

## **The Representation of Neuroscientific Research In Dutch Newspapers**

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*Science Education and Communication Research Project (45 ECTS)*

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### **Abstract**

The Hersenstichting is a Dutch non-profit institution that aims to reduce suffering from brain diseases and disorders. They are in contact with several target audiences, for instance patients, medical professionals, and benefactors. In order to better engage their target audience, it is important to know how neuroscientific research is currently represented in mass media. This provides the opportunity to actively choose to follow or diverge from that representation. Comparing the current representation of neuroscientific research with the information need and perceptions of the target audience concerning that research, gives insight into both the social discourse of neuroscience and the specific needs and wishes of the target audience. The representation of neuroscientific research was investigated through a media analysis of 180 articles on this topic published in Dutch newspapers between 2012 and 2016. Additionally, a survey among 95 members of the target audience of the Hersenstichting was conducted to gain insight into their information need and perceptions regarding neuroscientific research. It was found that neuroscientific research is mainly presented in a traditional linear communication approach, emphasizing expert scientific voice, with a high trust in and perceived relevance of neuroscience. High trust and perceived relevance was also found among the target audience, and, in addition, they desire more engagement and more patient representation in the media. These results highlight the importance of audience engagement and the interactivity of neuroscience. The impact of these findings on the communication of neuroscience is discussed.

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## The Representation of Brain Research in Dutch Newspapers

### Introduction

Neuroscience affects lives on an individual level and a societal level. Whether it regards the development of drugs against dementia or methods to increase memory capacity, neuroscience is relevant for individual people. It not only provides knowledge on diseases and the clinical domain, it gives us information on the healthy brain and normal functions as well. In addition, neuroscience has philosophical, ethical and societal implications as technological innovations impact our bodies and policies. For example, the public attention in the United States for the so-called “Mozart effect” –the idea that classical music can improve an infant’s intelligence- lead to several legislative initiatives. Most notably, it prompted one US state to pass a bill to distribute free CDs with classical music to all new parents (Bangerter & Heath, 2010). It is clear that contemporary neuroscience has particular social weight. New fields such as neuroethics, neurocriminology and neurolaw are emerging in response to the impact neuroscience has on society (Racine, Waldman, Rosenberg, & Illes, 2010).

There are several ways in which science can be communicated in the media, with different approaches for weighing the value of different types of knowledge, for engaging stakeholders, delivering information, and relating science to society (Seeko, Amend, & Friday, 2013). Science journalism in general comes with challenges, such as the communication of tentative knowledge, of uncertainties and probabilities (De Semir, 2000). In addition to this, the communication of neuroscience has additional challenges such as the complexity of the brain and the stigma’s surrounding mental health (Illes et al., 2010; Racine, Bar-Ilan, & Illes, 2005). This is discussed in more detail on page 10 and 11. In spite of these challenges, media coverage of neuroscience has increased dramatically in recent years (O’Connor, Rees, & Joffe, 2012). One of the Dutch organisations that attempts to navigate neuroscience within cultural and social contexts, is the Hersenstichting (*Brain Foundation*), a non-profit organisation whose mission is to reduce suffering from brain disorders. They attempt to attain this goal by raising money to fund efforts such as translational research, education and care programs in order to decrease suffering and increase awareness for brain disorders. In addition, they provide information on the workings of the brain, brain diseases and disorders, and neuroscientific research through their website and a specialized telephone service called the “Infolijn” that people -patients, professionals, and others- can call with questions. The Hersenstichting is actively engaging and communicating with brain patients, scientists, health care providers, and

benefactors about neuroscience. It is essential that these target audiences are kept informed about current endeavours from the Hersenstichting and are made aware of the results of past efforts and research. The Hersenstichting expressed an interest in new or different ways to engage their target audiences. They report a lack of insights into the target audiences with regards to the communication of neuroscience. In order to understand the target audience, it is valuable to consider the communications about neuroscientific research they already encounter in mass media such as newspapers.

For this purpose, a media content analysis can be conducted. For many, newspapers are still the primary information source on science and science-related topics (Pauwels, Lovell, & Rouge, 2012). The coverage of science in the media is important for several reasons. For the Hersenstichting it is important to be present in the media landscape for fundraising purposes, both to attract new donations and to retain relations, and to raise awareness and increase knowledge about brain diseases and disorders. Therefore it is pertinent for the Hersenstichting to know how the media represents neuroscientific research, e.g. what topics are covered, who are interviewed, and what expressions are used, in order to align its own communication. The analysis of the communication of neuroscience gives insight into the representation of neuroscience the general public comes into contact with, which not much is known about (O'Connor et al., 2012). While this alone can give valuable insights into neuroscience in the media landscape and possible ways to navigate it, the Hersenstichting relies on specific audiences as well for funding and support. These are benefactors that have come into contact with brain disease and disorders either directly or through loved ones. It is valuable to investigate how the target audience's perceptions of neuroscience compares to its representation in newspapers, as effective communication to the target audience about the neuroscientific research that the Hersenstichting funds, shows the target audience why their support is important and keeps the target audience engaged with the Hersenstichting. A comparison between the target audience and newspapers could show the perceptions and interpretations that are unique to the target audience. These results can support a communication strategy regarding neuroscientific research that is tailored to more effectively the target audience from the Hersenstichting, but is still informed by how neuroscience is generally represented. With this knowledge, the Hersenstichting can make informed decisions about following or diverging from trends and dominant representations of neuroscientific research in mass media to further engage existing audiences or to appeal to new ones. Therefore, this research investigated the representation of neuroscience in Dutch newspapers and

compared it to their perception and information need of neuroscience by members of the main target audience of the Hersenstichting.

Taking the foregoing in consideration, the following research questions can be proposed:

RQ1: How is neuroscientific research currently represented in Dutch newspapers?

RQ2: What is the perception and information need concerning neuroscientific research of the target audience of the Hersenstichting?

I have endeavoured to answer these questions through a media content analysis on newspaper articles and a survey among the target audience of the Hersenstichting, in order to gain insight into how neuroscientific research is communicated in Dutch newspapers and to compare it to the interpretations and opinions of the target audience of the Hersenstichting.

## **Theoretical Background**

### **Neuroscience in the media**

Reports in the media, especially on health-related issues, can have a significant impact on people. These reports can raise expectations, shatter hopes or provoke alarm. Mass media can influence behaviour and policy (Larsson, Oxman, Carlin, & Herrin, 2003) and can trigger discussion among the general public. This has been the case for genetics, for example, where media coverage has played a role in the safety concerns concerning genetically modified foods. For many, news media are the primary source of health information (Brechman, Lee, & Cappella, 2009).

According to the classic book written by Dorothy Nelkin, (Nelkin, 1995), science journalism has three tasks: it should inform people about scientific advancements, it should help people assess the appropriateness of evidence from scientific research, and it should help people make choices related to perceived personal risks. Since then, researchers have continued her work, which has been cited close to 2000 times and come to a general consensus that it is beneficial for the general public to be informed by science communication because it supports their decision making process in socio-scientific issues that relate to their safety, health and environment (Secko et al., 2013). It is therefore warranted to not only investigate the quality of the science journalism, such as the veracity of the claims that are made, but also the 'how' of science journalism. How are certain topics, such as neuroscientific research, represented in the public sphere? In other words, how is neuroscience communicated in the media?

There are several approaches, or models, to science journalism. Models in this context mean representations of how science is currently being communicated or should be communicated. According to Secko et al. (2013), these models can be broadly categorized into

traditional and non-traditional models of science communication. The traditional models are focused on the transmission of scientific knowledge to an audience with a perceived knowledge gap and/or are focussed on increasing public understanding and scientific literacy. Non-traditional models of science communication focus less on transmission of scientific knowledge and more on increasing the value of non-scientific forms of knowledge, as well as engaging the public. Secko et al. examined four of these models, two of each category. The Science Literacy model and the Contextual model make up the traditional category of science communication. The non-traditional category is comprised of the Lay Expertise model and the Public Participation model. See Figure 1 for an overview of these models and their key points. These four models are chosen because they represent the primary goals of traditional and non-traditional science communication (to inform or to engage). Within those categories, the models represent the wide diversity of the ways scientific knowledge can be handled (Secko et al., 2013).

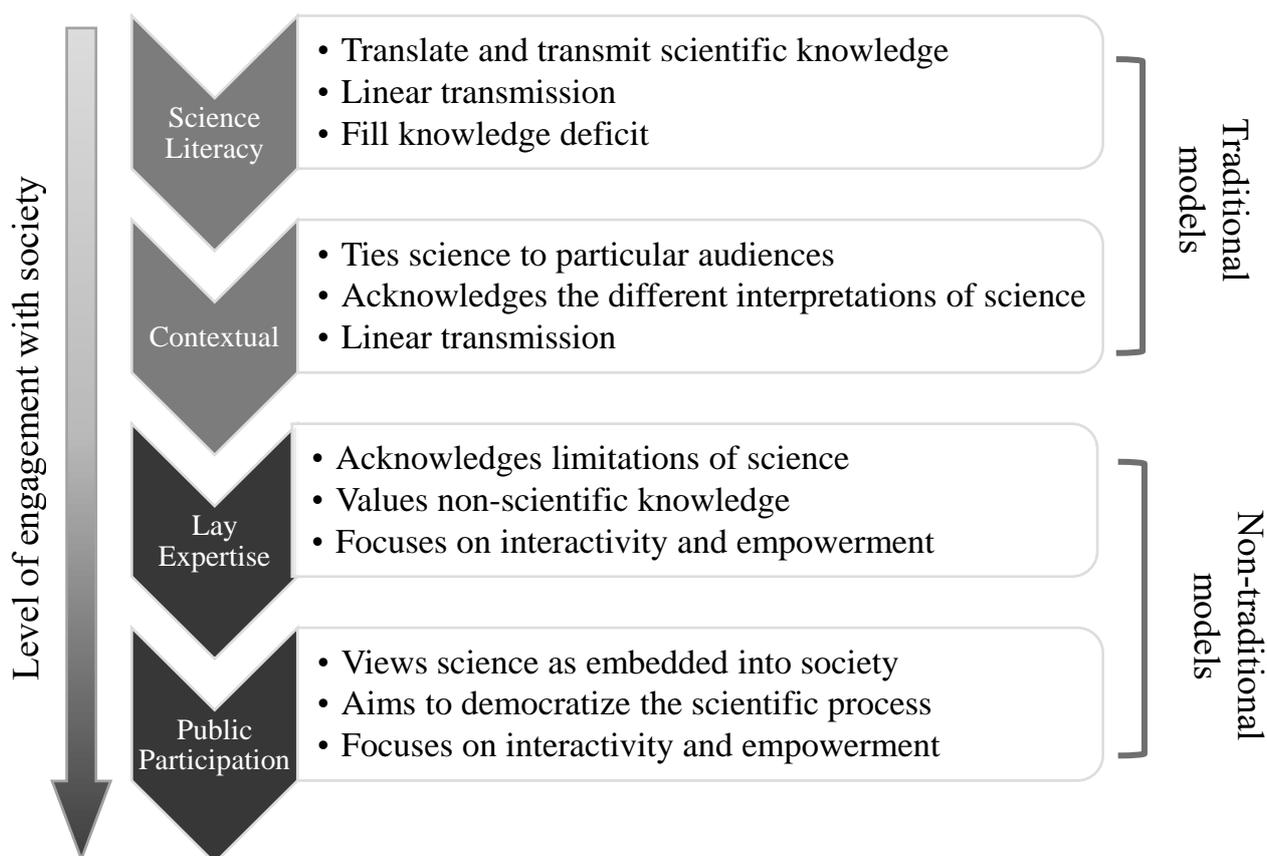


Figure 1. A description of four models of science communication. Adapted from Secko et al., 2013.

These four models each have their own characteristics when it comes to their application to science journalism. For the traditional models, the primary journalistic purpose is to inform audiences about science and in case of the Contextual model, how the science in question relates to the audience's lives. The non-traditional models' primary purpose is to promote engagement of the audience. The complication is that journalistic writing in printed media, such as newspapers, is per definition linear communication. Therefore, science journalism that adheres to non-traditional models has to incorporate audience engagement in other aspects of the story-writing, for instance the focus of the story, the sourcing of the voices that are included in the story, *why* the story is written, and *how* science is portrayed. The focus of the story, for example, is the aspect that determines the angle of the story. Traditionally, this angle is influenced by classic news values such as timeliness, conflict, and impact. The more important audience engagement is to a model, the further the focus deviates from traditional news values. The traditional Scientific Literacy model is associated with a focus on the "wow factor" and conflict in the associated articles, whereas the Contextual model mainly focuses on occurrences like events, issues, and concerns, that are tied to specific populations. The non-traditional Lay Expertise model has a focus on the attitudes and knowledge of the community and the Public Participation model focuses on the processes behind science and the consequences of choices. The sourcing is another aspect in which the four models differ. The sourcing determines what information and whose voices are included. The traditional models, such as the Science Literacy model, often navigate towards scientific experts. Within the Contextual model, the story may also include community members' voices to provide more background to the science story. For the Lay Expertise model, this is reversed; community members, lay people and organizations act as the main sources, while scientific experts provide background and context. The Public Participation model invites all stakeholders to participate in the story and equal weight is given to their perspectives (Secko et al., 2013). These are some of the ways science journalism can take different approaches and can influence the content and form of the articles.

Science writers set an agenda for public policy through their selection of news and their treatment of it, as described by the different models. With this, they frame socio-scientific reality for their audience and influence public consciousness (Nelkin, 1995). For this study, these models are relevant to set the context of neuroscience in the media and to distinguish between the often linear communication in newspapers and the desire expressed by the *Hersenstichting* to engage their target audiences and stakeholders in their communication.

### **The challenges of reporting neuroscience.**

In addition to the challenge of engaging audiences in science communication, the reporting of neuroscience has its own particular challenges. Illes et al. identified four specific challenges for the communication of neuroscience (Illes et al., 2010). The first challenge is communication about complexities of the brain, like its intricate pathways and their interactions, while new information is emerging every day and much is still unknown. The second communication challenge relates to the ‘personal, philosophical, and religious salience to mind and body.’ In other words, results from neuroscientific research can lead to new definitions of what normal human behaviour is, and new insights in how we think and learn, which can differ from other worldviews, for example religious perspectives. An example of this is the “we are our brain’ discussion in the Netherlands that came about after a Dutch neurobiologist, Dick Swaab, published a book on how, according to him, all human behaviour can be explained by processes in the brain. This led to backlash in the media from several groups of people, such as some Christians and philosophers of science, as free will is important in their belief systems (for example Aleman, 2017 and Bos & Mees, 2017). The implication of Dick Swaab’s beliefs about the brain determining all human behaviour, a belief that is also known as neurodeterminism, is that there is no free will as all is decided by the unconscious brain (Walter, 2001).

The third specific challenge is the burden of diseases of the central nervous system (CNS) and impact on public health. The impact of CNS diseases, such as Alzheimer’s disease, is significant, both on personal and societal levels. This impact leads not only to a high awareness of scientific discoveries relating to treatments, diagnoses and cures, but also to hypes and high hopes (Illes et al., 2010). The fourth challenge is concerned with the stigma that surrounds neurological and mental health disorders. Public discussions about mental health suffer from the negative social perceptions surrounding neurological and mental health disorders (Illes et al., 2010). Stigmas about mental illness are harmful to those suffering from them and the media are often identified as being in part responsible for increasing those stigmas (Corrigan, Powell, & Michaels, 2013). Communicating in a way that is responsible, accurate and decreases stigmatizing portrayals of mental illness, is a challenge.

### **Three neurointerpretations**

Navigating those challenges surrounding neuroscience leads to communication about an impactful topic that sparks debates. Racine et al. (2005) studied the interaction of society and neuroscience through the media in order to better understand how media coverage of neuroscience can shape debates about neuroscience in the social sphere, such as debates about

neuromarketing or the use of neuroimaging as legal evidence. They identified three phenomena that could influence public perceptions: neuroessentialism, neurorealism and neuropolicy. These phenomena, or neurointerpretations, represent ways in which neuroscience can be reported (Racine et al., 2010). In essence, these interpretations are unconscious, implicit manners that reflect the reliability and relevance of a study or research outcome. They contribute to the public appreciation of risks and benefits of neuroscience and the meaning of the data (Racine et al., 2005).

In 2005, they identified these concepts through a media analysis on articles concerning functional MRIs. Racine et al. did not analyse the media content on the accuracy of the statements and claims it made, but studied the media content as a phenomenon of communication, in other words: *how* the media communicated about neuroscience, in order to gain insights into how media content could influence public perceptions. They analysed 1256 newspaper articles featuring neurotechnology with a majority of the articles sourced from U.S. newspapers (70%) and the remainder from U.K. newspapers. From those articles, three trends of public representations of neuroscience emerged, which they coined neurointerpretations.

The three neurointerpretations are neurorealism, neuroessentialism and neuropolicy. Neurorealism reflects describes how the coverage of neuroimaging, such as PET, EEG or fMRI, can make a phenomenon seem real, as if the imaging provides direct evidence. This disregards the complexities that are associated with the acquisition and analysis of the data, the image processing and the limitations of the techniques. Neurorealism describes how brain activation patterns are used as the ultimate proof of a certain phenomenon. One neuro-realist metaphor is neuro-imaging as mind-reading: “Brain scan can catch a lie”. Other metaphors that are described are neuroimaging as visual proof and neuroimaging as imagery or footage of the ‘brain in action’.

Neuroessentialism represents interpretations of the brain as the defining aspect of the self and personal identity. In neuroessentialist coverage of neuroimaging, the brain is implicitly used as a shortcut for the person or the self. The brain is often the grammatical subject of a sentence: “brain can banish unwanted memories”. Other neuroessentialist interpretations are that neuroscience is able to reveal our ‘essence’, or that neuroscience reveals the cause or basis of personality traits or disorders.

Neuropolicy describes when coverage uses neuroimaging results to promote political and/or personal agendas. Examples are divided by Racine (2010) in two categories: neuroimaging that informs policies and social practices and neuroimaging that informs everyday activities and lifestyle. For example, in an article on the use of fMRI to study

teenagers' reactions to particular situations, the sentence "These research findings have profound implications for policy makers, teachers, parents and, most of all, for teenagers" is an instance of the first category of neuropolicy. Similarly, a sentence such as "Serious scientific research efforts have been going on in this area for many years now, and recent successes may have enormous implications for the lifestyle of the future" is seen as the second category of neuropolicy by Racine et al.

These interpretations of neuroscience in the media have the potential to influence public perception of neuroscientific research as they implicitly convey interpretations of neuroscience (Racine et al., 2010). For example, neuroessentialism conveys the implicit message of neurological reductionism and the trust that is placed in neuroscience through neurorealism can lead to unrealistic expectations, especially about medical applications of neuroscientific research (Allgaier, Dunwoody, Brossard, Lo, & Peters, 2013). It is not uncommon for scientists to receive emails, letters, and phone calls inquiring about a potential clinical application from patients or their relatives, which result from media coverage that inflates promises or exaggerates results (Allgaier et al., 2013).

These interpretations represent ways in which media coverage of neuroscience may shape debates, through reinforcing the equation of brain and personhood, for example.

A question that arises is then: are these interpretations also present for coverage of neuroscientific research in Dutch newspapers?

### **The public image of neuroscience**

O'Connor, Rees and Joffe (2012) studied how neuroscience research was represented through a media analysis of 2,931 articles that appeared over the span of 10 years in six major UK newspapers to shed light on the meaning of neuroscience in the public sphere and its potential social implications. They analyzed the context the neuroscience appeared in (e.g. psychopathology, basic brain functions, sexuality, morality, and brain optimization). They found three emerging themes: the brain as capital, the brain as an index of difference, and the brain as biological proof. The first, the brain as capital, is the framing of the brain as a resource that can be improved and optimized. This means that neuroscience would have a direct impact on daily life, which relates to Racine's neuropolicy. The second, the brain as an index of difference, is the use of neuroscience to explain or underline differences between groups of people, such as male-female differences. It is also used to argue that some groups of people, such as substance abusers or obese people, are neurobiologically different from others. This points to the representation of a direct relationship between the brain and personhood, which Racine et al. (2005) calls neuroessentialism. The third theme, the brain as

an index of difference, presents neuroscience as biological proof for certain beliefs or phenomena. This is similar to neurorealism. O'Connor concludes that if scientists are aware of these contexts and the potential issues surrounding the communication of neuroscience, they can explicitly address what their research means for these contexts. The scientists should engage in dialogue with society, instead of passively imparting facts. Neuroscience does not exist in a vacuum, but is part of a large social context with social, political and cultural implications. This means that contemporary neuroscience is embedded in society, which results in the use of neuroscience as a rhetorical tool. How this tool is employed and what its effects are, are therefore important questions.

**Neuroscience in Dutch media.** Neuroscience in the media is mainly studied in UK and US contexts, but a media analysis of Dutch newspapers is particularly interesting as the use of written media in the Netherlands differs from other countries. More than half of the Dutch population (55%) reads written press daily (Commissariaat voor de Media, 2016). This is significantly more than the European average of only 31%. In addition, Dutch newspapers and magazines are trusted more than their counterparts in different European countries. Dutch trust in newspapers and magazines is 63%, while trust in Great Britain for the print media is a mere 22% (Commissariaat voor de Media, 2016). Almost half of the Dutch population is still reached with paper editions of newspapers, but a growing number of people read their news on-line. As such, newspapers are still an important source of information about science for the Dutch population, making a media analysis of Dutch newspapers an appropriate tool to study the representation of neuroscientific research.

## Methods

In order to answer the first research question: “How is brain research represented in Dutch written media?”, a media content analysis has been conducted on news articles from national newspapers as found in LexisNexis over a period of 5 years (2011-2016). Media content analysis allows for the examination of a wide range of data to identify popular discourses. Although its results are not meant to make direct inferences about the audience of the content, the outcomes can facilitate this inference by pointing out key characteristics, either qualitatively or quantitatively, which provides leads for further study (Macnamara, 2005).

Key word searches were carried out using the LexisNexis truncation operator (!) to include synonyms for brain (brein! OR hersen!); synonyms for (neuroscientific) research (onderzo! OR studie! OR neuro!) to capture a wide range of neuroscientific researches. The search included headlines, body paragraphs, and image captions. Trial samples established a minimum word count of 350 which eliminates very short articles that lack the rich content that is needed for coding.

The articles that followed from this query were investigated and further curated to exclude articles that did not include scientific research at all or included research that was not neurobiological, psychological or medical in nature (e.g. anthropological or paleontological research on brain volume). This final search yielded a total of 981 articles. Three articles per month were randomly selected for coding, which lead to a total of 180 articles to be coded according to the following descriptions.

### News value

The code for news value was determined based on the article as a whole and followed the categorization as laid out by Harcup & O’Neill, 2001 (see Table 1). The most prominent news value was selected and coded. When two news values were equally prominent, both were selected.

*Table 1. News value codes (adapted from Harcup & O'Neill, 2001)*

News value	Explanation
The power elite	Stories that concern organizations, institutions and/or individuals that are particularly powerful (e.g. the army)
Celebrity	Stories concerning famous people
Entertainment	Stories concerning human interest, animals, sex, show business, fun facts, entertaining photographs or witty headlines
Surprise	Stories that have an element of surprise such as surprising contrast or outcome
Bad news	Particularly negative stories, such as conflict or tragedy.
Good news	Particularly positive stories, such as rescues and cures.
Magnitude	Stories that involve a large number of people or in its potential impact
Relevance	Stories about issues or groups that are relevant to the audience.
Follow-up	Stories about subjects and topics that were already in the news previously
Newspaper agenda	Stories that set or fit the medium's own agenda.

## Context

The following codes were used to determine the context and subject of the neuroscientific research:

1. Context of neuroscience. The context of neuroscientific research was divided into medical and non-medical. Medical context refers to any research that is directly related to a disease or condition, its treatment or understanding. A non-medical context refers to any research that does not fit the medical context, but instead is related to the workings of a healthy brain or research techniques.
2. Subject of the neuroscience. The subject of the neuroscience was registered. E.g. research into dementia, biological clock or psychopathy.
3. Diseases or conditions mentioned. Any diseases or conditions that are mentioned in relation to the neuroscientific research, both brain and otherwise, were registered.

### **Prevention and optimization**

The following quotes were used to analyse the role of prevention of brain disease and optimization of brain performance in the representation of neuroscience.

4. Expectations or promises with regards to the future. Any promises or raised expectations were recorded, for example promises about the arrival of new treatments in a certain number of years.
5. Mention of preventative measures. Similar to expectations and promises, any advice that was meant to help prevent a disease, condition or adverse outcome was registered.
6. Advice that is not for prevention. Any advice to the reader that is not in aid of prevention is registered.

### **Neurointerpretations**

The three neurointerpretations were coded separately, as well as their sub codes. They were recorded as ‘instances’, which are sentences or parts thereof. Please refer to Appendix A for examples of the different types of neurointerpretations.

7. A distinction was made between the following types of neurorealism (Racine et al., 2010)
  - a. Neuroimaging as mind-reading
  - b. Neuroscience as visual proof for phenomena; neuroscience reveals the true nature of phenomena
  - c. Neuroimaging providing a “window into the brain”; pictures or a movie of the brain “in action”
8. The following types of neuroessentialism were differentiated
  - a. Neuroscience reveals our ‘essence’; who we are as persons
  - b. Neuroscience reveals the neurobiological basis of personality traits or illness
  - c. The brain becomes a grammatical subject; personification of the brain; assigning emotions to the brain but not the person (e.g. the brain loves to be surprised)
9. The following types of neuropolicy were separately registered
  - a. Neuroscience informs policies and social practices
  - b. Neuroscience informs lifestyle, everyday activities and provides a new wisdom in the conduct of one’s life.

10. Neurointerpretations. The three neurointerpretations were recorded as ‘instances’: sentences or parts thereof that fall into the categories as established by Racine (2010). One instance is counted if the same code continues over subsequent sentences. It is counted as multiple instances if there are different sub codes. Refer to Appendix A for all codes and sub codes of the neurointerpretations.

### **Expertise**

The following codes were used to determine the role of expertise in the discourse about neuroscientific research.

11. Spokesperson or persons/’expert’. A spokesperson is defined as a person that is interviewed by the journalist on the neuroscientific research and directly quoted.
  - a. Name
  - b. Occupation/source of expertise
12. Neuroscientific research techniques mentioned. It was recorded whether there was mention of the research techniques (e.g. fMRI) that was used in the research.
13. Explanation of neuroscientific research techniques. It was recorded whether the aforementioned research technique was explained in any way.

The above coding structure is adapted from Racine, Waldman, Rosenberg, & Illes, 2010b. To aid the systematic analysis, a coding tool and codebook were created. The codebook (Appendix A) includes all instructions for coding and provided examples. The coding of one article was done by filling in the coding tool (Appendix B). Data from the coding tools were later transferred to Excel for frequency analysis of all codes that are described above.

Both quantitative and qualitative analyses were performed. The frequency of occurrence was calculated for the neurointerpretations, presence of spokespeople, explanations of research techniques, expectations or promises to the future, mentions of preventative measures, advice, advantages, and disadvantages.

**Survey.** The second research question was answered through a survey that was conducted among 95 members of target audience of the Hersenstichting. They were reached through social media posts by the Hersenstichting on Twitter and Facebook among their ‘followers’. The social media posts included a link to an on-line survey. The survey can be found in Appendix C. The survey was designed based on the media analysis. The media analysis showed the representation of neuroscientific research in different areas: the context, the sourcing, and neurointerpretations. Their perception of neuroscience within these areas was

examined using 6 questions; 7 questions were used to investigate their information need. An additional 3 questions were used to gather information on the characteristics of respondents, namely age, gender, and if they have ever donated money to the Hersenstichting. Frequencies for answers were calculated, as well as levels of agreement or disagreement whenever applicable. Results of the survey are presented in tables and figures whenever possible. Additionally, a comparison between the perceptions and information need of neuroscience of the participants and the representation of neuroscience in the newspapers is made.

## Results

### Media analysis

The search in LexisNexis yielded a total of 981 articles between 2012 and 2016, of which 180 were coded and analysed according to the described method. Figure 2 shows the distribution of the total number of articles per year and fFigure 3 per quarter year. The peak in the final quarter of 2016 can be attributed to an increased interest in neurotechnological advancements. In November alone, 10 articles concerned brain-machine interfaces for paralysis. Half of them covered the news of a woman suffering from ALS being able to speak due to brain implants and a tablet.

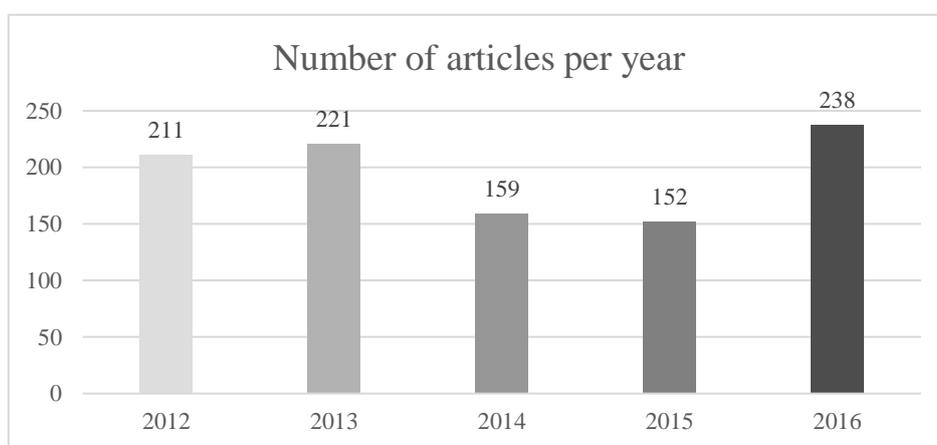


Figure 2. Number of articles on neuroscience per year.

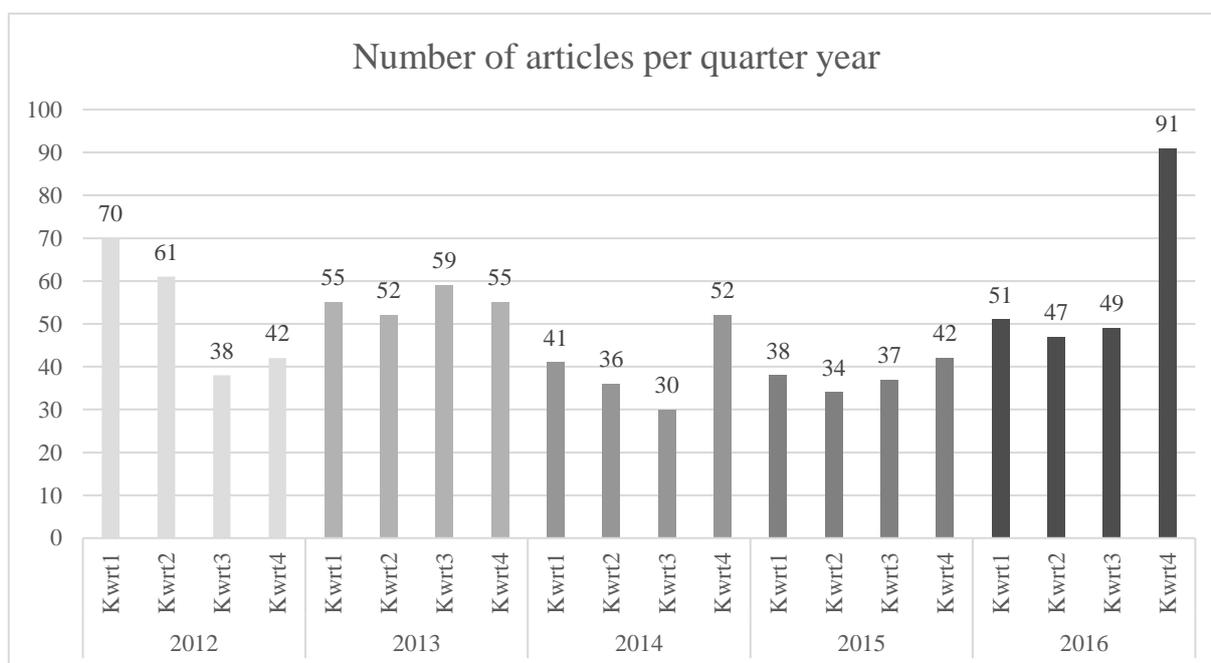


Figure 3. Number of articles on neuroscience per quarter year

The 180 analysed articles were published by 14 different national newspapers. Table 2 shows the number and percentage of articles that were published per newspaper. 72% of articles on brain research were published by De Volkskrant, NRC Handelsblad, Trouw and NRC next. These are all newspapers with a larger section for science.

*Table 2. Newspapers in which the articles on neuroscience appeared in order of number of articles*

<b>Newspaper</b>	<b>Number of articles</b>	<b>% of total</b>
De Volkskrant	57	32%
NRC Handelsblad	27	15%
Trouw	24	13%
NRC next	21	12%
Nederlands Dagblad	13	7%
Reformatorisch Dagblad	13	7%
Algemeen Dagblad	10	6%
Het Parool	6	3%
De Telegraaf	3	2%
Het Financieele Dagblad	3	2%
Boerderij Vandaag	1	1%
Het Parool	1	1%
Metro	1	1%

Within the 180 articles, 9 overarching topics can be distinguished (see Table 3). 40% of articles cover research into the normal workings of the brain, such as navigation, the biological clock, and emotions. 11% of the articles cover discussions about brain research in general, such as certain research methods or the reliability of results from neuroimaging studies. Another 11% of articles discuss personality disorders. The most common topic within personality disorders is psychopathy (42% within this category). Neurodegenerative diseases, such as dementia and Alzheimer's disease, represent 9% of the articles. These are the most covered brain diseases, combined with the mental illnesses. Together they represent 78% of all articles on brain disease – the other 22% is reserved for congenital and traumatic brain disorders. Technological advancements, machine-brain interface and deep brain stimulation in particular, represent 9% of all articles. The vast majority articles cover humans or infer results from animal studies to humans. Only 3% of all articles cover the workings of the animal brain only. Philosophical discussions, such as the discussions about neurodeterminism and neuroethics, were the main focus of 4% of the articles. When seeing these topics in the context of medical

and non-medical neuroscience, non-medical neuroscience is best represented in Dutch newspapers. However, often, a connection to brain disorders or diseases is made in articles on the study of the healthy brain even when that is not the main focus of the study.

*Table 3. The 9 overarching topics of the articles on neuroscientific research*

Topic	Number of articles	Percentage of total
Studies of normal workings of the brain (e.g. navigation, biological clock)	72	40%
Discussions about brain research in general (e.g. a discussion of the appropriateness of animal models for neuroscience)	20	11%
Personality & personality disorders (e.g. autism, empathy)	19	11%
Neurodegenerative diseases (e.g. Alzheimer's Disease)	17	9%
Technological advancements (e.g. brain-machine interface)	17	9%
Mental illness (e.g. depression, PTSD)	13	7%
Other brain disorders, such as congenital and traumatic disorders (e.g. mild traumatic brain injury)	9	5%
Philosophy (e.g. neurosophy, discussions about "we are our brain".)	7	4%
Animals (e.g. do dogs understand human language)	6	3%

### **Medical context**

All neuroscientific research can be generally divided into two categories: medical and non-medical. Medical neuroscientific research concerns diseases or treatments. Non-medical neuroscientific research focuses on non-pathological areas of study, such as memory and brain development. Although less than half (41%),  $n=73$  of the articles concern research on medical topics, such as diseases or treatments, 59% ( $n=107$ ) of all articles mention one or multiple diseases. In these cases, the spokespeople are researchers. One type of article that stands out within the medical context is the in-depth article that covers one disease and the current state of research on treatments. This type of article is not noteworthy because of the number of articles in this format (4), but because these are the only type of article that features patients' stories. Therefore, these articles are more patient-focused than others and tend to be more positive than the often neutral description of other studies. One example is the article on a novel treatment for tinnitus, where the patient is put central, which is discussed under 'Expertise'.

A similar patient-focused article is on deep brain stimulation for epilepsy, where the first Dutch patient to receive this treatment has a central role in the narrative.

*“What if nothing helps? Then deep brain stimulation steps into the picture for a growing number of conditions. The story of the Netherlands’ first epilepsy patient with implanted electrodes in his brain. “*

*(De Volkskrant, 20-07-2013)*

This third patient-focused story is a little different. It is a book review, but it mostly discusses the contents of the book. It is therefore a discussion of the current state of research on Parkinson’s disease, following the order laid out in the book. Even though the author of the book is never interviewed, he is posited as the main character for this article.

*“Palfreman is a science journalist, and so he went to investigate when he got his diagnosis. What have we learned about Parkinson’s in the meantime? And are we close to finding a cure? What is it like being a patient in an advanced stage?”*

*(De Volkskrant, 06-02-2016)*

A common characteristic of these types of articles is the positivity and focus on the future where there is hope for a cure or treatment. Furthermore, there is almost always a scientist quoted as well, although their role is much smaller. In the article on deep brain stimulation for epilepsy, a neurosurgeon compares it to deep brain stimulation for Parkinson’s disease:

*“Deep Brain Stimulation has proved its worth mainly for movement disorders, like the tremors patients with Parkinson’s Disease experience. “They achieve good results with that generally”, Rick Schuurman, neurosurgeon at the AMC in Amsterdam, says. ‘But even here we should not overestimate the possibilities. Parkinson patients who can play the banjo after their treatment go over well in the media, but success stories from that caliber are rare.’”*

*(De Volkskrant, 20-07-2013)*

Often articles in the medical context concern treatments and new drugs for several conditions. The most widely covered topics within the medical context are dementia and Alzheimer’s disease (16 articles in total, 9%). The second most popular topic in the media is the brain-machine interface with a total of 8 articles (4%). The coverage on the brain-machine interface differs from the other topics as it is one of the few where multiple newspapers wrote an article on the same event. For example, in 2014, a Brazilian neuroscientist made the news by letting one of his paralyzed patients perform the kick-off for an important soccer match in an exoskeleton. The field of brain-machine interfaces is more recent than other medical research areas that are commonly covered in the media and therefore has more ‘break-throughs’ which are easily picked up by multiple newspapers.

### News value

The most prominent news value is ‘entertainment’ (48%), followed by ‘relevance’ (23%). 6% of articles contained both ‘entertainment’ and ‘relevance’ as their news value, totaling 68% of articles that include one or both of these news values. Because more knowledge on the normal workings of the brain does not generally impact day-to-day life when communicated through newspaper articles, many of these articles represent the results from these studies as “interesting facts”, making them a form of entertainment. Articles in the medical context often fall under the news value type ‘relevance’, as these neurodegenerative diseases and mental illnesses affect a large percentage of the population negatively. Similarly, articles whose news value is ‘good news’ (8% of articles), all relate to medical neuroscience and some type of research breakthrough, such as promising new treatments or even cures. The news value ‘bad news’ is present in 4% of articles, which are all articles on medical neuroscience. The vast majority of ‘bad news’ articles are reports on growing numbers of patients for certain diseases, such as Alzheimer’s disease. The most prominent news values, relevance and entertainment, are indicative of traditional models of science journalism.

### Prevention and optimization of the brain

Although prevention is an important governmental focus point, with initiatives such as the Nationaal Programma Preventie (*National Prevention Program*), this spotlight is not mirrored by media coverage. Prevention is not a popular topic, with only 30 articles of 180 explicitly mentioning preventative measures for a disease or condition. An example of this is advice on preventing brain damage in an article on marijuana use.

*“The brain has restorative power,” says Professor Van de Mheen, “But the later you start with smoking weed or drinking, the better.”*

*(Algemeen Dagblad, 29-8-2012)*

This quote is an example of the type of advice that is given on prevention. However, most advice on prevention is implicit and/or general, relating to a healthy life style, as illustrated by the following quotes. While the interviewee never explicitly advises the reader to have a healthy lifestyle, he makes his point by listing the diseases that can be prevented by a healthy lifestyle.

*“More lives are saved and more handicaps are prevented with a healthy lifestyle than with whichever therapy.”*

*“High blood pressure, too much fat in the blood, too much fat around the organs in the stomach, the inflammatory responses that it causes in other places in the body, the*

*diabetes that can be the consequence of that, the heart attacks and brain infarction, the dementia, the joint problems, the cancer sometimes – it can all be largely prevented by a healthy lifestyle.”*

*(NRC Handelsblad, 29-06-2013)*

Media coverage on medical neuroscientific research is concerned with conditions that affect many people, like dementia, and with scientific breakthroughs, as with brain-machine interfaces. Prevention is not often a topic of interest. This analysis shows that there is a preference for cures rather than preventative methods in the media coverage.

When it comes to improving brain function, rather than preventing harm, the media coverage of neuroscientific research is not extensive. Articles that do cover improving brain functions, focus almost exclusively on improving memory. It is possible that outside the scope of neuroscientific research there is more attention for both prevention and improvement of brain function, as suggested by O'Connor (2012), but within a context of neuroscientific research, the media does not exhort action on part of the reader to take charge of their brains.

### **Neurointerpretations**

The neurointerpretations, neuroessentialism, neurorealism and neuropolicy, were coded per instance, which can range from parts of a sentence to several sentences. These interpretations are often subtle and only appear in one or two instances in one article.

Figure 4 shows the percentage of articles that contain one or more instances of a single neuro-interpretation. In some cases, more than one type of neuro-interpretation was present. This is the case for 7 articles, 5 of which contain both instances neuroessentialism and neurorealism and 2 of which contain both neuropolicy and neuroessentialism. It is not uncommon that many articles do not include an instance of a neurointerpretations (Racine et al., 2010). For example, Racine et al. (2010) reported that only 6% of the total number of studied articles on neuroimaging included instances of neuroessentialism. Some neuroimaging techniques had more instances than others (13% of fMRI articles versus 4% of EEG articles). Racine therefore identified these interpretations as emerging trends. This analysis indicates that the use of these neurointerpretations is not tapering off, making them still relevant to the discussion of neuroscientific research in a social context.

## Percentage of articles with neurointerpretations

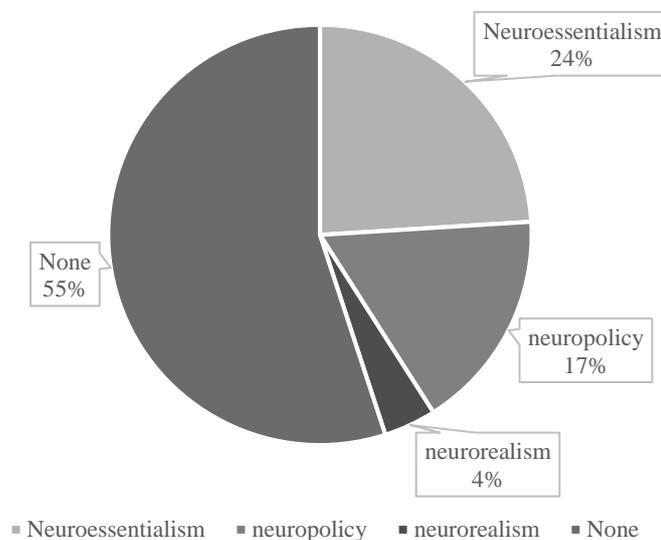


Figure 4. Percentage of articles with a certain neurointerpretation and without any neurointerpretations. Some articles have more than one type of neurointerpretation.

**Neuroessentialism.** Neuroessentialism as described by Racine (2005) covers three interpretations: neuroscience as revealing our essence; neuroscience reveals the neuronal basis of personality traits or illness; the brain, or parts thereof, is an autonomous object by becoming a grammatical subject. 24% of articles contained at least one form of neuroessentialistic interpretations (n=43). Most of these articles (n=38) contained one or more references to the brain as a grammatical object. One critical opinion article in the sample mentioned that the brain as an autonomous unit was a way to concretize abstract processes and to give the message more credibility, as illustrated by the following quote:

*“[...]many people talk about the brain as if it is some sort of autonomous unit within the brainpan. ‘My brain is in love’ or ‘A child’s brain is still developing’. As if not the child itself is learning and growing, but merely the grey matter in the upstairs.”*

*(Trouw, 27-11-2012)*

The author of the above quote refers to journalists and other writers writing about the brain as a grammatical object deliberately, which is corroborated by instances of neuroessentialistic interpretations. This is illustrated by the quote below which stems from an article on why people prefer swiping motions on touch screens as opposed to a computer mouse:

*“Your brain probably finds [swiping] easier than controlling a cursor with a computer mouse, for example.”*

*(De Volkskrant, 19-03-2014)*

A similar instance is seen in an article on motion sickness. The article refers to skepticism from Dutch scientists on a British invention. This time it was the journalist using a neuroessentialistic interpretation:

*“The cause of motion sickness is still a mystery, but it has something to do with the brain getting confused by contradicting information.”*

*(Trouw 05-09-2015)*

In the three examples above, the interpretation referred to the brain as an autonomous unit. One headline from an article about direction finding personifies individual brain cells in the following manner:

*“No sense of direction? Come now, even the cells in your brain have it!”*

*(Headline in NRCnext, 12-08-2013)*

The second most found type of neuroessentialism was “neuroscience revealing the neuronal basis of personality traits or illness” (n=17). Only 7 of 180 articles contained references to “neuroscience revealing our essence”.

*Martijn van den Heuvel, brain researcher at UMC Utrecht says: “all of our memories and our personalities are stored in the brain. You are your brain connections.”*

*(NRC Handelsblad, 13-10-2015)*

Most instances of neuroessentialism occur in articles with a non-medical context (84%). These articles often attempt to explain cognitive phenomena, such as how the sense of taste works in the brain, which may clarify the use of neuroessentialist interpretations. An example of this is the following quote of the article “Tasting with your head”

*“The scent receptors give signals to the brain, where they reach the prefrontal cortex, the part directly above the eyes. According to [a neurobiologist], this is the heart of the brain, the part that truly makes us human. Connections are made between our sensations in the mouth, the scent, the emotions they evoke and previous experiences that are stored in our brains. This gives rise to flavor.*

*(Financieele Dagblad, 17-02-2012)*

The example above shows how neuroessentialist metaphors created a narrative where the brain is a repository of the self. At the same time, neuroessentialism is about incorporating neuroscience into everyday experiences, representing neuroscience as relevant to day-to-day thoughts.

**Neuropolicy.** Neuropolicy is a neurointerpretation that consists of two types: neuroscience having impact on policy and social practices and neuroscience having an impact on daily life. A total of 31 articles contained instances of neuropolicy, 14 of which only explicitly explained neuroscience having an impact on policies and social practices and 13 of which explicitly mentioned neuroscience having an impact on daily lives. An example of the first type of neuropolicy, neuroscience as having an impact on policies, refers to medical policies in the following case:

*'This research will, without a doubt, have an enormous impact on the treatment of cerebral infarctions worldwide.'*

*(De Volkskrant, 18-12-2014)*

Another example can be found in the following quote of an article on eating. There is a direct link between neuroscience and policy, as the quoted scientist, believes the science should be taken into account in anti-obesity campaigns and interventions.

*What we are eating nowadays (...) leads to a constant stimulation of the brain, the production of an enormous amount of flavor and therefore a lot of satisfaction, according to [Shepherd]. We want more and more; our brains want to be stimulated constantly. That, according to Shepherd, should be taking into account when combating obesity.*

*(Het Financieele Dagblad, 17-03-2012)*

The following quote is an example of the interpretation of neuroscience as having an impact on daily lives (as opposed to policy). Most instances of this type of neuropolicy related to a healthy lifestyle. These articles backed up the recommendations with scientific results that a healthy lifestyle either offers neurocognitive health benefits or aids in preventing disease.

*"Chronic sleep deprivation leads to depression, burn-outs and heart problems. Moreover, it makes you hungry. If you want to stay fit, you have to go to bed on time."*

*(NRC Handelsblad 18-8-2012)*

Although only 31 articles could be coded as containing neuropolicy phrases, many articles referred implicitly to the impact neuroscience has on daily life or medical practice, meaning that these articles do not explicitly link neuroscience with policy or daily life like in the quote above. Instead, the link is left implicit and up to the reader to interpret.

Because neuropolicy refers to the application of research outcomes on policies and practices, the research must be relevant and reliable in order to be used as an argument for change. Similarly, articles on medical research often have an implicit relevance (e.g. research to cure a disease); which is not always the case for articles on non-medical research. Almost half of the articles in the sample (84; 47%) do not contain explanations of relevance. For

example, in 2016, two articles were published in different newspapers on one research on how dogs process human speech. The results indicated that dogs process intonation and words in different areas of their brains. Neither article mentions what this new information will be used for or what questions this evidence will help answer.

**Neurorealism.** Neurorealism is the interpretation that research data directly yields data on brain function and cognitive processes, without taking into account the complexities of data acquisition. Neurorealism specifically refers to media coverage of imaging techniques. There are three types of neurorealistic interpretations: neuroimaging as mind-reading; neuro-imaging as visual proof; neuroimaging metaphors like ‘window into the brain’ or ‘pictures or movies of the brain in action’. 7 out of 180 articles contained neurorealistic instances. Three of these articles refer to neuroimaging as mind reading, and three interpret neuroimaging as visual proof. One instance can be coded as using the neurorealistic metaphors of ‘window into the brain’ or ‘pictures or movies of the brain in action’. The headline and excerpt below are one example of neuroimaging as proof of a certain phenomenon.

*“Brain scans from American study deliver definitive proof*

*Women have been convinced for a long time, but only now has the proof been delivered: the female brain is programmed to perform a whole host of tasks at the same time.”*

*(Algemeen Dagblad, 05-12-2013)*

The most notable thing about the use of neurorealistic interpretations in the sample is the lack thereof. Neurorealistic interpretations and metaphors concern neuroimaging only, but the sample shows that the research techniques are not often explained or even mentioned. 53 articles (29%) offer some explanation of the research techniques that were used, but neuroimaging seems to be considered well-known. MRI-scans, brain scans and fMRI-scans are mentioned in the articles, but the science behind them are not explained as it would with newer techniques. The following two quotes shows typical coverage of neuroimaging.

*“The Hungarian scientists knew that it was possible: already in 2014 Hungarian dogs went into the fMRI-scanner. That research showed that dogs process barking and non-verbal human emotions (laughing and crying) are processed in the same area in their right hemisphere.”*

*(NRC Handelsblad 02-09-2016)*

*“By playing music while the drugged participants were laying in the MRI-scanner, the information traffic between the visual cortex and parahippocampus increased, which is an area that is involved in memory among other things.*

*(Trouw, 21-05-2016)*

When neuroimaging is not treated as novel and is not seen as something that needs explaining, there is also little use for neurorealistic metaphors or interpretations. Statements that are typical for neurorealistic coverage, such as “window in the brain” or “mind-reading” are not applicable when “brain scan” is a part of everyone’s vocabulary. Although a neurorealistic interpretation can be seen as a considerable trust that is put in brain scans, the lack of these interpretations in this sample do not necessarily reflect a lack of trust. Brain scans are still treated as direct evidence for phenomena and are rarely, if ever, disputed or criticized. In conclusion, the neurointerpretations as identified by Racine (2005) are present in the coverage of neuroscientific research in Dutch newspapers, meaning that these are possible ways in which the public debate about neuroscience can be shaped. They indicate a high level of trust in neuroscience, as well as perceived relevance of neuroscientific research. Additionally, the use of neuroessentialism strengthens the representation of neuroscientific research as being relevant to everyday experiences.

### **Expertise**

Most articles (74%, n=134) had statements from one or more experts. 85% of those articles (63% of total) only featured neuroscientific experts. 14 articles (10%, 8% of total number of articles) also featured experts that were either scientific experts from different disciplines (e.g. clinical physicist, professor of biophysics) or non-scientific experts such as patients or their relatives or corporate representatives. The remaining 6 articles (4%; 3% of total) only featured non-scientific experts or scientific experts from a different discipline. Table 4 shows the number of times a certain type of experts is quoted. From this can be concluded that these newspapers prefer neuroscientific experts to provide commentary on neuroscientific research, which is line with the traditional models of science journalism, especially the scientific literacy model. Although the Hersenstichting aims to be a knowledge base for matters concerning the brain, with extensive information on the website and the information telephone line, they are not sourced for commentary on neuroscientific research. It is possible that outside the scope of research, they are more present in the media, as they do not conduct research themselves.

Table 4. Number of times a type of expertise is used as an expert in the total sample. Note that one article can have multiple experts.

Type of expertise	Times used as expert
Neuroscientific expert	130
Scientific expert of a different discipline (e.g. biologists, geneticists)	50
Corporate representatives	3
Patients	8
Relatives or caretakers of patients	2
Other	12
Journalists	2
The Hersenstichting	2

Neuroscientific experts are asked to comment on both medical and non-medical research from the Netherlands and international research. They often give their opinion, but are not restricted to positive comments. In some cases, they are asked to give advice to the readers. There are three typical responses from neuroscientific experts:

- A. They comment and explain their own research
- B. They comment on research from someone else. They interpret, explain or provide an opinion.
- C. They answer a knowledge question from the writer

An example of a response of the first category, is illustrated in the following quote. Gerkema explains his research group's finds in an article on a related research by others:

*“Gerkema’s own group in Groningen has furthered the research into the biological clock. “We have discovered that the nucleus in the brain is not all decisive. Mice whose nuclei were disabled genetically still had a memory for space and time. In other words: you can still teach those mice that there will be food in a maze at a certain time and place. That is only possible if you have a certain form of a biological clock. We’re discovering more and more that your biological clock is seated in your entire body, even literally in all your cells.”*  
(Trouw, 19-3-2015)

A typical interpretation from a study by a foreign research group is illustrated by the following quote, where neuroscientist Arjen Stolk is asked to comment on an Israeli research. The scientists found that dogs process meaningful messages in their left hemispheres and nonsensical noises in their right hemisphere.

*“The resemblance between dog and man is striking, neuroscientist Arjen Stolk from the Radboud University Nijmegen says. “The hemispheric lay-out is roughly the same. Even for people, the left hemisphere is dominant in the understanding of language. This points to evolutionary similarities.*

*(De Volkskrant, 27-11-2014)*

The same category of response can also include negative or apprehensive comments on research, as can be seen in the following quote. Martin van den Bent is asked to comment on a new technique to make brain tissue transparent in order to study tumors. His comment, in contrast to the comment by Stolk, is more apprehensive about the study.

*Martin van den Bent, professor of neurology and connected to the Erasmus MC Cancer Institute, reacts reserved after reading a publication by Stanford University about Clarity. “I think it is a fascinating technology, but what we can do with it is not yet clear. Its worth has to be proven with further research. It could be a tool that can possibly give insight in brain routes and tumors, but that will have to be seen.”*

*(Volkskrant, 01-11-2014)*

Negativity may also be directed to policymakers or the scientific community in general. Some articles pleaded for more funding or more research; others pleaded for a change in policy. Kortekaas, in de quotation below, criticizes the political decision to prohibit the use of LSD in scientific research.

*‘This type of political decision making is problematic for scientists like me’, says Kortekaas. ‘I would like to study the effects of LSD on the brain, but LSD has that touchy history, because some hippies in the sixties ended up in hospital, completely out of it. Partly because of that, the substance is blacklisted everywhere, even though the method of action does not differ that much from ketamine, which is very promising for patients with depression”*

*(De Volkskrant, 6-10-2012)*

The scientists from different disciplines have essentially the same roles as neuroscientists, but are less commonly invited to comment. The patients and their relatives are not invited as often to comment. When they are, they give insights into their lives as a patient. One of those patients is Dankart Martens, who is the first Dutch person to get deep brain stimulation for epilepsy. In the article, the explanation of the technique behind deep brain stimulation is alternated with Marten’s perspective as a patient. In the following quote, Marten (then 5 months without an attack) tells about how epilepsy affects his life.

*‘The attacks are ‘doable’ according to himself. If he gets an attack in his local pub, he will still drink his beer afterwards. It is the unpredictability of the attacks that are hell. Driving, cycling, swimming; it’s all too dangerous. “The epilepsy makes my world very small.”*

*20-7-2013, De Volkskrant*

A similar story is provided by Margriet van Loon who suffers from tinnitus. The news value is provided by the possibility of a novel treatment for tinnitus, which Dutch researchers were close to developing. Although she is not receiving the treatment, she provides the sense of urgency as she explains how sufferers can feel:

*“There are patients that consider suicide because they cannot deal with it anymore”, Margriet van Loon tells us. “I can understand that. It is impossible to explain to others how hellish tinnitus can be.”*

Additionally, she provides a cautiously optimistic perspective for the future, with that emphasizing the importance of research:

*“Margriet hopes that there will be a time that her head will become quiet again. “Let’s see if the implant works first. I am very glad that there is so much research for solutions, though. In Maastricht, but also in Groningen and Antwerp. I hope they will find something. If not for me, than for all those other patients.”*

*(Algemeen Dagblad, 05-02-2013)*

The patients’ perspective provides an emotional aspect to the article that is less common in articles that only feature scientists.

In conclusion, the neuroscientific expert is the most dominant type of expertise in the researched sample. These experts provide opinions, knowledge or interpretation of neuroscientific research in many of the newspaper articles. Patients, although not commonly quoted, provide insight in living with a certain disease and with that add human interest to a story.

## Survey

In order to answer the second research question: ‘What is the perception of neuroscientific research of the target audience of the Hersenstichting?’ and ‘What is the perception and information need concerning neuroscientific research of the target audience of the Hersenstichting?’, a survey was conducted among Facebook and Twitter followers of the Hersenstichting. In this survey, the respondents’ information needs and perceptions of neuroscience were investigated to compare to the representation of neuroscientific research in newspapers. This comparison can be found under Conclusions.

*Table 5. Characteristics of participants in the survey.*

Characteristics	Number of participants
Participants	95
Women	77
Men	18
Median age	48
Age range	20-77
Benefactor	70
Yes	26
In the past	4
One-off	40
Not a benefactor	27
Prefer not to say	4

The survey yielded 95 complete responses, given by 77 women and 18 men. This discrepancy can be explained by the skewed ratio of male and female followers on the social media pages of the Hersenstichting. Table 3 shows some demographic data. The respondents ranged in age from 20 to 77 years old, with the biggest group falling in the category 31-55 y/o and a median age of 48. This is slightly younger than the median age of the typical target audience for the Hersenstichting (55-60 years old). 71.6% of the respondents have donated to the Hersenstichting in the past or still do so structurally, meaning many respondents are involved with the Hersenstichting in some way or another.

**Information need.** One part of the survey was dedicated to determining the information need of the target audience. The participants reported a high interest in news articles on brain research. 64% read at least one paper newspaper regularly, but 78% report that they would read an article about brain research when they encounter it in a newspaper and 19% report that they would do this “sometimes”. A follow-up question shows that reasons for reading such an article are based on relevance to their situation and personal interest, as the quote below shows.

*“When the title appeals to me and it is about meningitis or encephalitis. And invisible brain trauma.”*

*A 39-year-old woman*

Apart from passive exposure to brain research through news outlets, 94% of respondents had in the past year actively looked up information on brain research, for various reasons (see Figure 5).

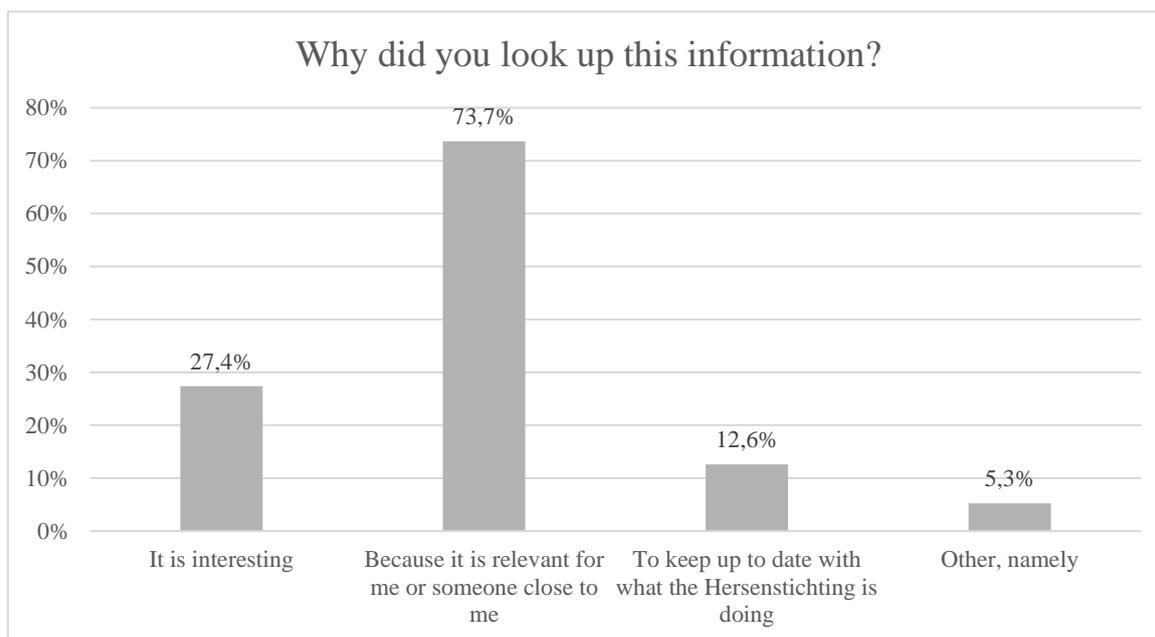
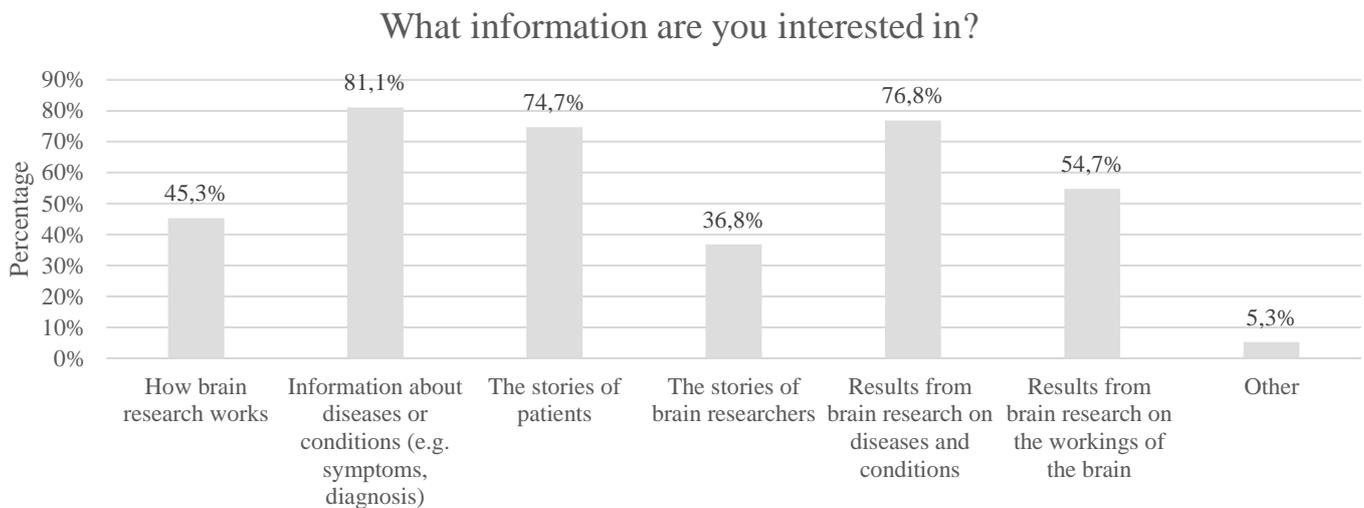


Figure 5. Reasons for looking up information on brain research

The most reported reason was because it was relevant for them or for someone close to them (74%). 27% disclosed that the reason was interest and 13% wanted to keep up with the Hersenstichting. 3 respondents included different reasons for looking up information, which were because of work, because of their education and because of their child’s school presentation. This is in line with the information they reported being interested in (Figure 6). Their interests mostly concern the medical side of brain research, as 81% reported being interested in disease symptoms, diagnoses, and treatments. Respectively 77% and 75% report being interested in outcomes of research on disease and stories from a patient’s perspective. The participants are less interested in how brain research works and new findings on how the healthy brain works (respectively 45% and 55% of respondents). The majority of respondents is not interested in stories from a researcher’s perspective.

Figure 6. Reported levels of being interested in certain types of information



**Perceptions of neuroscience.** Even if most participants are not interested in stories from researchers, most do believe brain researchers are most knowledgeable about brains and brain disease compared to other experts. Contrastingly, communicating about research in the media is the least important task for brain researchers, according to the respondents. They consider finding cures for brain diseases and conditions the most important task (see also Table 7). The second most knowledgeable source is the *Hersenstichting*, in third place doctors. Patients, according to respondents, know less than doctors but more than nursing staff and patients' family and peers. In accordance with the sourcing in newspapers, brain researchers are seen as the most knowledgeable. However, our analysis shows that the *Hersenstichting* is considered an expert on neuroscientific research by their target audience but not by newspapers.

Likewise, trust in brain scans and neuroscience in general is high (Table 6). Only 4% of respondents consider brain scans to be somewhat unreliable, and no one feels they are entirely unreliable. This contrasts the perception of brain research on animals, which only 30% feels is reliable, 39% is neutral about it and 23,2% perceives it as unreliable to some extent. The majority of respondents agrees that neuroscience has a large impact on policies and regulations and on daily lives (respectively 83% and 73%), but would like to see more attention for prevention in the media.

Table 7. Level of agreement with statements regarding neuroscientific research.

Statement	Number of answers	Agree completely	Agree	Neutral	Disagree	Disagree completely	No Opinion
Outcomes of research on the brain and brain diseases have a lot of impact on daily life	92	31,2%	41,9%	9,7%	10,8%	5,4%	1,1%
Research on the brain and brain diseases are important for governmental policy and medical policy	94	58,9%	24,2%	3,2%	4,2%	8,4%	1,1%
Curing brain diseases and disorders is the most important task for brain researchers	90	30,4%	35,9%	15,2%	8,7%	7,6%	2,2%
There is enough attention for the prevention of brain disorders in the media	88	8,8%	12,1%	26,4%	33,0%	16,5%	3,3%
Brain scans are important proof for how the brain works	88	31,6%	29,5%	18,9%	7,4%	5,3%	7,4%
I agree with the statement: "we are our brains" (the brain decides who we are and what we do)	89	39,1%	27,2%	16,3%	4,3%	9,8%	3,3%

Table 6. Perceived reliability of research methods

Question	Completely reliable	Reliable	Neutral	Unreliable	Completely unreliable	No Opinion
How reliable is research on experimental animals?	3,2%	26,3%	38,9%	18,9%	4,2%	8,4%
How reliable are the outcomes of brain scans?	38,9%	37,9%	15,8%	4,2%	0,0%	3,2%
How reliable are the results from measuring brain waves (EEG)	27,4%	43,2%	23,2%	2,1%	0,0%	4,2%

To conclude, the target audience has a generally positive view on neuroscientific research, with a large amount of trust placed in neuroimaging techniques and researchers. Although the respondents view neuroscientists as the most knowledgeable on the brain and brain diseases, they do not consider it the researcher's main responsibility to communicate in the media. Possibly they see the *Hersenstichting* as a better fit for this. The respondents are particularly interested in stories about medical neuroscience as many of them are patients of have patients in their direct environment.

### **Conclusions**

The research questions posed in this study is: "How is brain research represented in Dutch newspapers?" and "What is the perception of brain research of people with an interest in the Brain Foundation?". To answer the first question, a total of 180 Dutch newspaper articles published over the course of 5 years were analyzed. To answer the second question, an online survey was conducted among 95 social media followers of the *Hersenstichting*. This provided insight into the perceptions of the participants regarding neuroscientific research and their information need.

### **Neurointerpretations**

The three neurointerpretations (neurorealism, neuroessentialism, and neuropolicy) are ways to gauge the perceived trustworthiness and importance of brain research. These concepts refer to specific ways neuroscientific research can be communicated, which includes wording. For example, when the brain becomes the grammatical subject in a sentence, it may be a neuroessentialistic interpretation: "As any good movie director or roller coaster designer knows, people love surprises. Now, it seems, at the most basic level, the brain does too" (Nagourney, 2001). Neuroessentialism, or the equation of the brain with the self, occurs in almost a quarter of the articles, making it the most common neurointerpretation. Interestingly, this is also the most debated interpretation. This neuroreductionist thinking as introduced by Dick Swaab in his 2009 book *We Are Our Brain*, sparked an intense debate and was fiercely contested by several groups, including religious groups. Therefore, neuroessentialism is an interpretation to be aware of as a communicator, because even seemingly inconspicuous neuroessentialistic statements contribute to a neuro-reductionist worldview which is controversial. The survey respondents, people that are in some way involved with or interested in the *Hersenstichting*, are also divided on the subject. While a small majority (66%) agree with the statement "we are our brains", 15% disagree and 16% are unsure. 3% of the respondents chose not to answer the question. The neuroessentialism in the representation of neuroscientific research, however, did not lead to a larger focus on personal responsibility for taking care of the brain, which was

found by O'Connor (2012) and seen as the emergent theme "The brain as capital". In this context, the self was regularly equated with the brain, but that did not lead to the media prescribing actions for prevention optimizing performance as often as one would expect from an emerging theme. It is possible the scope of this study, neuroscientific research, is too narrow to include these calls to action. It did, however, lead to a representation of neuroscientific research as being relevant to day-to-day experiences.

Although neuroessentialism comes up in many articles, neurorealism is less often found in articles on brain research. Neurorealism is the interpretation of neuroscientific research as indisputable evidence, relating specifically to evidence provided by brain scans. In the investigated sample, only a few cases of neurorealism have been found. A possible explanation for this is that brain scans are treated as universally understood methods that require no further explanations. However, the unquestioning trust that is reflected in neurorealistic interpretations is not necessarily lacking in the articles, which generally provide no critical opinions and present study outcomes as absolute truths.

Based on these results, it seems that neurorealistic interpretations do not play an important part in media coverage of neuroscience, because of a perceived shared understanding of and trust in brain scans. This trust is also found in the survey results, as only 4% of respondents expressed that brain scans may be unreliable. Less neuroessentialistic coverage can be seen as a sign of more balanced reporting that in the long run works to decrease unrealistic expectations especially around medical applications of neuroscience.

Neuropolicy is the third neurointerpretation and relates to the use of neuroresearch for policy and personal decisions. In a larger frame, this refers to trust in neuroresearch and perceived importance. In order for results to have a significant impact on decision making, they must be perceived as important and trustworthy. Similar to neurorealistic interpretations, neuropolicy was not often expressed explicitly in terms of the results informing policies, practices or lifestyle. Instead, the relevance or application of the research was left implicit. The vast majority of survey participants agreed that research outcomes are important for both policy and practices, and lifestyle (respectively 83% and 73%). It can be concluded that neuroscience in general is seen as very relevant, but non-medical applications of research may be made more explicit.

### **Voices in the media**

The most commonly invited expert in the analyzed articles was the neuroscience researcher. These experts either explained their own research, or commented on other research. For the survey participants, neuroscience researchers were also the most knowledgeable

experts, followed by the Hersenstichting. Although the Hersenstichting plays a significant role in neuroscience research in the Netherlands, they do not conduct research themselves. This may explain why newspaper articles on research generally do not mention the Hersenstichting and favor opinions from researchers.

However, the vast majority of survey participants expressed an interest in patient stories, but patient spokespeople are not generally found in the articles. When patients are asked for their side, they provide insight in living with a certain disease which evokes empathy. Patients' perspectives may be more represented outside the context of research or newspapers, but within newspaper coverage of neuroscientific research patients are rarely invited to speak. This means that for the intended audience of the Hersenstichting, ideal coverage of research should perhaps feature a researcher as the theoretical expert and a patient as an experience expert, as opposed to the researchers exclusively. This is in line with the wish from the Hersenstichting to engage more with their audience, as sourcing from scientific experts is indicative of traditional models of science communication (Secko et al., 2013). The Hersenstichting can choose to source from patients, lay people, and other community members in an effort to promote engagement and step away from linear dissemination of knowledge.

### **Medical and non-medical applications of neuroscience**

Neuroscientific research can be roughly divided into medical and non-medical studies. The first category includes research on new medication, pathologies, and prevention. The second category is involved with the study of the healthy brain, including its workings and development. Both categories are almost equally represented within the sample, but many articles on non-medical topics still mention relevant diseases or conditions. As brain diseases are well-known and far-reaching, mentioning diseases such as Alzheimer's disease is a way to increase the perceived relevance of a study and the reader's involvement in the story at hand. Although the Hersenstichting is working on ways to maintain a healthy brain, disease plays a large part in their activities. Most of the support they receive is from patients with brain diseases or from their loved ones. It is then no surprise that the survey participants expressed a considerable interest in the medical category of neuroscience, going as far as actively researching relevant topics themselves. They also expressed that they feel that there is not enough media attention for prevention of brain diseases and conditions. Correspondingly, there was very little written about prevention within the sample. It is possible that there is more attention for prevention than this sample shows, because of the current focus on research. Prevention may be discussed in more detail in other contexts. However, because of the trust

that is placed in research, more articles on evidence-based prevention would correspond with the sentiments expressed by the participants.

Everything considered, it can be concluded that neuroscientific research in the media is a popular topic that is inseparable from medical science, but considered relevant in many aspects, both on a personal level and an institutional level. Research outcomes, especially those based on brain scans, are considered very reliable and rarely disputed. Neuroscience can be subject to discussions, because of a generally high interest and the implications of neuroscience for people's beliefs, and simultaneously used as a rhetorical tool to provide legitimacy to arguments.

## **Discussion**

### **Limitations**

This research has certain limitations which will be discussed below.

Firstly, the search query used was designed to encompass all articles above a certain word count and included explicit mentions of research. Therefore, it may have excluded articles on relevant topics such as prevention as these topics might be more common in other contexts. Furthermore, the articles dated from a period of 5 years, which is too short to find trends over time. A sample from articles from a longer period of time would have allowed analysis of the development of coverage of neuroscientific research.

Secondly, only newspaper articles were used for this research, however, there are more sources of information about brain research. Most notably television and online articles, but also magazines such as the *HersenMagazine (Brain Magazine)* which is published by the *Hersenstichting*, and lifestyle magazines such as the *Libelle*.

Thirdly, the participants of the survey were not a cross section of the typical benefactors of the *Hersenstichting*, because of the age range. The distribution of the survey through social media likely has played a role in this. Additionally, the participants are not an accurate cross section of the general public.

### **Recommendations**

Based on the data and results several recommendations can be made for parties that communicate about neuroscientific results, including the *Hersenstichting* and science journalists.

The first recommendation for communicators is to be aware of neuroessentialistic language that can inadvertently give the impression of neurodeterministic thinking, which is a

debated view that possibly not everyone is comfortable with expressing. Neuroessentialistic metaphors should ideally be avoided.

The second recommendation is to ground prevention advice in evidence-based and research contexts. The results show that trust in research is high, as is the perceived relevance. Placing prevention in a research context could aid in behavioral change, but it is important to create these stories about prevention through dialogue with relevant stakeholders. This creates opportunities for non-traditional approaches to communication, which values engagement with all stakeholders and embeds the science behind prevention in society.

The third recommendation is to give space for patients' voices and stories. Patients and their loved ones are very interested in these stories, but do not find them in newspapers. Similar to the stories about prevention, there are opportunities here for the co-creation of knowledge about neuroscience that is more engaging and embedded in the social sphere than the linear transmission of knowledge that is solely created by scientific experts.

### **Further research**

In further research, more sources of science news could be analyzed. Especially online articles and television are growing media with specific sets of challenges and communication styles, which may lead to different representations of neuroscientific research. Furthermore, a study into the effects of the ways of communicating about neuroscientific research would provide insight into its direct effects on opinions and interpretations by a general public.

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## **Appendix A: Codebook**

## Code book

<b>Newspaper</b>	Indicate full name of newspaper in which current article was published
<b>Date of article</b>	Indicate the date on which the article was published (dd-mm-yy)
<b>Title of article</b>	Indicate full title of article, including possible subtitles. (Full title – <i>subtitle</i> )
<b>Length</b>	Indicate length of article
<b>Article ID</b>	Fill in article ID as indicated on the article ID list

If you quote a headline, please precede the quote with an asterisk(\*)

<b>Main message of article</b>	What is the main message of the article in one sentence?
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<b>What is the news value of this article?</b>	Indicate what makes this article news worthy. Does it concern a new innovation, a celebrity, a tragedy, etc.
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<b>Quotations</b>	Are there experts quoted in the article? If yes, write down name and occupation (if mentioned).
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<b>Type of expertise</b>	If there is someone quoted, indicate what makes them an expert. E.g. a neuroscientist, a brain patient, a family member, politician, company representatives, health care provider.
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<b>Context</b>	In what context is neuroscience presented? Medical (e.g. as a cure), non-medical (e.g. improving memory) or other (please indicate).
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<b>Conditions</b>	If the context is medical, what diseases or conditions are mentioned?
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<b>Prevention</b>	Is there mention of preventative measures? E.g. to prevent head injuries or to maintain 'good brain health'? If yes, indicate what preventative measures are mentioned.
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**Advantages**

Are advantages of this field of neurosciences mentioned? If yes, indicate which. This includes clinical and non-clinical benefits. Clinical benefits include benefits for diagnosis, prevention, therapy, surgery and monitoring. Non-clinical benefits includes benefits for research and technology design, economy, moral or spiritual benefits, social, educational, legal and political benefits.

**Issues**

Are issues concerning the science mentioned? This includes scientific issues such as validity, reliability, interpretation, misunderstanding, safety, side-effects. This also includes social, ethical or legal issues such as stigma, conflicts of interest, privacy, autonomy, integrity, enhancement, animal rights, policy and consent.

**Neuro-essentialism, -policy and -realism**

Please see tables

**Advice**

See tables. Is implicit or explicit advice given to the reader?

**Neuro-essentialism (I)** From Racine, Waldman, Rosenberg, & Illes (2010)

Code	Type	Example
IA	Neuro-essentialism: Neuroscience reveals our “essence”, who we are	“With more powerful imaging devices and new genetic information, scientists are exploring the secrets of the organ <b>that makes humans unique</b> ” (Colburn, 1999).
		“The most mysterious, complex system in the universe is perched inside the skull at the top of your neck. The brain holds your memories, your emotions, your hopes, dreams and understanding. (.) <b>It holds “you” - the private you,</b> not the public you that others see. It’s so private that even you don’t know the “you” that resides inside” (Hall, 2001).
IB	Neuroscience reveals the neuronal basis of personality traits or illness	“Looking for that brain wave called love: humanities experts use M.R.I.’s to scan the mind for <b>the locus of the finer feelings</b> ” (Eakin, 2000).

		<p>“Scientists spot the site of addictive craving in brain (.) Childress can peer into brains and <b>literally see the seat of desire</b>, the wanting-place inside addicts that orders them to abandon jobs, children and spouses to hunt for mind-spiraling products” (Lubrano, 1997 p. A35).</p>
		<p>“One of the most striking findings came in 1997, when a team of researchers from the University of California at San Diego <b>found what they called the “God module” in the brain</b>” (Cook, 2001).</p>
		<p>“If your child has trouble reading, <b>the problem may indeed be all in his head</b>” (Hall, 1999).</p>
		<p>“Are you guilty? It’s all in the mind: A new test is being used <b>to detect memories in suspects</b>” a (Spinney, 2001).</p>
		<p>“<b>Optimists owe it all to the brain</b>” (Henderson, 2001).</p>
IC	Brain implicitly becomes a grammatical subject	<p>“As any good movie director or roller coaster designer knows, people love surprises. Now, it seems, at the most basic level, <b>the brain does too</b>” (Nagourney, 2001).</p>
		<p>“There have always been strong hints that <b>the brain can use separate brain regions</b> for first and second languages” (Blakeslee, 1997).</p>

**Neuro-realism (II)** Racine, Waldman, Rosenberg, & Illes (2010)

Code	Type	Example
IIA	Neuroimaging as “mind-reading”	“ <b>We know what you are thinking.</b> The nature of things: Spin doctors are delving deeper into our grey matter ”a (Derrington, 1998).
		“ <b>Reading the brain:</b> New imaging technique lets doctors see inside, but some question how it is used” (Blakeslee, 2000).
		“Brain scan can <b>catch a lie</b> ” (Anonymous, 2004).
		“Hi-tech hairnet <b>that reads minds</b> ” (Macdermid, 1997).
IIB	Neuroimaging provides a “visual proof” or reveals the true nature of cognitive phenomena	“Plourd showed the jury a PET scan that depicted the damaged section of his brain. The jury voted for life imprisonment. “A PET scan is very helpful,” says Plourd. “The jury can accept it more readily than just words or the testimony of an expert“” (Terry, 2000).
		“But the fact that pain, like blood pressure or body temperature, can now <b>be measured</b> (.) will help <b>convince doctors that patients’ pain is very real</b> ” (Noble, 1999).
		“It’s hard to fight an enemy (mental illness) you can’t see (.) <b>This will make it as easy to see sickness in the mind</b> as it is to see a broken bone in the body” (Anonymous, 1999).
		“Hypnosis really does turn red into white (.) Scientists have shown that hypnosis produces changes in the brain, the first conclusive proof that the practice works. <b>Brain scans have revealed beyond doubt</b> that people who are hypnotized are not simply humouring their interviewers but that <b>they see the world differently</b> while in a trance” (Henderson, 2002).
IIC	Neuroimaging provides a “window into the brain”; pictures or movies of the “brain in action”	“ <b>The fMRI gives us a window into the human brain</b> ” (Fackelmann, 2001). “In an illustration of how the kind of ”photography” known as brain imaging has come of age, scientists Tuesday announced findings that could affect the understanding and treatment of schizophrenia, drug addiction and post-traumatic stress disorder. (.) “We now have remarkable tools to see the living, feeling, thinking human brain at work” (Vedantam, 1996).
		“How to get inside the thinking brain (.) Recently, in a darkened lecture theatre, I watched on a flickering screen a slow-motion <b>video of a brain actually thinking</b> ” (Charlton, 1996).

		<p>“In their study, 36 women played the non-zero-sum game “Prisoner’s Dilemma” while getting functional magnetic resonance imaging scans, a new type of MRI that <b>shows a movie of brain activity</b>” (Wahlberg, 2002).</p>
		<p>In a quiet laboratory, Andrew Newberg <b>takes photographs of what believers call the presence of God</b>” (Cook, 2001)</p>

**Neuro-policy (III)** Racine, Waldman, Rosenberg, & Illes (2010)

Code	Type	Example
IIIA	Neuroimaging informs policies and social practices	<p data-bbox="1115 320 2114 507">“Neuroscientists, mainly in the US, have started using a technique known as functional magnetic resonance imaging to study the responses of teenagers to particular situations. (.) These research findings have <b>profound implications for policy-makers, teachers, parents and, most of all, for teenagers</b>” (Johnstone, 2004).</p> <p data-bbox="1115 515 2114 778">“Zak says fMRI <b>stands to make a big impact in what has been dubbed “neuro- marketing”</b>. As an example of how fMRI might be used, Zak proposes a company that wants to increase its sales of milk. One way it might is to gather a group of people who like milk and scan them as they drink a glass. Some of the regions of the brain that buzz with activity might be triggered by any drink, but others may be triggered only by milk” (Sample &amp; Adam, 2003).</p> <p data-bbox="1115 786 2114 1129">“After monitoring brain activity with functional magnetic resonance imaging, Just and colleagues concluded that people can’t effectively drive a vehicle and talk on a cell phone, or with a passenger, at the same time. The brain, it seems, has its limits. <b>The findings interested many, including Bob and Jeff, radio hosts in Sydney, Australia; legislators and police nationwide; great numbers of science writers; the Discovery Channel, which aired a 15-min special; CBS News anchor Dan Rather, whose report worked its way into Just’s presentations; and the legislator who authored New York’s new “hands free” cell phone law</b>” (Mendenhall, 2002).</p>

		<p>“<b>The breakthroughs are so rich in insights for parents and so pregnant with possibilities for health care and public policy</b> that the nation has become absorbed with the scientific intricacies of what happens inside a baby’s head. News magazines spew articles replete with heart-melting images of babies and mind-boggling diagrams of their brains. TV specials draw us into the arcane world of synapse formation. Parents contemplate reading Shakespeare to their infants” (Cummins, 1997).</p>
<p>IIIB</p>	<p>Neuroimaging informs lifestyle, everyday activities and provides a new wisdom in the conduct of one’s life</p>	<p>“Serious scientific research efforts have been going on in this area for many years now, and recent successes may <b>have enormous implications for the lifestyle of the future</b>” (Mcnaught, 1996).</p> <p>“<b>Get a good night’s sleep. Evidence suggests that sleep deprivation can impair memory.</b> Studies also point to sleep as an important way for the brain to consolidate what it has learned during the day. Exercise. Physical activity helps the brain as well as the body by improving circulation, lowering blood pressure and increasing blood oxygen levels” (Squires, 1999).</p> <p>“Overall, a woman’s brain, like her body, is 10 percent to 15 percent smaller than a man’s, yet the regions dedicated to higher cognitive functions such as language are more densely packed with neurons. (.) <b>recognizing some of these differences can make a difference in our daily lives</b>” (Hales, 1998).</p> <p>“The findings <b>do not mean that people can’t perform more than one task, but suggest that they ought to master each individually</b>” (Stein, 1997).</p>

## **Appendix B: Coding tool**

## Tool for analysis

<b>Article ID:</b>	Enter the article ID.
<b>Newspaper:</b>	Enter the name of the newspaper.
<b>Title of article:</b>	Enter the title of the article.
<b>Date of article:</b>	Enter the newspaper section

What is the main message of this article?	Enter main message.
What is the news value?	Pick one. If other, please specify.
Are spokespersons present in the article?	If yes, please indicate who is speaking. <input type="checkbox"/> No
What is the context of neuroscience?	<input type="checkbox"/> Medical Enter area, e.g. dementia. <input type="checkbox"/> Non-medical Enter area, e.g. memory.
What techniques are mentioned?	Enter techniques, e.g. fMRI.
Are these techniques explained?	<input type="checkbox"/> Yes Please specify. <input type="checkbox"/> No Other, please specify.
Are diseases or conditions mentioned?	<input type="checkbox"/> Yes Please specify what conditions. <input type="checkbox"/> No
Is there mention of preventative measures?	<input type="checkbox"/> Yes Please specify. <input type="checkbox"/> No
Is advice given? (Any advice that is not advice for prevention)	<input type="checkbox"/> Yes Please specify. <input type="checkbox"/> No
Are advantages of this field of neuroscience mentioned?	<input type="checkbox"/> Yes Please specify number of advantages and quotes. <input type="checkbox"/> No

Are issues concerning this field of neuroscience mentioned?	<input type="checkbox"/> Yes <input type="checkbox"/> No	Please specify number of advantages and quotes.	
<hr/>			
Are there instances of neuro-policy?	<input type="checkbox"/> No <input type="checkbox"/> IA <input type="checkbox"/> IB <input type="checkbox"/> IC	Enter number of times. Enter number of times. Enter number of times.	Enter quotations. Enter quotations. Enter quotations.
<hr/>			
Are there instances of neuro-realism?	<input type="checkbox"/> No <input type="checkbox"/> IIA <input type="checkbox"/> IIB <input type="checkbox"/> IIC	Enter number of times. Enter number of times. Enter number of times.	Enter quotations. Enter quotations. Enter quotations.
<hr/>			
Are there instances of neuro-essentialism?	<input type="checkbox"/> No <input type="checkbox"/> IIIA <input type="checkbox"/> IIIB	Enter number of times. Enter number of times.	Enter quotations. Enter quotations.

## **Appendix C: Survey questions**

## Enquête hersenonderzoek

Bedankt voor uw deelname aan deze enquête. Het invullen duurt ongeveer 5 minuten. Alle gegevens worden anoniem verwerkt. De resultaten worden gebruikt om de producten en diensten van de Hersenstichting te verbeteren. Voor vragen of opmerkingen kunt u een e-mail sturen naar [eoosterbeek@hersenstichting.nl](mailto:eoosterbeek@hersenstichting.nl)

Er zijn 16 vragen in deze enquête

## Persoonsgegevens

**[ ]Wat is uw geslacht? \***

Kies één van de volgende mogelijkheden:

- Vrouw  
 Man

**[ ]Wat is uw leeftijd? \***

In dit veld mogen alleen cijfers ingevoerd worden.

Vul uw antwoord hier in:

**[ ]Bent u op dit moment donateur van de Hersenstichting? \***

Selecteer alle mogelijkheden:

- Ja  
 Nee  
 In het verleden geweest  
 Ik heb weleens eenmalig gedoneerd  
 Ik heb weleens gegeven aan de collecte  
 Zeg ik liever niet  
 Anders, namelijk:

## Informatiebehoefte

### **[ ] Welke krant(en) leest u regelmatig? \***

Selecteer alle mogelijkheden:

- Geen
- Algemeen Dagblad
- Trouw
- NRC Handelsblad
- NRC Next
- De Volkskrant
- Het Parool
- De Telegraaf
- Regionale krant
- Reformatorisch Dagblad
- Anders, namelijk:

### **[ ] Als u in de krant een artikel over hersenonderzoek tegenkomt, leest u deze dan? \***

Kies één van de volgende mogelijkheden:

- Ja
- Nee
- Soms

### **[ ] Waarom leest u deze artikelen niet?**

**Beantwoord deze vraag alleen als aan de volgende voorwaarden is voldaan:**

Antwoord was 'Nee' bij vraag '5 [Artikel]' (Als u in de krant een artikel over hersenonderzoek tegenkomt, leest u deze dan?)

Vul uw antwoord hier in:

### **[ ] Wanneer leest u deze artikelen wel?**

**Beantwoord deze vraag alleen als aan de volgende voorwaarden is voldaan:**

Antwoord was 'Soms' bij vraag '5 [Artikel]' (Als u in de krant een artikel over hersenonderzoek tegenkomt, leest u deze dan?)

Vul uw antwoord hier in:

**[ ] In welke informatie bent u geïnteresseerd? \***

Selecteer alle mogelijkheden:

- Hoe het hersenonderzoek in elkaar zit
- Het ziektebeeld van een aandoening of ziekte (symptomen, diagnose, etc.)
- Het verhaal van hersenonderzoekers
- Het verhaal van patiënten
- Uitkomsten van hersenonderzoek naar ziektes en aandoeningen
- Uitkomsten van hersenonderzoek naar de werking van hersenen
- Anders, namelijk:

**[ ] In uw ogen, wie weten veel over hersenen en hersenaandoeningen?**

Uw antwoorden moeten verschillend zijn.

Geef een nummer voor elke optie volgens uw voorkeur van 1 tot 6

- Artsen
- Hersenonderzoekers
- Patiënten
- De naasten van patiënten
- Zorgprofessionals zoals verpleegkundigen
- De Hersenstichting

**[ ] Heeft u in het afgelopen jaar actief informatie opgezocht over hersenonderzoek, bijvoorbeeld op het Internet?**

\*

Kies één van de volgende mogelijkheden:

- Ja
- Nee

**[ ] Waarom zocht u deze informatie? \***

Selecteer alle mogelijkheden:

- Interesse
- Omdat het relevant is voor mij of iemand in mijn omgeving
- Om op de hoogte te blijven van het werk van de Hersenstichting
- Anders, namelijk:

## Percepties

### [ ] Geef aan in hoeverre u het eens bent met onderstaande stellingen.

Kies het toepasselijke antwoord voor elk onderdeel:

	helemaal mee oneens	mee oneens	neutraal	mee eens	helemaal mee eens	geen antwoord
Uitkomsten van onderzoek naar hersenen en hersenaandoeningen hebben veel impact op het dagelijks leven.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Onderzoek naar hersenen en hersenaandoeningen is van belang voor overheidsbeleid en medisch beleid.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Het genezen van hersenziektes en -aandoeningen is de belangrijkste taak van hersenonderzoekers.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Er is voldoende aandacht voor het voorkomen van hersenaandoeningen in de media	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Hersenscans zijn waardevolle bewijzen voor hoe het brein werkt.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ik sta achter de uitspraak "wij zijn ons brein" (de hersenen bepalen wie wij zijn en wat wij doen).	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

### [ ] Welke methoden voor het uitvoeren van hersenonderzoek kent u?

Vul uw antwoord hier in:

**[]Geef aan in hoeverre u onderstaande methoden betrouwbaar vindt. \***

Kies het toepasselijke antwoord voor elk onderdeel:

	Absoluut onbetrouwbaar	Een beetje onbetrouwbaar	Neutraal	Een beetje betrouwbaar	Absoluut betrouwbaar	Geen antwoord
Hoe betrouwbaar vindt u uitkomsten van onderzoek op proefdieren?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Hoe betrouwbaar vindt u uitkomsten van hersenscans?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Hoe betrouwbaar vindt u uitkomsten van metingen van hersengolven (EEG)?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**[]Wat vindt u de belangrijkste taak van hersenonderzoek?**

Uw antwoorden moeten verschillend zijn.

Geef een nummer voor elke optie volgens uw voorkeur van 1 tot 9

- Het voorkomen van hersenaandoeningen
- Genezen van ziektes en aandoeningen
- Diagnose verbeteren
- Ontdekken hoe het brein werkt
- Nieuwe technologie ontwikkelen
- De zorg aan patiënten verbeteren
- Hersenonderzoek op de kaart zetten in de politiek
- Communiceren in de media over hersenonderzoek
- Erkenning en acceptatie van hersenaandoeningen verbeteren

**[]Is er een andere taak van hersenonderzoek die u belangrijk vindt?**

Vul uw antwoord hier in:

Hartelijk dank voor het invullen van deze enquête. Voor vragen of opmerkingen kunt u een e-mail sturen naar [eoosterbeek@hersenchting.nl](mailto:eoosterbeek@hersenchting.nl)

Verstuur uw enquête

Bedankt voor uw deelname aan deze enquête.

**Appendix D: List of included articles**

<b>Title</b>	<b>Newspaper</b>	<b>Date</b>
Recent onderzoek werpt nieuw licht op linkshandigheid	AD	28-1-2012
Sportende kinderen halen hogere cijfers op school	AD	4-1-2012
Fascinatie voor de grijze massa	Reformatorisch Dagblad	6-1-2012
Hersenactiviteit wordt vertaald naar verstaanbare woorden	De Volkskrant	2-2-2012
Brein veroudert sneller door fijnstof	NRC Handelsblad	15-2-2012
Ingespoten virus kleurt apenhersenen groen	NRC next	13-2-2012
Merk toch hoe sterk	De Volkskrant	6-3-2012
Proeven met je hoofd	Het Financieele Dagblad	17-3-2012
Het is een en al ziel wat de klok slaat	NRC next	30-3-2012
Babystress door bezuinigingen creches	De Volkskrant	19-4-2012
Batterijgestuurde kunstenaar: onderzoek naar DBS bij epilepsie	Reformatorisch Dagblad	7-4-2012
Brein verandert bij taalstudie	Nederlands Dagblad	14-4-2012
Das will das weib Leven Beschouwing Porno voor vrouwen: porna	De Volkskrant	23-5-2012
Psychopaat wordt soms directeur	Het Parool	5-5-2012
Kuur fragiele Xsyndroom op de lange baan	De Volkskrant	12-5-2012
'Angstcentrum brein doet aan meer dan bangmakerij';	De Volkskrant	12-6-2012
Breinbodem in zicht: Drama met Amerikaanse vriezer klap voor internationale hersenonderzoek	Telegraaf	16-6-2012
Zoek de psychopaat	NRC next	19-6-2012
Het invoelende brein	Nederlands Dagblad	21-7-2012
Kinderen met adhd: geen hersenziekte	Het Parool	14-7-2012
Neurofilie	NRC next	17-7-2012
Blowen maakt dommer	AD	29-8-2012
Het slapende brein geeft voorrang aan de belangrijke herinneringen	De Volkskrant	31-8-2012
Veel slapen houdt de dokter weg	NRC Handelsblad	18-8-2012
Oude hersenen communiceren anders	Reformatorisch Dagblad	8-9-2012
Legergames tegen oorlogsstress	Telegraaf	28-9-2012
Uruzgan verstoort concentratie	De Volkskrant	4-9-2012
Trippen voor de wetenschap	De Volkskrant	6-10-2012

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De orgaanchip als loep op het leven	De Volkskrant	27-10-2012
Verboden stofjes blijken wonderpillen	Het Parool	13-10-2012
Bij hersensprookjes vooral je gezonde verstand gebruiken	Trouw	27-11-2012
Moe tv recensie	De Volkskrant	22-11-2018
Autistische muizen worden socialer als neurologinesynthese stopt	NRC Handelsblad	24-11-2012
Muziek maakt slimmer; nextcheckt	NRC next	11-12-2012
Een angstaanjagend shirt als wapen	NRC next	11-12-2012
Oudere is echt wijzer dan jongere en ook emotioneel stabiel	Trouw	21-12-2012
Groot brein eist offers van organen	De Volkskrant	10-1-2013
Debat over ernst alzheimer stukt	Nederlands Dagblad	8-1-2013
Waarom stotter je niet als je zingt?	De Volkskrant	15-1-2013
Jong muziekles? Goed voor de hersenen	Reformatisch Dagblad	16-2-2013
Implantaten maken het weer rustig in je hoofd	Ad	5-2-2013
Rat kan met sensor ook in het donker zien	NRC next	18-2-2013
Met schrik zie je: dat ben ik!	NRC Handelsblad	16-3-2013
Elektrode op drift in het brein	De Volkskrant	25-3-2013
Het optimisme van hersenwetenschapper verbaast me	Trouw	19-3-2013
Door-eet-effect bij consumptie van chips bestaat echt	Boerderij vandaag	16-4-2013
Vroeg seksueel contact heeft nadelige gevolgen	Reformatisch Dagblad	23-4-2013
Zo blijf je keurig en beleefd	Het Parool	27-4-2013
Celgroei doet prille jeugd snel vergeten	De Volkskrant	24-5-2013
Slappend naar de eindexamens	Nederlands Dagblad	11-5-2013
Zonder ritalin je eindexamen halen	De Volkskrant	18-5-2013
Liefde en wetenschap	Nederlands Dagblad	1-6-2013
Gezond hart, gezond hoofd	NRC Handelsblad	29-6-2013
Twijfel over nut scan bij dementie	De Volkskrant	12-6-2013
Hersens kun je al jong verpesten	Het Parool	16-7-2013
Sluiting	De Volkskrant	20-7-2013
Psychopaat heeft iets aardigs	De Volkskrant	27-7-2013
Ik ben mijn eigen proefpersoon	De Volkskrant	10-8-2013

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Geen richtingsgevoel? Kom, zelfs de cellen in je hersenen hebben het!	NRC next	12-8-2013
EEG-scan in je hoor: snel en handig	De Volkskrant	24-8-2013
Hiernamaals is echter dan echt	Trouw	7-9-2013
Racespel helpt het oude brein	NRC Handelsblad	5-9-2013
Een venster op het levende brein	De Volkskrant	4-9-2013
Detectives in het brein	Trouw	26-10-2013
Kinderleed zet je niet meer uit je hoofd	NRC Handelsblad	26-10-2013
De hersenscanner is niet eenduidig	De Volkskrant	26-10-2013
Monsterklauwtje	De Volkskrant	23-11-2013
Oorlog in het hoofd	De Volkskrant	23-11-2013
Tweetaligheid stelt dementie gemiddeld vierenhalf jaar uit	De Volkskrant	7-11-2013
Dyslecticus bereikt juiste hersendeel niet	Trouw	6-12-2013
Bij dyslectici mist er een bruggetje in de hersenen	NRC next	9-12-2013
Het klopt écht! Alleen een vrouw kan 2 dingen tegelijk	AD	5-12-2013
Depressie door een te actief afweersysteem	NRC next	20-1-2014
Herinnering kan veranderen	De Volkskrant	6-1-2014
Valkuilen in het brein	De Volkskrant	25-1-2014
De hond luistert als een mens	De Volkskrant	25-2-2014
Hersenen weten al voor de slag dat de bal uit zal gaan	NRC next	24-2-2014
Doemscenario lijkt te donker	De Volkskrant	8-2-2014
We weten niet waarom swipen zo makkelijk is	De Volkskrant	19-3-2014
Vergeten en onthouden is een delicaat eiwitwenspel	Trouw	17-2-2014
Niemand ontkomt aan de zwermgeest	Trouw	1-3-2014
Gevederde chimpansees	NRC Handelsblad	26-4-2014
De mens wordt gereduceerd tot geavanceerde computer	Reformatorisch Dagblad	16-4-2014
Eeuwig leven felbegeerd ideaal	Reformatorisch Dagblad	16-4-2014
Zonder beweging ziet de wereld zwart	Trouw	31-5-2014
Een dode zalm heeft ook gevoel	NRC next	17-5-2014
Doodlopende weg	NRC Handelsblad	24-5-2014
Frans heeft een probleem, Frans kan niks weggoeien	Trouw	14-6-2014

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Niet de rede, de emoties winnen	NRC Handelsblad	13-6-2014
Verlamde staat op en geeft de bal een trap	Trouw	12-6-2014
Een fortuinlijke psychopaat	De Volkskrant	26-6-2014
Nog nooit een geest ontmoet zonder brein	Trouw	19-7-2014
Jij wordt een zuiplap, dat kunnen wij nu al zien	NRC next	5-7-2014
We weten niets over verliefdheid Hoewel, bijna niets Drie feiten over verliefd zijn;	NRC Handelsblad	30-8-2014
Zappen met je hersenen	Metro	5-8-2014
Het maken van een ding dat denkt onthult nog niets van het mysterie van denken	NRC Handelsblad	2-8-2014
Vliegjes hebben net zo'n dorst als wij	NRC next	30-9-2014
Gedachten lezen met magnetisch veld	NRC next	15-9-2014
Kinderen 'pijn' doen voor de wetenschap; wel of geen morfine	NRC next	1-9-2014
Geldkraan open voor breinproject	De Volkskrant	28-10-2014
Interne gps-cellen zeggen waar je bent	Trouw	7-10-2014
Slimmer worden met een spel? Vergeet het maar; vloeiende intelligentie	NRC Handelsblad	4-10-2014
Honden luisteren net als mensen	De Volkskrant	27-11-2014
Je ziet er niks van	De Volkskrant	22-11-2014
Helder brein	De Volkskrant	1-11-2014
Wonderen bestaan	De Volkskrant	20-12-2014
Kans op herstel na beroerte groter	De Volkskrant	18-12-2014
Hersenscade door alcohol: wel of niet	Reformatorisch Dagblad	3-12-2014
Virus	De Volkskrant	22-1-2015
Rechtstreekse mail tussen hersenen	Nederlands Dagblad	10-1-2015
Overactieve hersenkern roept angstgevoelens op	NRC Handelsblad	24-1-2015
Oostenrijkers laten hand afhakken voor prothese	AD	26-2-2015
Empathie: herinneringen verbonden aan emoties	Het Parool	21-2-2015
Techniek zet geneeskunde op zijn kop	Financieele Dagblad	14-2-2015
Sleutelen aan de mens	Reformatorisch Dagblad	20-3-2015
Een lijf vol klokken	Trouw	19-3-2015
Miljardenproject menselijk brein gaat op de schop	De Volkskrant	9-3-2015
Koolhydraten in de ban om hersentumor te bestrijden	De Volkskrant	25-4-2015

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Pijnpunt: de vis	De Volkskrant	25-4-2015
Empathie ontwikkelt toch langer bij meisjes	Het Parool	4-4-2015
Eiwitophoping bij vijftigers toont sterk verhoogd risico op dementie	De Volkskrant	20-5-2015
Autisme zit in de darmen	De Volkskrant	2-5-2015
Uittreding is foutje van het brein	Trouw	3-5-2015
Groene longen voor fitte hersenen	Reformatorisch Dagblad	20-6-2015
De genen van een krijger maar toch niet agressief	Trouw	27-6-2015
Dieetpil stapje dichterbij	De Volkskrant	3-6-2015
Auto leest wegdek en gedachten de toekomst volgens jaguar land rover	AD	31-7-2015
Met een korrel zout	De Volkskrant	4-7-2015
Ons brein leert ons niets over kunst	Trouw	24-7-2015
Alle mensapen zijn een beetje bi; seks en de mens	NRC Handelsblad	29-8-2015
Altijd psychisch en fysiek	De Volkskrant	22-8-2015
De vijf obsessies van ons brein	NRC Handelsblad	15-8-2015
Hersenen hebben 28 dagen nodig om aan een nieuw patroon te wennen	NRC next	22-9-2015
Waarom zou dit nu net onoplosbaar zijn?	De Volkskrant	19-9-2015
Straks een elektrische pet in de winkel tegen wagenziekte	Trouw	5-9-2015
Koorddansen om dementie te voorspellen	Ad	29-10-2015
Over ouderdomsziekten en depressie	Nederlands Dagblad	31-10-2015
Kloon kloon me	NRC Handelsblad	3-10-2015
Oren spelen rol bij schatten afstand	Nederlands Dagblad	7-11-2015
Zo hebben we vanuit de christelijke theologie reden genoeg om sceptisch te staan tegenover een reductionistisch mensbeeld en tegelijk de Kopbal voor vrouw linker dan voor man	Reformatorisch Dagblad De Volkskrant	7-11-2015 10-11-2015
Hersenonderzoek al bij foetus	AD	28-12-2015
Wie goed kijkt, kan slecht horen	De Volkskrant	9-12-2015
Mannenbrein en vrouwenbrein bestaat niet	NRC Handelsblad	5-12-2015
Een beetje schoppen en slaan enzo, dat kan wel bij een vriend	NRC Handelsblad	30-1-2016
Hersenscan werpt licht op impulsiviteit jongeren	De Volkskrant	29-1-2016
Het brein van de terrorist	De Volkskrant	23-1-2016
Zonder hoop heb je niets	Trouw	13-2-2016

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Vreemde gevoelens	De Volkskrant	6-2-2016
Steeds zekerder dat zika hersengroei verstoort	NRC next	12-2-2016
Bange fruitvlieg neemt wetenschappers aan de hand op weg naar medicijnen	Trouw	1-3-2016
Onderzoekers krijgen geheugen alzheimermuis weer aan de praat	De Volkskrant	17-3-2016
De zin en onzin van geheugentraining	Nederlands Dagblad	12-3-2016
Geen betere opvang dan bij moeder thuis	Reformatorisch Dagblad	27-4-2016
Zikavirus stopt de groei van hersenen in kweek	NRC Handelsblad	12-4-2016
Verlamde Ian (24) kan z'n hand weer bewegen	Reformatorisch Dagblad	14-4-2016
Soldaat van de slaap; en nu allemaal naar bed	NRC next	31-5-2016
Die doktoren doen belangrijk werk	AD	25-5-2016
De wetenschap tript weer	Trouw	21-5-2016
Software zet schetsjes om in prima foto's	NRC handelsblad	27-6-2016
Dit kunnen pubers beter	Nederlands Dagblad	4-6-2016
Dementie kan ontstaan door lek in bloedvaten	NRC Handelsblad	2-6-2016
Buitenaards	Telegraaf	30-7-2016
Kleuren zien, stemmen horen	NRC next	30-7-2016
De dementiegolf die niet gaat komen	Trouw	2-6-2016
Hond begrijpt woord voor woord wat het baasje te zeggen heeft	De Volkskrant	31-8-2016
Slijmerig kwabje	NRC next	30-8-2016
Singularity University Durf te dromen, de feiten staan het toe	Het Financieele Dagblad	27-8-2016
Is wat we doen dan zinloos?	NRC handelsblad	24-9-2016
Helpt jong bloed tegen de ziekte van alzheimer	De Volkskrant	13-9-2016
Hond begrijpt het verschil in intonatie	NRC Handelsblad	2-9-2016
Wie ben ik is filosofische vraag	Nederlands Dagblad	17-10-2016
Jong geleerd is oud onthouden	Trouw	15-10-2016
Onderzoeker van het brein	Nederlands Dagblad	8-10-2016
Van brein naar robohand en terug	NRC handelsblad	19-11-2016
Brein-computer laat verlamde vrouw 'praten'	De Volkskrant	15-11-2016
Preventief alzheimermedicijn op komst	NRC Handelsblad	3-11-2016
Zwangerschap verandert moederhersen	NRC Handelsblad	20-12-2016

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Kerkbezoek vergelijkbaar met seks en drugs?	Nederlands Dagblad	17-12-2016
Lichtflitsjes houden alzheimer eronder	Trouw	8-12-2016

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