to experience emotions. Since (human) intelligence is not fully understood, it is hard to define when a machine or computer program can be called intelligent.

Many different approaches to creating intelligent machines or computer programs have been taken. Some approaches are concerned with reasoning and others with behavior. For some approaches success is measured in terms of human intelligence and for others the more general notion of rationality is used. A system is rational when it takes the best possible action given a situation (Russell and Norvig, 2003). Humans are not always rational, they often make mistakes. Russell and Norvig (2003) organize different approaches to artificial intelligence into four categories:

1. *Acting humanly* - According to Alan Turing, a system is intelligent if it passes the Turing Test (Turing, 1950). The Turing test is based on the indistigushibility between an intelligent being (a human) and artificial intelligence. It involves a human interrogator sitting behind the computer having a (typed) conversation with another human or a computer program. If the human thinks he is talking to a human when in fact he is

having a conversation with a computer program, the program is said to be intelligent. A system can pass the Turing Test when it acts like a human (Russell and Norvig, 2003).

2. *Thinking humanly* - In cognitive science, computer programs are used to model human thought processes. Researchers are not interested in getting correct answers from an intelligent system, but want to determine how the human mind works. They use systems that think like humans to do so (Russell and Norvig, 2003).

3. *Thinking rationally* - Systems that think rationally use logic to represent knowledge and solve problems. The focus lies on making correct inferences. Many things, such as informal knowledge and uncertainty are not easily represented in formal languages, so, this approach is not always feasible (Russell and Norvig, 2003).

4. *Act rationally* - Acting rationally is the most general approach to artificial intelligence. In contrast to human intelligence, rationality is clearly defined and completely general. Being rational (doing the right thing in a situation), may involve making correct inferences, but is more general than that (Russell and Norvig, 2003).

All four directions have yielded valuable insights to the field (Russell and Norvig, 2003).

### 2.1.2 Foundations

The field of artificial intelligence has incorporated many ideas, viewpoints, principles, and techniques from other fields (Russell and Norvig, 2003, p. 5-16). The viewpoint that the mind is constituted by the operation of a physical system stems from *philosophy* (Russell and Norvig, 2003). Philosophers also came up with theories of reasoning and learning. Formal theories of logic, probability, decision making, algorithms, and computation originate from *mathematics* (Russell and Norvig, 2003). The field of *economics* contributed ideas of maximizing payoff and game theory (Russell and Norvig, 2003). *Psychology* supplied tools to investigate the human mind and behavior (Russell and Norvig, 2003). In *neuroscience* the brain and nervous system is studied from a biological perspective (Russell and Norvig, 2003). Insights about how the brain processes information proved valuable for the field of artificial intelligence. *Linguistics* contributed theories about the structure and meaning of languages (Russell and Norvig, 2003). And *computer science* provided tools, such as computers and programming languages, to build actual systems that display intelligent behavior (Russell and Norvig, 2003).

Artificial intelligence is built on a variety of different academic disciplines. These disciplines study (different aspects of) intelligence from their own perspective and come together in the multi disciplinary field of artificial intelligence.

### 2.1.3 Disciplines

As mentioned before, artificial intelligence is broad and diverse. Russell and Norvig (2003) distinguish six important disciplines in the field of artificial intelligence: natural language processing, knowledge representation, automated

reasoning, machine learning, computer vision, and robotics. These disciplines are not separate sub-fields. Different disciplines are often combined to create intelligent systems. In order to get an overview of the field of artificial intelligence, each of the six disciplines is explained briefly.

1. *Natural language processing* - Natural language processing is concerned with the automated generation and understanding of natural languages. Natural language is complex and ambiguous. In order to be able to understand natural language, knowledge of the subject matter and context is required in addition to knowledge of the structure of sentences. In natural language processing, language is modeled either with statistical techniques or based on grammatical rules.

2. *Knowledge representation* - Knowledge can be used to solve problems. Knowledge representation addresses the issue of how knowledge should be stored in order for a system to be able to use it. When knowledge is represented in a suitable way, solving the problem becomes easier. Languages for knowledge representation are usually based on logic.

3. *Automated reasoning* - Automated reasoning is concerned with creating 'systems that think rationally' (see section 2.1.1). The goal is to automate the process of making correct inferences based on formal logic. Important topics include theorem proving, model checking, reasoning with uncertainty, and non-monotonic reasoning.

4. *Machine learning* - Machine learning is about automatically extracting information from data using statistical and computational methods. Supervised learning can be formulated as a classification task: given a number of data samples and the class to which they belong, the learner has to approximate a function that maps a new sample to the correct class. When the data is not labeled, the learner models the input samples. This is called unsupervised learning.

5. *Computer vision* - Computer vision is concerned with automatically extracting information from images. Humans are very good at making sense of images. For computer programs it is much harder: they only see series of individual pixels and try to make sense of those. Important tasks in computer vision are object detection, object tracking, and object recognition.

6. *Robotics* - Many intelligent systems are computer programs and do not exist in the physical world. The sub-field of robotics deals with (intelligent) systems that do. Intelligent robots use sensors to perceive the world. After processing their perceptions, the action that maximizes the chance of achieving one or more goals is selected, and appropriate signals are send to the actuators (motors) in order to execute the action. When the action is performed, cycle of sensing, processing, and performing actions starts again. Intelligent robots have to be able to deal with uncertainty, e.g. it is usually impossible to gather all information needed to choose the best action, the environment is dynamic (with moving people or objects), and actions may fail or have undesired consequences.

### 2.1.4 Social and Ethical Implications

What consequences can be expected when intelligent machines or computer programs come into existence? Possible impacts of artificial intelligence on society have been addressed since the emergence of the field (Collins, 1987; Minsky, 1979; Woolgan, 1987; Yazdani, 1984). Obviously, the nature of the consequences and the strength of the impact strongly depend on the level of intelligence attained and whether the system is meant to support decision making or perform tasks autonomously. In addition, whether envisioned consequences are positive or negative, usually depends the preferred point of view.

Usually, intelligent systems are utilized to automate certain activities. By taking over boring, uninteresting, and repetitive tasks from humans, people can spend more time focusing on interesting work, which could lead to an improvement in the quality of life (Boden, 1990; Serenko et al., 2007). On the other hand, artificial intelligent systems might replace humans completely, which could lead to unemployment (Boden, 1990). Serenko et al. (2007) argue that the atomization of certain tasks will lead to the creation of new tasks (and thus new job opportunities), e.g. on an organizational level. Another possible consequence of the replacement of human activity by intelligent systems is skills erosion (Serenko et al., 2007). When humans start relying on the system to perform certain tasks, they might forget how to perform them themselves.

The development of intelligent systems can lead to the widespread availability of knowledge. Intelligent systems may provide support in expertise-dependent areas such as medicine, law, military and education (Boden, 1990). Many believe that especially the people in developing countries world can benefit from information technology (Tongia et al., 2003). Others, however, fear that the gap between information rich and information poor jobs will grow, because mostly knowledge-intensive tasks will be automated (Sackman, 1987).

Another important issue is privacy. Intelligent systems store knowledge and/or can be used to extract information from large data sets (data mining). Some people fear intelligent systems will be employed by governments or other organizations in order to suppress individuals or groups (Boden, 1990).

Users of intelligent systems could experience a dehumanizing effect when they become less dependent upon human contact for advice, communication, and information (Boden, 1978). In addition, people could be concerned about the ethics, morale and responsibility of intelligent systems, distrust them and worry about issues such as relationships between intelligent systems and humans, or the systems' ability to express (or experience) emotions (Epstein, 2000). The question of whether human capabilities are unique could be another source for psychological distress (Firschein et al., 1973; Weizenbaum, 1976). Boden (1990) feels that the absence of emotions in machines will actually lead to higher appreciation of the emotional dimension of human personality. She concludes that the quality of being human is not threatened by artificial intelligence as long as people do not abandon their "responsibility for evaluating –and, if necessary, rejecting– the 'advice' or 'conclusions' of computer programs" (Boden, 1990).

### 2.1.5 The AI Effect

Many common applications, such as air conditioners, cameras, video games, medical equipment, traffic lights, refrigerators, recommendation services ('if you like this, you should try ...'), Internet search engines, cruise control, optical character recognition, and robot pets, make use of AI techniques. However, people do not recognize this widespread availability of artificial intelligence. This is called the AI effect. When a machine or computer program is able to perform a task, it does not seem intelligent. Rijsdijk and Hultink (2007) found evidence suggesting that when an innovation takes over cognitive tasks, it is perceived to be less complex than when a physical task is taken over.

The history of artificial intelligence is characterized by periods of great optimism and high expectations followed by disappointment (Russell and Norvig, 2003, p. 16–27). In 1956, when the field of artificial intelligence was founded it was expected that human level intelligence would be achieved in a matter of years. In reality, things turned out to be far more complicated. Intelligent systems that were realized fell short of expectations. It is possible that the early setbacks spoiled the mood for later developments.

## 2.2 Science in Newspapers

Since artificial intelligence is an academic discipline, it is expected that many reports about artificial intelligence write about science or scientific research. Therefore, it is instructive to establish how newspapers write about science in general.

During the 1980s the attention given to science in newspapers increased (Hanssen and Willems, 1992; Bader, 1990). This increase is probably related to the introduction of science sections. Science sections were added to Dutch newspapers during the 1990s. For the general public, newspapers still are the main source for news about scientific research and technological developments (Becker and van Rooijen, 2001).

In 2003, a quantitative study of scientific news in Dutch newspapers was performed (Hijmans et al., 2003). Hijmans et al. explored the ways in which newspaper reports handle difficult issues related to scientific research, such as background, research methods, ranges of uncertainty, and/or benefits or risks associated with the outcomes. The researchers sampled editions from national and regional newspapers. Reports that mentioned scientific research were subjected to further analysis. In addition, journalists and editors from different newspapers were interviewed about technical aspects of general news items, editing science news for both general news pages and science sections, and the handling of scientific terminology.

Hijmans et al. found that national newspapers regarded 'quality' newspapers contained most reports mentioning science or scientific research. Less reports mentioning science were found in so-called 'popular' papers. And regional papers contained the least number of reports about science. For 85% of the reports, the research featured as a primary news fact. 67% of the reports on research appeared in the news pages of newspapers. The remaining 33% was found in other sections of which 11% appeared in science sections.

News reports were divided over different science domains according to the fol-

lowing distribution: social sciences 56%, medical sciences 17%, natural sciences 13%, humanities 8%, technical sciences (which includes artificial intelligence) 4%, and environmental sciences 2%. Recently, climate change has become an important issue. Therefore, it is expected that environmental sciences currently receive more attention.

For every news report, Hijmans et al. calculated a score based on the sum of six items (information on researcher identity, publication mentioned, university background, consultation of secondary sources, mentioning risks, and mentioning benefits). The score ranges from 0 to 6; a point is added for each item present in the report. The mean score for all reports was 2.6. Contrary to expectations, reports in 'quality' newspapers did not have higher scores. Risks and/or benefits are often mentioned, but not discussed.

The geographical origin of the research mentioned in news reports is mainly Dutch, except in the science sections. Science sections mostly report on natural sciences. Reports in science sections are usually short and therefore contain less information about the research.

For journalists and editors, the news value of reports is more important than scientific aspects such as correctness or completeness. So, scientific research is selected for the newspaper based on general news value. However, some journalists consider the scientific value of the research outcomes more important. When reporting about scientific research, journalists try to avoid complex information. This corresponds to what Hijmans et al. found during their content analysis.

Hijmans et al. conclude: "Dutch newspapers show a relatively high attention to scientific research, but little information is given on research backgrounds and methodological aspects of the research project. The relevance of the findings is hardly discussed."

## 2.3 Concluding Remarks

It is hard to give a precise description of what artificial intelligence is. The notion is very broad and abstract, mainly because it is not clear what it means to be intelligent. Most people agree that humans are intelligent, but when machines or computer programs are concerned it is not that easy to ascribe intelligence. In addition, because of the AI effect, (artificial) intelligence is usually not recognized in applications. Since the image people have of artificial intelligence depends on how it is explained, these explanations provide an interesting issue for the analysis of newspaper reports.

It is also interesting to look at how reporters deal with social and ethical implications of artificial intelligence. Are they mainly positive or negative? Is the output of intelligent systems questioned? These issues will also be examined during the content analysis.

The related work of Hijmans et al. (2003) raises interesting questions. What patterns can be found in reports about artificial intelligence? Do they correspond with the findings from the related work?

# Chapter 3

# Methods

## 3.1 Selection of Newspaper Reports

News reports were selected from Dutch national papers between 2005 and 2007. Reports were collected using a LexisNexis[1] search based on the occurrence of the term 'artificial intelligence' ('kunstmatige intelligentie' in Dutch). Of course, the public image of artificial intelligence is also influenced by reports about artificial intelligence that do not explicitly mention the term. It is very hard to retrieve these articles using a keyword search. In an attempt to retrieve additional reports about artificial intelligence, the terms 'intelligent software' and 'intelligent robot' (in Dutch: 'intelligente software' and 'intelligente robot' respectively) were added to the query. LexisNexis automatically includes plurals (and other minor inflexions) in the search.

Table 3.1 contains results about the number of reports retrieved from each newspaper. Thanks to adding 'intelligent software' and 'intelligent robot' to the search, 14 additional reports were retrieved (4 in 2005 and 2006, and 6 in 2007). No reports were retrieved from *Agrarisch Dagblad*, *Nederlands Dagblad*, *Reformatorisch Dagblad*, and *Metro*. Apart from *Metro*, these newspapers are relatively small. *Metro* is a free newspaper, as well as *DAG* and *Spits*. Of the newspapers from which reports were retrieved, *NRC Handelsblad*, *de Volkskrant*, and *Trouw* are generally regarded as quality newspapers. *Algemeen Dagblad* and *De Telegraaf* are popular newspapers. *Het Financieele Dagblad*, *Het Parool*, and *NRC.next* have a special focus. *Het Financieele Dagblad* is focused on financial news, *Het Parool* on news from Amsterdam, and *NRC.next* is aimed at young, higher educated people. Even though *NRC Handelsblad* and *NRC.next* each have their own editors, many reports that appear in *NRC Handelsblad* are also published in *NRC.next*, sometimes in a slightly altered form (Reijnders, 2006). The first edition of *NRC.next* was released on March 15, 2006, and the first edition of *DAG* on May 8, 2007, so reports from these papers come from these dates onwards.

After a first read through the reports, the need to make a further selection became apparent. In many reports, the term 'artificial intelligence' is used without explanation, e.g. to mention a feature of a video game, or to indicate

[1] LexisNexis (`http://academic.lexisnexis.com/`) provides access to full text reports from many newspapers and magazines.

| | 2005 | 2006 | 2007 |
|---|---|---|---|
| Quality | | | |
| *NRC Handelsblad* | 5 (4) | 8 (6) | 14 (4) |
| *Trouw* | 3 (0) | 7 (2) | 3 (1) |
| *de Volkskrant* | 6 (4) | 12 (6) | 14 (4) |
| Special focus | | | |
| *Het Financieele Dagblad* | 7 (5) | 4 (3) | 6 (1) |
| *Het Parool* | 3 (0) | 1 (1) | 4 (0) |
| *NRC.next* | | 5 (2) | 8 (3) |
| Popular | | | |
| *Algemeen Dagblad* | 0 (0) | 1 (1) | 6 (3) |
| *Telegraaf* | 5 (2) | 0 (0) | 6 (0) |
| Free | | | |
| *DAG* | | | 1 (0) |
| *Spits* | 0 (0) | 0 (0) | 2 (0) |
| Total | 29 (15) | 38 (21) | 64 (16) |

Table 3.1: Numbers of reports retrieved and selected (in parentheses).

the profession of the author of the report. Since nothing can be said about these reports apart from the fact that they mention the term 'artificial intelligence', only reports containing substantive information about artificial intelligence were selected for further analysis. Substantive information means that the report writes about scientific research, an application, and/or contains an explanation of artificial intelligence. Table 3.1 contains the numbers of reports selected for analysis (in parentheses).

## 3.2 Framework for Analysis

In chapter 2, several topics concerning artificial intelligence and newspaper reports about science were brought up. In order to allow for a structured approach to the content analysis of newspaper reports, a framework containing these topics was constructed. An overview of the framework can be found in table 3.2.

Newspapers usually consist of multiple sections, such as news, economics, or the science section. The *location in paper* of the newspaper reports will be examined during the content analysis. Since artificial intelligence is an academic discipline, it is expected that most reports about AI can be found in the science section.

A number of issues regarding the *subject* of reports are explored in the content analysis, such as whether artificial intelligence is the main subject, whether the report is about scientific research, what the country of origin of the researchers is (cf. Hijmans et al., 2003), and whether an application of artificial intelligence is described or artificial intelligence in general.

The next three items cover the image or explanation of artificial intelligence. *Description* is about the words, images, and metaphors used to describe artificial intelligence. What similarities and differences can be found in these descriptions of artificial intelligence? The *approach to AI* is about which one

| | Item | Explanation |
|---|---|---|
| • | Location in paper | Science section, other section, unknown |
| • | Subject | Is AI the main subject of the report? Is the report about an application? Is the report about scientific research? What is the country of origin of the research? |
| • | Description | Words, images, and metaphors used to describe AI. |
| • | Approach to AI | Acting humanly, thinking humanly, acting rationally, thinking rationally (Russell and Norvig, 2003) |
| • | Discipline | Natural language processing, knowledge representation, automated reasoning, machine learning, computer vision, and/or robotics |
| • | Risks and benefits | Are risks and benefits mentioned or discussed? |
| • | Social and ethical implications | Are social and ethical implications mentioned or discussed? Is the output of the system questioned? |
| • | Status of AI | What is said about the current status of AI in general? |

Table 3.2: The framework for analysis.

of the four approaches distinguished by Russell and Norvig (2003) is proposed in the report: acting humanly, thinking humanly, acting rationally or thinking rationally. What approach is considered typical for artificial intelligence? The *discipline*s described in reports also say something about what is commonly associated with artificial intelligence.

Since perceived *risks and benefits* influence people's attitudes towards technology and "technologies that are seen to be high in benefit are also perceived to be low in risk" (Frewer et al., 1998), it is interesting to look at what is said about the risks and benefits of artificial intelligence and to determine whether the risks or benefits are emphasized. In addition, Hijmans et al. (2003) found that risks and benefits are often mentioned in newspaper reports about science, but not discussed. Can this pattern also be found in reports about artificial intelligence? *Social and ethical implications* of a technology are closely related to risks and benefits. Since artificial intelligence has been predicted to have all kinds of social and ethical implications, attention will be paid to what is said about these implications in newspaper reports.

The field of artificial intelligence is still evolving. What do newspaper reports say about the current *status of AI* and what predictions are being made about the future?

# Chapter 4

# Results

## 4.1 Reports Selected for Analysis

Table 3.1 (in section 3.1) contains the number of reports retrieved and selected (in parentheses) for each newspaper. A total of 131 reports were retrieved from Dutch national newspapers between 2005 and 2007. 117 reports mention 'artificial intelligence' and 14 additional reports were retrieved because 'intelligent software', and 'intelligent robot' were added to the search. Of these 131 reports only 52 contain substantive information on artificial intelligence (and were subjected to the content analysis). 46 reports containing substantive information mention the term 'artificial intelligence', and the remaining 6 reports mention 'intelligent software', or 'intelligent robot'. A list of the newspaper reports selected for analysis can be found in appendix A. Reference numbers used in this chapter refer to this list.

A number of 131 reports mentioning artificial intelligence in three years amounts to an average of 3.63 reports a month in all editions of 10 different newspapers. Given that a newspaper edition contains on average 6.5 reports that mention scientific research (Hijmans et al., 2003), this is not a lot. Since only 52 reports contain substantive information, the actual number of reports making statements about artificial intelligence is even less. The small amount of reports confirms the subject is relatively unknown and difficult. This is supported by the fact that most reports containing substantive information on artificial intelligence are retrieved from quality newspapers (60%) and not from popular or free newspapers (12%) (see table 3.1).

Since the number of reports mentioning artificial intelligence increased over the years (29 in 2005, 38 in 2006, and 64 in 2007), the term seems to become more common. However, the total number of reports remains small. In addition, the number of reports selected for the content analysis even much smaller. This makes it hard to draw general conclusions from the data.

In order to make sure results are gathered from a sufficient number of reports, selected reports are not divided by year (potential trends over time are ignored). Instead, reports containing substantive information on artificial intelligence were divided into two sets: a set where artificial intelligence is the main subject and a set where artificial intelligence is a side issue. Table 4.1 shows that artificial intelligence is the main subject in 29 reports (56%) and a side issue in 23 reports

| | Selected | Main subject | Side issue |
|---|---|---|---|
| 2005 | 15 | 11 | 4 |
| 2006 | 21 | 6 | 15 |
| 2007 | 16 | 12 | 4 |
| Total | 52 | 29 | 23 |

Table 4.1: Division of the data into a set of reports where artificial intelligence is the main subject and a set where artificial intelligence is a side issue.

(44%).

Apart from *NRC Handelsblad* and *NRC.next*, that share some reports, only a few stories on artificial intelligence appeared in multiple papers. A report about using cryptography and artificial intelligence to match personal data in databases without violating privacy appeared in *Het Financieele Dagblad* (August 2005) and *de Volkskrant* (January 2007) (13, 37). Both *Trouw* and *de Volkskrant* published a report about the robot soccer tournament RoboCup (June 2006) (26, 27). Finally, in September and October 2007 a number of reports about a research project investigating intimate relationships between robots and humans appeared in *Trouw*, *NRC Handelsblad*, *NRC.next*, and *Algemeen Dagblad* (44, 45, 46, 47, 49). *Telegraaf* also published a report about this topic, but it did not contain substantive information about artificial intelligence.

In general, newspapers seem to choose topics of reports independently of each other.

## 4.2 General Impression

This section gives a general impression of artificial intelligence in newspaper reports. First the location of the reports in the paper is discussed. Next, the subject of reports is explored. Finally, important disciplines and the most important approach to AI will be identified.

### 4.2.1 Location in Paper

Table 4.2 contains results about the location of the reports in the newspaper. 37% of the reports were found in science sections and 42% in other sections, such as news, economics and media. The rather large percentage of reports for which the location in the newspaper is *unknown* can be explained by the fact that for some papers only page numbers (and no section names) are stored in LexisNexis. In addition, some papers do not contain dedicated science sections.

Although a large part of the reports containing substantive information on artificial intelligence was found in science sections, they can be found anywhere in the newspaper. Hijmans et al. (2003) found similar results for newspaper reports about science in general.

### 4.2.2 Subject

Since artificial intelligence is an academic discipline, it is expected that many reports on AI are also about scientific research. Results in table 4.3 show that

| | Main subject | Side issue | Total |
|---|---|---|---|
| Science | 14 | 5 | 19 (37%) |
| Other | 5 | 17 | 22 (42%) |
| Unknown | 10 | 1 | 11 (21%) |
| Total | 29 | 23 | 52 (100%) |

Table 4.2: Numbers of reports in different sections of newspapers.

| | Main subject | Side issue | Total |
|---|---|---|---|
| Total | 29 | 23 | 52 (100%) |
| Science | 22 | 7 | 29 (58%) |
| Artificial intelligence | 21 | 2 | 23 (44%) |
| Application | 27 | 12 | 39 (75%) |
| Application & science | 22 | 4 | 26 (50%) |

Table 4.3: Numbers of reports about scientific research and mentioning applications.

23 of the 52 reports (44% of the data) are about the academic discipline of artificial intelligence. When considering reports where AI is the main subject, this percentage is much higher: 21 of 29 reports (72%) mention research from the field of artificial intelligence. Scientific research from other disciplines, such as philosophy, medicine, and linguistics, is mentioned in 7 of 30 reports. It can be concluded that scientific research is an important subject in reports about artificial intelligence, especially when artificial intelligence is the main subject of the report.

According to the work by Hijmans et al. (2003), 65% of the scientific research reported in Dutch newspapers originates from The Netherlands. For 79% of the reports that contain substantive information about artificial intelligence and mention scientific research, the geographical origin of the research is The Netherlands (23 of 29 reports). This result roughly corresponds to what was found in the related work.

Table 4.3 also contains results about the numbers of reports mentioning an application of artificial intelligence instead of (the field of) artificial intelligence in general. Applications play an important role in newspaper reports that contain substantive information on artificial intelligence: 75% of the reports is about an application. Furthermore, all reports about scientific research where artificial intelligence is the main subject mention an application. The relation between applications and the description of artificial intelligence is investigated further in section 4.3.

### 4.2.3 Discipline

Table 4.4 contains results about which of the six disciplines of artificial intelligence is mentioned in the reports. For reports mentioning multiple disciplines, only the most distinctive discipline was included in the calculation. For 11 reports the discipline was unclear or unspecified. And in 5 reports disciplines

| | Main subject | Side issue | Total |
|---|---|---|---|
| Natural language processing | 1 | 0 | 1 (2%) |
| Knowledge representation | 0 | 0 | 0 (0%) |
| Automated reasoning | 0 | 1 | 1 (2%) |
| Machine learning | 10 | 5 | 15 (29%) |
| Computer vision | 2 | 3 | 5 (10%) |
| Robotics | 11 | 3 | 14 (27%) |
| Other | 0 | 5 | 5 (10%) |
| Unknown or unspecified | 3 | 8 | 11 (21%) |
| Total | 29 | 23 | 52 (100%) |

Table 4.4: Numbers of reports mentioning different disciplines.

| Machine learning | Robotics |
|---|---|
| • Financial search agent (1) | • Robot dog (10) |
| • Program that wins at Go (2) | • Robots and emotions (51) |
| • Automatic stock trader (5, 6) | • Robot soccer (26, 28, 48) |
| • Learning hearing aid (38) | • Robots for elder care (18) |
| • Software agents (11, 14) | • Robot that repairs itself (34) |
| • Simulation of language development (8) | • Qrio and Aibo (types of robots) (17) |
| • Handwriting recognition (40, 41) | • Robots for love and sex (44, 45, 46, 47, 49) |
| • If you like this, you should try ... (21, 43) | • Robots that can work in the real world (15) |
| • Electronic nose (disease recognition) (50) | |

Table 4.5: Topics from reports about machine learning and robotics.

outside the field of artificial intelligence were described. These *other* disciplines include philosophy and cognitive psychology.

Most reports are about machine learning (29%). Robotics also is an important topic (27%). Computer vision occurs less frequently (10%). Natural language processing (2%), knowledge representation (0%), and automated reasoning (0%) receive minimal attention in the reports.

Even though most reports are about machine learning, robotics is probably more vital to the image of artificial intelligence. Table 4.5 contains a list of topics from reports about machine learning applications and robotics. Since applications of machine learning vary widely, from intelligent agents to linguistics, it clearly is a highly heterogeneous sub-field of artificial intelligence. Applications of robotics are far more recognizable; any one can imagine what a robot dog or a robot soccer player must look like.

| | Main subject | Side issue | Total |
|---|---|---|---|
| Acting rationally | 17 | 8 | 25 (48%) |
| Thinking rationally | 0 | 0 | 0 (0%) |
| Acting humanly | 7 | 5 | 12 (23%) |
| Thinking humanly | 0 | 1 | 1 (2%) |
| Unknown or unspecified | 5 | 9 | 14 (27%) |
| Total | 29 | 23 | 52 (100%) |

Table 4.6: Numbers of reports supporting different approaches to AI.

- "Monique Snoeien explores the boundaries of artificial intelligence." (10)
- "(...) further developments in artificial intelligence should lead to a human like cyber nurse." (18)
- "The electronical nose works in exact the same way using sensors and artificial intelligence." (50)

- "(...) currently working at the department of Artificial Intelligence of the university of Groningen." (8)

Table 4.7: Examples where the term 'artificial intelligence' is introduced explicitly (first three) and casually (bottom one).

### 4.2.4 Approach to AI

Table 4.6 contains results about the approach to AI supported in the reports. Again, it was not always possible to establish which approach was described. For 27% of the reports the approach to AI was unknown or unspecified.

Just one report mentions thinking as approach to artificial intelligence. Since thinking is mainly used in automated reasoning (see section 2.1.3) and no reports about automated reasoning were found, this is not surprising. Acting is more general than thinking and the other reports mention acting: acting humanly (23%) and acting rationally (48%). Being rational (doing the right thing, given the knowledge available (Russell and Norvig, 2003, p. 1)) is also more general than being human, so, it is also not surprising that acting rationally is the most important approach supported in the reports.

The fact that acting humanly also is an important approach to AI indicates that artificial intelligence is often compared to human intelligence. The relation between artificial and human intelligence is further investigated in section 4.3.

## 4.3 Description of Artificial Intelligence

Most reports selected for analysis explicitly introduce the term 'artificial intelligence'. In some reports 'artificial intelligence' is introduced casually. Table 4.7 lists some examples of both situations.

Despite the explicit introduction of 'artificial intelligence' in most reports, an explicit explanation of the term is usually absent. Only three explicit explanations were found in the 52 reports containing substantive information on

| |
|---|
| • Classical artificial intelligence: programming the computer so that it does what humans do (35) |
| • When a computer can make a human believe he or she is dealing with another human, it is artificially intelligent (Turing Test) (42) |
| • The computer in the robot contains different algorithms that execute these types of operations. Together they make up the artificial intelligence of the robot. (48) |

Table 4.8: Explicit explanations of artificial intelligence.

artificial intelligence. These 'definitions' can be found in table 4.8.

However, most other reports contain some description of artificial intelligence. As mentioned in section 4.2.2, 75% of the reports is about applications. Artificial intelligence is usually explained in terms of the application described in the report. Table 4.9 contains a list of descriptions and images used to characterize intelligent systems and/or artificial intelligence. Most reports explain artificial intelligence by listing abilities of intelligent systems. Capabilities to learn and automatically perform tasks are mentioned frequently. In addition, human qualities, such as being able to think, or experience emotions, are also attributed to intelligent systems. One report explicitly states that artificial intelligence bares no resemblance at all to human intelligence. In a number of reports abilities of intelligent systems are described as simulation or imitation. Some reports pay attention to how the intelligent behavior is realized (procedure). Finally, examples are used to describe artificial intelligence. A chess engine is the most popular example used in these explanations.

Words used to describe artificial intelligence are mostly very general. The description column of table 4.9 contains words that are taken from the reports. Other examples include: 'inquisitive', 'independent', and the adjectives 'smart' and 'intelligent' (either between quotation marks or not). The term 'machine learning' is hardly used in reports about machine learning (applications). Instead general terms such as 'learning', 'adapt to changes', and 'remember preferences' are used. Finally, software agents are often referred to as robots.

Clearly, there is quite some overlap in the descriptions of artificial intelligence. However, the image depicted in newspaper reports is rather vague and broad. In addition, instead of explaining artificial intelligence as a whole, different aspects are described by stating characteristics of specific applications.

## 4.4 Risks, Benefits, and Social and Ethical Implications

Since risks, benefits, and social and ethical implications are often related, they are discussed together. In 28 of 52 reports (54%) risks, benefits, and social or ethical implications are mentioned. Most risks and benefits concern specific applications. Since very specific risks and benefits attribute little to how artificial intelligence in general is perceived, they will not be repeated here. Mentioning benefits is more common than mentioning risks, so, it can be concluded that the reports mostly address artificial intelligence in a positive way.

Social and ethical implications are more general. The issue of privacy is

| Category | Description | Reports |
|---|---|---|
| Abilities of system | Learn | (2, 10, 11, 14, 15, 40, 41, 50) |
| | Self-learning | (1, 38, 52) |
| | Automatically perform task | (3, 4, 14, 17, 24, 36, 39) |
| | Recognition | (10, 25, 36, 39) |
| | Pattern recognition | (11, 50) |
| | Communicate | (14, 15, 17) |
| | Adapt to changes | (15) |
| | Predict | (38) |
| | Save preferences | (11) |
| | Internal self-representation | (34) |
| Human qualities | Think | (23, 24, 28, 36) |
| | Have feelings, emotions | (10, 16) |
| | Develop consciousness | (9) |
| | Develop personality | (10, 17) |
| | Electric or artificial brain | (11, 30) |
| | No relation to human intelligence | (48) |
| Simulation | Simulation | (47) |
| | Imitate human abilities | (23, 26, 32, 33, 45, 46, 49) |
| Procedure | Algorithm | (17, 48) |
| | Examining features and keywords | (1) |
| | Self-organization | (8) |
| Examples | Chess engine | (2, 6, 26, 45, 46, 49, 51) |
| | Robot soccer | (26, 27, 48) |
| | Search engine | (1, 22) |

Table 4.9: Words and images used to describe artificial intelligence.

| |
|---|
| • A computer program that can beat a strong Go-player does not yet exist (2) |
| • A computer program can do everything a (human) stock trader can, and for some tasks the computer outperforms the human (6) |
| • In 2015 software agents have taken over many boring and repetitive tasks (14) |
| • Now robots come to less structured environments (15) |
| • Use of (intelligent) robots in health care will increase (18) |
| • Soccer robots will beat the human world champions in 2050 (16, 17) |
| • In 2029 artificial intelligence will be just as powerful as the human brain (30) |
| • An artificial human brain cannot be build with the computers currently available (35) |

Table 4.10: Remarks about the current status and future of artificial intelligence.

mentioned in 4 reports (12, 13, 37, 39). In 6 reports issues concerning relationships between robots and humans are named, such as 'can feelings for a robot pet be real?' (10), 'how should people treat intelligent (humanoid) robots?' (44, 45, 46, 49), and 'should robots have rights?' (44).

Risks, benefits, and social and ethical implications are mentioned in reports, but hardly ever discussed. This corresponds with the findings of Hijmans et al. (2003).

## 4.5 Status of Artificial Intelligence

Since most reports consider applications of artificial intelligence and not artificial intelligence in general, the status of AI is hardly mentioned. Only 8 reports refer to the current status or future of artificial intelligence. Table 4.10 contains remarks from the reports. In most cases artificial intelligence is compared to human intelligence to say something about the current status or make predictions (2, 6, 16, 17, 30, 35).

Concerning the historical context, one report mentions the Turing Test (see table 4.8) (42).

## 4.6 Concluding Remarks

The number of reports mentioning 'artificial intelligence', 'intelligent software', or 'intelligent robot' is rather low and the number of reports containing substantive information on artificial intelligence is even lower. In many reports the term 'artificial intelligence' is used without explanation, which suggests journalists consider the term known, choose not to explain it (e.g. because it is just a side issue in the report), or do not know how to explain it.

Considering the small number of reports analyzed, the question arises whether all reports about artificial intelligence in Dutch national newspapers between 2005 and 2007 were retrieved. Since the term 'artificial intelligence' is explicitly introduced in most reports and only a few additional reports were retrieved after adding 'intelligent software' and 'intelligent robot' to the search, it is unlikely that many reports about artificial intelligence were missed. However, because of the AI-effect, it is possible that reports write about (applications of) artificial

intelligence without mentioning the term, but since most reports describe artificial intelligence in very general terms, it will be hard to select additional search terms. Still, the small number of reports containing substantive information on artificial intelligence makes it hard to draw conclusions about the image of AI in newspapers.

In general, almost everything mentioned in reports containing substantive information on artificial intelligence, concerns specific applications rather than the field of artificial intelligence as a whole. This is true for descriptions of artificial intelligence as well as risks, benefits, and social and ethical implications. In addition, descriptions vary. Evidently, people do not agree about what artificial intelligence entails exactly. The image of artificial intelligence remains general, broad and vague. The image can also be called one-sided, since the newspapers mainly write about machine learning and robotics. While some descriptions of artificial intelligence are somewhat contradictory, the information given about the field or specific applications is mostly correct.

While the image of artificial intelligence disseminated through newspapers is generally correct, there is also room for improvement. The content analysis showed that reports about artificial intelligence are rare and that newspaper coverage is rather general, broad, and one-sided. A first suggestion for improvement is to make artificial intelligence more known by increasing the number of reports written about this subject. Reporters and researchers should cooperate to try to achieve this goal. Reporters should also pay more attention to disciplines of artificial intelligence that are currently underrepresented, such as knowledge representation and natural language processing. The image of artificial intelligence can also be improved by giving an explicit explanation of the term and a (very) brief overview of the field, instead of just describing an application. Providing more context (e.g. by explaining the AI-effect, mentioning the current status of artificial intelligence, making predictions about the future, and/or discussing risks, benefits, and social and ethical implications) can also improve the image of artificial intelligence.

# Chapter 5

# Conclusion

## 5.1 Conclusions

The matter of how artificial intelligence is depicted in newspapers has been investigated by making a content analysis of newspaper reports. The main research question was formulated as follows: *What image of artificial intelligence is disseminated through newspaper reports?*

Artificial intelligence is the academic discipline concerned with the automization of tasks that require intelligence when performed by humans. The field of artificial intelligence is very broad and varied, which makes it hard to give a precise explanation. The complexity of the subject is confirmed by small amount of newspaper reports found that contain substantive information about artificial intelligence and the fact that most reports containing substantive information on artificial intelligence were found in quality newspapers. The small amount of reports found also indicates the subject is relatively unknown. Newspaper reports that contain substantive information about artificial intelligence in general do not give an explicit explanation of the term artificial intelligence. This also confirms the subject is difficult.

The image of artificial intelligence disseminated through newspaper reports is rather general. Even though most reports that contain substantive information about artificial intelligence are about scientific research, they can be found anywhere in the newspaper and are not restricted to the science sections. In addition, the approach to AI supported in the reports is mainly 'acting rationally', which is the most general approach. More importantly, the words used to describe artificial intelligence are very general. The image is also general in the sense that little background is given in the reports. Risks, benefits, and social and ethical implications of artificial intelligence are mentioned occasionally, but not discussed. Furthermore, little attention is paid to the historical context, the current status and the future of artificial intelligence.

The image of artificial intelligence in newspapers is also one-sided. Reports are mainly about machine learning and robotics. Other disciplines, such as computer vision, natural language processing, knowledge representation, and automated reasoning, receive little or no attention. In addition, mainly specific applications are mentioned in the newspaper reports, without referring to artificial intelligence as a whole. This also indicates that artificial intelligence is a

difficult topic, since it is hard to give a description of the field as a whole.

Numerous applications are described in the reports and only a few applications are mentioned in multiple newspapers. To describe artificial intelligent systems, human qualities are often ascribed. While different explanations of artificial intelligence are sometimes a bit contradictory, the information given is mainly correct.

Finally, since more reports mention benefits of artificial intelligence instead of risks or negative consequences, the image of artificial intelligence is mainly positive.

## 5.2 Future work

For this study, Dutch newspaper reports were analyzed in order to get an impression of the image of artificial intelligence in the media. Some concerns were expressed about whether all reports about artificial intelligence were retrieved by the keyword search. This problem can be circumvented by using a collection of reports known to be about artificial intelligence, such as the reports filed on the 'AI in the news' webpage maintained by the Association for the Advancement of Artificial Intelligence (AAAI)[1]. However, only English reports are posted on this website. It is also interesting to compare the image found in Dutch newspapers to what is written about artificial intelligence in foreign newspapers. The image found in newspaper reports can also be compared to images disseminated through movies, TV-series and novels.

In section 4.6 some suggestions were made for improving the image of artificial intelligence in newspapers. It is interesting to test whether these suggestions actually help making the image of artificial intelligence more specific and diverse. This can be done by adapting newspaper reports according to the suggestions and checking people's responses before and after reading original or adapted reports. A comparison of the differences between people's responses before and after reading the reports will show whether the suggestions are useful.

[1] `http://www.aaai.org/`

# Appendix A

# Newspaper Reports

The following reports were subjected to the content analysis:

1. Fiscus zet nieuwe speurhond Xenon in; Nieuwe software zoekt internet af op websites met zwarte handel [Tax collectors office employs new tracker Xenon; New software searches the Internet for black market websites], *NRC Handelsblad*, January 8, 2005

2. Computer kraakt simpele versie Go [Computer solves simple version of Go], *de Volkskrant*, January 22, 2005

3. Wereld achter de spiegel [World behind the mirror], *de Volkskrant*, Febrary 12, 2005

4. Google helpt computer snappen [Google helps computer understand], *de Volkskrant*, February 12, 2005

5. Computerstrijd [Computer battle], *Het Financieele Dagblad*, February 22, 2005

6. Robothandelaar vervangt de mens [Robot trader replaces human], *Het Financieele Dagblad*, March 1, 2005

7. Cameracontrole bij grens Hazeldonk [Video surveillance at the border near Hazeldonk], *Telegraaf*, March 31, 2005

8. Aparte klanken; Simulatie van klinkerontwikkeling wijst op zelforganisatie taal [Distinct vowels; Simulation of vowel development indicates selforganisation of language], *NRC Handelsblad*, May 7, 2005

9. 'Ooit willen we ook kunsthersenen' ['One day we'll want artificial brains too'], *NRC Handelsblad*, May 7, 2005

10. De robot wordt huisvriend. Maatje. Partner [Robot becomes family friend. Buddy. Partner], *NRC Handelsblad*, May 21, 2005

11. Zelflerende software zoekt meester en financiers [!!software is looking for master and sponsors], *Het Financieele Dagblad*, July, 26, 2005

12. Honderd jaar [A hundred years], *de Volkskrant*, August 4, 2005

13. Wetenschap kan conflict met Amerika oplossen [Science can end dispute with America], *Het Financieele Dagblad*, August 15, 2005

14. 'Encie? Dit merk wil ik straks niet meer zien' ['Encie? I don't want to see this brand anymore'], *Het Financieele Dagblad*, August 31, 2005

15. Brussel en bedrijven samen in ontwikkeling van robots [Brussels and companies develop robots together], *Telegraaf*, October 13, 2005

16. Yonderboi ziet songs als karakters, kleine robots die je een duwtje geeft [Yonderboi views songs as personalities, small robots you can push around], *Trouw*, January 11, 2006

17. Sony stopt productie van Qrio en hond Aibo [Sony stops producing Qrio and dog Aibo], *Het Financieele Dagblad*, January 31, 2006

18. Gerontorobotica [Robotics for elder care], *Het Financieele Dagblad*, February 4, 2006

19. Stijldansen met een opzichtige porseleinkast [Ballroom dancing with a blatant china cabinet], *de Volkskrant*, February 6, 2006

20. Natuurlijk sleutelen aan de mens [Naturally tinkering human beings], *de Volkskrant*, February 11, 2006

21. Musicmap, *NRC Handelsblad*, February 27, 2006

22. Scroogle, *de Volkskrant*, April 15, 2006

23. Logisch maar volstrekt paranoïde [Logical but completely paranoid], *de Volkskrant*, April 22, 2006

24. Technologie en wetenschap zijn de motor achter de dans van Wayne McGregor [Technology and science are drive behind Wayne McGregor's dances], *Trouw*, April 27, 2006

25. Twee agenten voor de prijs van een [Two officers for the price of one], *Het Parool*, May 11, 2006

26. Duitse voetbalrobots [German soccer robots], *Trouw*, June 13, 2006

27. Robotvoetbal [Robot soccer], *de Volkskrant*, June 17, 2006

28. Nieuwste zoekmachine denkt helemaal zelf [Newest search engine thinks for itself], *Algemeen Dagblad*, June 28, 2006

29. Slimmer met games [Smarter thanks to games], *NRC Handelsblad*, October 21, 2006

30. Horizon, *NRC Handelsblad*, October 24, 2006

31. Stemwijzer van IPP deugt van geen kant [IPP's program giving voting advice not suitable at all], *NRC Handelsblad*, October 26, 2006

32. Op woorden letten terwijl je op je beurt wacht [Minding words while waiting for your turn], *NRC Handelsblad*, October 31, 2006

33. Vaak onderbroken? Doe iets aan je taal [Interrupted frequently? Fix your language], *NRC.next*, November 2, 2006

34. Robot kan zichzelf genezen [Robot can cure itself], *Het Financieele Dagblad*, November 21, 2006

35. Alles bewust [Everything conscious], *NRC Handelsblad*, December 2, 2006

36. 7 redenen om uit te gaan [7 reasons to go out], *NRC.next*, March 27, 2006

37. Privé en toch in de databank [Private but still in the database], *de Volkskrant*, January 20, 2007

38. 'Van een hoortoestel wordt een oor niet lui. Zonder apparaat verslechtert het meer'; Gehoorapparaat wordt intelligent ['A hearing aid doesn't make your ear lazy. Hearing deteriorates faster without aid; Hearing aid becomes intelligent'], *Algemeen Dagblad*, February 5, 2007

39. Machines gluren objectiever [Machines peep objectively], *de Volkskrant*, March 10, 2007

40. Computer herkent hand van de schrijver [Computer recognizes handwriting], *NRC Handelsblad*, March 13, 2007

41. Wie schrijft hier?; Computer herkent persoon aan handschrift [Who is writing?; Computer recognizes handwriting], *NRC.next* March 15, 2007

42. Apple-logo verklaard [Apple logo explained], *NRC Handelsblad*, April 13, 2007

43. Gnod; webvoorkeur [Gnod; web preferences], *NRC.next*, July 12, 2007

44. Levy voorspelt trouwen met een robot [Levy predicts marriage with robot], *Trouw*, September 7, 2007

45. De opmars van de lieve robot [March of the lovable robot], *NRC Handelsblad*, October 11, 2007

46. De perfecte seks met een hoopje oud ijzer [Perfect sex with a heap of scrap metal], *NRC.next*, October 12, 2007

47. Robotseks beter dan man [Robot sex better than man], *Algemeen Dagblad*, October 13, 2007

48. Mens-machine is nog een beetje dom [Human machine still is a bit stupid], *de Volkskrant*, October 20, 2007

49. Lieve robot, laat me niet alleen [Darling robot, please don't leave me alone], *NRC Handelsblad*, November 23, 2007

50. Een elektronische neus voor ziektes [An electronic nose for diseases], *Algemeen Dagblad*, December 10, 2007

51. Het gaat steeds weer over Ros [It's constantly about Ros], *de Volkskrant*, December 15, 2007

52. Einde van de Babylonische spraakverwarring in zicht [End is near for confusion of tongues], *Het Financieele Dagblad*, December 31, 2007

# Summary

Artificial intelligence is the academic discipline concerned with the automization of tasks that require intelligence, usually by developing computer programs. Giving a precise description of artificial intelligence is hard, since the field broad, complex, and abstract.

Ever since the emergence of the field, artificial intelligence has been predicted to have a profound impact on society, either in a positive or negative way (Boden, 1990). Currently, the application of artificial intelligence in many computer programs and devices goes largely unnoticed. Nevertheless, the impact of artificial intelligence will most likely increase in the future.

Given that artificial intelligence is complex and unknown, the question arises how newspapers write about this topic. This issue is explored by making a content analysis of newspaper reports about artificial intelligence. The main research question was formulated as follows: *What image of artificial intelligence is disseminated through newspaper reports?* Reports were retrieved from Dutch national newspapers between 2005 and 2007 based on the occurrence of the terms 'artificial intelligence', 'intelligent software', or 'intelligent robot' (in Dutch: 'kunstmatige intelligentie', 'intelligente software', and 'intelligente robot').

Only reports containing substantive information about artificial intelligence were subjected to the content analysis. A report contains substantive information, if it is about scientific research or an application, and/or if an (implicit) explanation of artificial intelligence is given. Of the 131 reports retrieved, 52 were selected for the content analysis. For 29 reports, artificial intelligence is the main subject and for 23 it is a side issue.

In order to allow for a structured approach to the content analysis, a framework containing several issues concerning artificial intelligence and science in newspaper reports was contracted. Items in the framework are: *location in paper* (science section, other section, or unknown), *subject* (What is the main topic of the report? Is it about scientific research? Is it about an application?), *description* (words, images, and metaphors used to describe AI), *Approach to AI* (Acting humanly, thinking humanly, acting rationally, thinking rationally (Russell and Norvig, 2003)), *discipline* (Natural language processing, knowledge representation, automated reasoning, machine learning, computer vision, robotics, other, unknown), *Risks, benefits, and social and ethical implications* (which ones are mentioned and/or discussed), and *status of AI* (What is said about the current status and future of artificial intelligence?).

The small number of reports that mention artificial intelligence or contain substantive information indicate that the subject is relatively unknown and difficult. This is supported by the fact that 60% of the reports containing sub-

stantive information on artificial intelligence were retrieved from quality newspapers. The small number of reports containing substantive information on artificial intelligence also make it hard to draw general conclusions about the data.

In general, newspaper reports about artificial intelligence can be found anywhere in the paper. Mostly, reports discuss scientific research and applications of AI. Acting rationally is the most common approach of artificial intelligence. Machine learning and robotics are the disciplines mentioned most often. Since applications of machine learning vary widely and the term 'machine learning' hardly occurs in the reports, robotics is probably most vital to the image of artificial intelligence.

Only a few reports explicitly explain the term 'artificial intelligence'. However, most reports contain some explanation of the term, usually by listing abilities of the intelligent system described. Common abilities include learning, automatically performing a task, and communication. Human qualities, such as thinking, experiencing emotions and developing personality, are also often attributed to intelligent systems. In a number of reports simulation and imitation are used to describe artificial intelligence. A few reports mention the procedure of realizing intelligent behavior, e.g. 'algorithm' or by examining features and keywords. Finally, examples of intelligent systems are used to explain artificial intelligence. In short, explanations of artificial intelligence are mostly general and consider specific applications of AI instead of the field as a whole.

Risks, benefits, and social or ethical implications are mentioned in 54% of the reports. Most frequently, benefits of artificial intelligence are named, so, artificial intelligence is mostly approached in a positive way. Concerns about privacy and relations between humans and robots are the most important social or ethical implications that occur in the reports. In general, very little attention is paid to the historical context, current status and future of artificial intelligence.

Results confirm artificial intelligence is a difficult topic that is relatively unknown. The image of artificial intelligence disseminated through newspaper reports is implicit and stated in rather general terms. By limiting attention to applications and the discipline of robotics, a one-sided image of the field is expressed. The information given is mostly correct.

# Bibliography


RG Bader. How science news sections influence newspaper science coverage: A case study. *Journalism Quarterly*, 67:88–96, 1990.

JW Becker and PM van Rooijen. Het beeld van de wetenschap in nederland [the image of science in the netherlands]. NWO, Den Haag, 2001.

MA Boden. Social implications of intelligent machines. In *ACM '78: Proceedings of the 1978 annual conference*, pages 746–752. ACM, 1978.

MA Boden. The social impact of artifical intelligence. In R Kurzweil, editor, *The Age of Intelligent Machines*. The MIT Press, Cambridge, 1990.

HM Collins. Expert systems and the science of knowledge. In WE Bijker, TP Hughes, and TJ Pinch, editors, *The social construction of technological systems: new directions in the sociology and history of technology*, pages 329–348. The MIT Press, Cambridge, 1987.

RG Epstein. Stories and plays about the ethical and social implications of artificial intelligence. *Intelligence*, pages 17–19, 2000.

O Firschein, MA Fischler, Coles LS, and JM Tenenbaum. Forecasting and assessing the impact of artificial intelligence on society. In *IJCAI*, pages 105–120, 1973.

LJ Frewer, C Howard, and R Shepherd. Understanding public attitudes to technology. *Journal of Risk Research*, 1(3):221–235, 1998.

L Hanssen and M van Katwijk. Paradigmashift in de wtc, van transmissie- naar transactiedenken [paradigm shift in science and technology communication, from transmission to transaction]. In J Willems, editor, *Basisboek wetenschapscommunicatie*. Boom onderwijs, 2007.

L Hanssen and J Willems. Wetenschap in het nederlandse dagblad: een vergelijking tussen de wetenschapspagina en de rest van de krant [science in dutch newspapers: a comparison of science pages and the rest of the newspaper]. *Massacommunicatie*, 20(4):301–312, 1992.

E Hijmans, A Pleijter, and F Wester. Covering scientific research in dutch newspapers. *Science Communication*, 25(2):153–176, 2003.

J McCarthy. What is artificial intelligence? retrieved March 20, 2008, `http://www-formal.stanford.edu/jmc/whatisai/`, 2007.

M Minsky. The society theory of thinking. In PH Winston and RH Brown, editors, *Artifical intelligence: an MIT perspective*, pages 421–452. The MIT Press, Cambridge, 1979.

M Reijnders. Nrc handelsblad en nrc.next vergeleken [nrc handelsblad and nrc.next compared]. retrieved, March, 24, 2008 `http://www.denieuwereporter.nl/?p=372`, 2006.

SA Rijsdijk and EJ Hultink. How today's consumers perceive tomorrow's smart products, 2007.

S Russell and P Norvig. *Artificial Intelligence: A Modern Approach*. Prentice-Hall, 2003.

H Sackman. Salient international socio-economic impacts of ai and robotics. In D Millin and BH Raab, editors, *Proceedings of the IFIP TC9 International Working Conference*, 1987.

A Serenko, U Ruhi, and M Cocosila. Unplanned effects of intelligent agents on internet use: a social informatics approach. *AI & Soc*, 21:141–166, 2007.

RJ Sternberg. *Cognitive Psychology*. Thompson Wadsworth, 2003.

R Tongia, A Subrahmanian, and VS Arunachalam. Information and communication technology for sustainable development. defining a global research agenda, 2003.

AM Turing. Computing machinery and intelligence. *Mind*, 59:433–460, 1950.

J Weizenbaum. *Computer Power and Human Reason: From Judgment To Calculation*. W. H. Freeman, 1976.

S Woolgan. Reconstructing man and machine: a note on sociological critiques of congnitivism. In WE Bijker, TP Hughes, and TJ Pinch, editors, *The social construction of technological systems: new directions in the sociology and history of technology*, pages 311–328. The MIT Press, Cambridge, 1987.

M Yazdani. Intelligent machines and human society. In M Yazdani and A Narayanan, editors, *Artifical intelligence: human effects*, pages 63–65. The MIT Press, Cambridge, 1984.