Bachelor Thesis Natural Science and Innovation management

Dutch media framing personalized medicine

A thesis about frames used by the Dutch media and their influence on public opinion

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Executive summary

In this thesis the Dutch media coverage on personalized medicine (PM) is analyzed in order to distinguish frames used by the media that can influence the public opinion on this potentially beneficial innovative medical therapy. Frames are a way to structure an event in which it emphasizes a certain aspect of it. When scientific events, linked to PM, are framed as negatively influencing the health of individuals, the public opinion can as a result be negative about PM. This can influence the diffusion and implementation activity within the innovation process that PM is currently engaged in. This information can be in the interest of risk managers in business and policy makers in the public sphere when being engaged in PM. The frames are identified by conducting a content analysis on the Dutch news articles, using LexisNexis Academic databank for the collection of the media sources. Following was a qualitative analysis by NVivo which resulted in coding of the articles based on the 4 elements of a frame according to Entman (1993). Frames are derived from a pattern of elements across several newspapers identified by the Wards method, a hierarchical cluster analysis by SPSS. This resulted in one frame with an explicit judgement of value: "*PM: a benefit to (future) research*" and one less explicit frame: "*PM: it's challenges and (potential) benefits*". One the latter frame was elaborated with a second analysis from which two additional frames could be distinguished: "*PM: ethics meets economics*" and "*PM: practical genetics*".

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1. Introduction

The innovation process can be defined as '*the development and implementation of new ideas by people who over time engage in transactions with others in an institutional context*' (Van de Ven, 1986, p. 590). The process has three core activities: invention, diffusion and implementation. Those activities entail a social, dynamic and knowledge-intensive character, and are influenced by many stakeholders (social groups and actors) and their judgements, subjective beliefs, interpretations and knowledge (Newell et al., 2009). Furthermore, political interests, power and influence play a vital role in this process as for instance they can favor and discourage the diffusion of an innovation by policy measures (Newell et al., 2009). The diffusion and implementation of an innovation can be influenced by mass media and interpersonal communication channels (Rogers, 2003; Newell et al., 2009). The diffusion holds the gradually spread of an innovation within a (social) group (Rogers, 2003). Implementation requires the integration of relevant knowledge (advantages, mode of use and the incorporated norms and values) about an innovation through social processes and networks in order to create a favoring environment for implementation of innovations (Newell et al., 2009). Policy making can be influenced as well by the media as this actor can direct the amount and prominence of events in a story. The public discourse concerning social and health problems can be shaped by this action of the media (Conrad, 2001; Petersen, 2001). This can result in an indirect influence on the public opinion which shapes the public agenda and as a result effects policy creation (Kamenova & Caufield, 2015; Conrad, 2001; Petersen, 2001). All in all, mass media can play a role in the successfulness of diffusion, implementation of an innovation as it can shape the public opinion and therefore can direct political creation of policies.

An innovative medical therapy that needs to overcome some challenges to become successfully implemented in the Dutch care system, is personalized medicine (referred to as PM in this thesis) (RIVM, 2016). PM is the optimal choice of therapy based on the genomic characteristics of a patient instead of the traditional one-dose-fits-all approach which can evolve for a patient in an exhaustive trial-and-error trajectory (Cho, Jeon & Kim, 2012; RIVM, 2016). The expectation is that the

effectiveness of treatment will increase as a result (Bates, 2010; Cho, Jeon & Kim, 2012; Lee et al., 2012; RIVM, 2016). The long term goal is a reduction of health care costs due to an increase in the effectiveness of health care resources (RIVM , 2016). PM is a new and rapidly developing therapy path as it is becoming increasingly evident that genomic characteristics are of big importance in the development of a disease and the response of an individual to drugs (RIVM, 2016). However some challenges have been identified as well like the lack of funding (for initiatives) for PM research and development, clinical validity issues, ethical issues and the need for an IT data infrastructure securing patient records as genetic information (RIVM, 2016). In order to maximize the advantages and overcome challenges of PM, control and change strategies are more likely to achieve this goal in early stages of development. Executing changes in an early stage is relatively more easy in comparison to applying changes in a later stage when the innovation is already a part of the economic and social system and will be time consuming, difficult and expensive (Collingridge, 1980; Liebert & Schmidt, 2010).

PM is categorized within the medical sciences as pharm genomics and genetics (Mini & Nobili, 2009). Media is an important source for public understanding of genetics and plays a major role in the public discourse with regard to related events and issues (Conrad, 2001; Petersen, 2001). Furthermore media is the primary source of information of the general public regarding health science (Guenther et al., 2015; Coveney, Nerlich & Martin, 2009). The media can direct the public to which subjects in the news they should pay attention (Marks et al., 2007). The higher the amount of and emphasis on (aspects of) subjects within the media coverage, the more important the public will judge it to be and vice versa (Marks et al., 2007; de Jong et al., 2016*)*. This way of structuring the news in a story is called *framing* (Conrad; 2001; Petersen, 2001; Guenther et al., 2015; Kamenova & Caufield, 2015). Previous studies have shown that the media tends to report more exhaustively on challenges and to write sensational stories (Moynihan et al., 2000). When challenges are reported in the media, those are perceived by the general public as risks (Moynihan et al., 2000; Marks et al., 2007; Bubela & Caulfield, 2004). As a result, media can influence the general public to judge PM as risky which can restrain the early stage development (Brossard et al., 2009). But if there is a discrepancy between the actual and the

portrayed potential benefits of a scientific than the public expectations rise which can lead to a misallocation of (financial) investments. This can harm the reputation of the technology in question and/or science and technology (Nerlich & Halliday, 2007).

This thesis strived to identify frames used by the Dutch media regarding PM and their influence on the public opinion of PM. The generated knowledge can be used by stakeholder considering executing change and control strategies. It can be particularly useful for stakeholders and scientists to counteract miscommunication about events/issues related to PM (de Jong et al., 2016). Furthermore understanding the public is receiving risks through the media is important to risk managers and communicators to get a grip on public concerns when making policies (Chang, 2009). In the Netherlands newspapers have the largest reach of all media sources (NPD Nieuwsmedia, 2017). Additionally newspapers are a particularly important source for retrieving knowledge about scientific and technological developments, especially in the early stages of the development (de Jong et al., 2016) like PM. On that account newspapers are chosen for this thesis as the unit of analysis. The research question that rose from this information is:

Which media frames are applied in the portrayal of personalized medicine in Dutch newspapers and what is the potential influence of these on the public opinion?

In the next section the theoretical framework construes the concept of frames as constructed by Entman (1993) and the relationship between frames and the public opinion. The methodology section describes the content analysis and the hierarchical cluster analysis that have been used in order to identify the applied fames in the portrayal of PM in the Dutch newspapers. It also argues the safeguarding of external and internal reliability, and as well the validity of this thesis. Thirdly the results are stated which concerns the identified frames and the potential influence those can have on the public opinion of PM. Further the discussion embed the results in the literature on media framing and genetics in general, gives advice to the stakeholders and proposes a research design a follow up study. Lastly the conclusion highlights the main findings, answers the research question and will make a statement about the prospects of (the development of) PM.

2. Theory

Entman (1993) defines framing as: "*To frame is to select some aspects of a perceived reality and make them more salient in a communicating context* (p. 52)." Salience is the practice of making a bit of the information more distinguishable, important, or memorable to the receivers (Entman, 1993). If the salience increases, the likelihood rises that the audience will pay attention to that part of information, derive meaning from, and process the information and store this in their memory (Entman, 1993). This increase can occur due to repetition or prominence of parts of information in the media, or by relating them to culture familiar symbols (Entman, 1993). Exposure to media framing can affect the schemas individuals use to interpret and organize information. These schemas consist of cognitive portrayal of an object or links between objects which individuals use to comprehend the world by familiarity and recognition through repetition of e.g. frames (Guenther et al., 2015). An example of a scheme created by the media is that when media reports about genomics and genetics, framing is used as a communication tool and to simplify communication. As a result the 'gene' has been framed into a very strong social (familiar) symbol aside from a scientific concept (Väliverronen, 2004).

In addition, media coverage on science is of influence on the attitude towards specific technologies but also on science at large (Brossard et al., 2009). Furthermore several scholars have stated that journalists create and implement meaning through frames in the public opinion. Frames that dominate the media discourse seem to dominate the audience (Entman, 1993; Scheufele, 1999; D'Angelo, 2002). A frame can be divided in several elements: "*a problem definition, a causal interpretation, a moral evaluation, and a treatment recommendation* (Entman, 1993, p.52)." One sentence may include more than one of these four framing elements. Though many sentences in a text will may perform none of them (Entman, 1993).

Problem definition is the main topic in the text and contains an assessment of risks and benefits (Donk et al., 2012; Matthes & Kohring, 2008). It includes the variables topic and actor. The topic is the central item which is being written about (David et al., 2011). An actor is one or more individuals or group who(m) is cited the most or is having the upper hand in presenting the message of the text (David et al., 2011).

Causal interpretation defines the forces that are causing the event (Entman, 1993). It is the entity that can be designated as attributing to the benefits or risks regarding a specific outcome (Matthes & Kohring, 2008; Donk et al., 2012). As well Matthes & Kohring (2008) as David et al. (2011) highlight that the forces causing benefits or risks can be the same as the actor variable mentioned in the concept problem definition. Other entities as programs and policies, can be assigned too and those can serve as variables as well (David et al., 2011).

Moral evaluation holds the moral judgement of benefits and risks, and can be positive, negative or neutral (Matthes & Kohring, 2008; Donk et al., 2012). The variables of this element are the most frequent mentioned benefit or risk evaluations as they promote a (direct) moral evaluation (Matthes & Kohring, 2008; David et al., 2011).

Treatment recommendations states the remedies offered and treatments suggested to counteract, prevent and reduce the problems and risks, and predict their likely effects (Entman, 1993). In particular it can consist of a call for regulation in favor or against the current state of the topic (Matthes & Kohring, 2008; Donk et al., 2012). The prospects of the topic can be mentioned as well, solely with a moral judgement. If both positive and negative recommendations (counteracting or stimulating current trends) are presented in the news, the more prominent is chosen by the coder (David et al., 2011).

3. Methodology

3.1. Research design

To identify the applied frames in the portrayal of PM in Dutch newspapers, a content analysis and a hierarchical cluster analysis was performed, inspired on the methodology of Matthes & Kohring (2008) as they identified media frames within articles of The New York Times on biotechnology. This method has been recognized for its reliability and validity in comparison to other analytical approaches for the analysis of frames (Donk et al., 2011; David et al., 2011). By following this approach frames are neither pinned down beforehand or determined by coding with solely one variable (Matthes & Kohring, 2008). The study has an explorative origin and proposes the research question: *Which media frames are applied in the portrayal of personalized medicine in Dutch newspapers and what is the potential influence of these on the public opinion?* Because PM is still in development, the number of proponents and engaged stakeholders concerned with and publicly debate on it, usually increases. This calls for a longitudinal study of media coverage (Donk et al., 2011).

3.2. Data collection & analysis

The LexisNexis Academic database was used to collect Dutch articles that reported on PM. This database holds a big range of media sources as well as countries. As PM is a relatively new technology, a time range was not used during the collecting of the data. LexisNexis dates back to 1980 so the time range was 1980 until the 1st of June 2017 (finalization of data collection). The key words that were used as input for LexisNexis and the output they generated in number of (useful) newspapers are shown in table 1. The key words were each looked for throughout the whole article and rose through multiple rounds of rereading and collecting data through LexisNexis inductively.

Table 1: Keywords used for the data collection through LexisNexis Academic databank

Key word(s)	Combined with	Number of (useful) newspapers
Personalized medicine	X	26
Tailored medicine	X	9
Tailored care	Genes	6
Tailored therapy	Genes	4
Tailored diagnostics	X	2
Personified medicine	X	2
Personalised medicine	X	2

When the first search run was performed through LexisNexis 471 newspapers were presented. The following step was to solely collect data (articles) from the five biggest national newspapers in the Netherlands (de Volkskrant, Trouw, NRC Handelsblad, De Telegraaf, and AD) and the five biggest regional newspapers (Dagblad De Limburger, De Gelderlander, Noordhollands Dagblad, Dagblad van het Noorden and Brabants Dagblad) and by doing so geographical diversity was integrated as well (de Jong et al. (2016). This resulted in a sample size of 58 articles from which the duplicates and irrelevant articles were excluded. An article was considered as irrelevant when applying the elements of a frame based on Entman(1993) did not seem accurate towards understanding PM. For example in a couple of articles it was stated that charity money was going to research institutes focusing, amongst other subjects, on PM. It was part of an enumeration without elaboration on PM itself. In the end 51articles were perceived as useful for the analysis.

The next step consisted of coding the articles based on the theory. The coding was done through NVivo, a qualitative data analysis tool. By multiple rounds of reading and coding the articles, the concept variables were inductively operationalized into variables which is shown in table 2. The formulated variables ought to grasp the whole debate around PM. Variables have to be: "*mutually, exclusive, exhaustive, and independent*" (Matthes & Kohring, 2008, p.266). This step resulted in concrete input (variables) for the hierarchical cluster analysis.

Table 2: Operationalization of Concept Variables in Variables

Framing Elements	**Concept variables**	**Variables**	**Description**
Problem Definition	Topic	Research	Research on PM
		Economics	Economic opportunities of PM
		Ethics	Ethical issues of PM
		Genetic Identity	Genetic testing, screening and DNA-profile
	Actor	Science	Research institutes, universities and hospitals
		Business	Pharmaceutical industry
Causal interpretation	Benefits attribution	Benefit attribution of Science	Science actors are responsible for benefit
	Risks attribution	Risk attribution of Science	Science actors are responsible for risk
		Risk attribution of Business	Business actors are responsible for risk
Moral evaluation	Judgements of benefits	Health benefits	PM is a benefit for health
		Economic benefits	PM is a benefit for economics
		Research benefits	PM is a benefit for research
	Judgements of risks	Economic risks	PM is a risk for economics
		Ethical risks	PM is a risk for ethics
Treatment recommendations	Call for regulation	Risk regulation	Call for regulation limiting risks of PM

		Benefit regulation	Call for regulation favoring PM
	Support prospects	Positive prospects	Positive expectations towards PM
	Indecisive prospects	Neutral prospects	Challenges and benefits of PM are observed

The hierarchical cluster analysis is an analysis method by which the variables hierarchically merged, dependent on the amount of related occurrence of those in articles. A cluster is the merger of several variables due to their relatedness therefore little variance in comparison with other objects. At the same time the variance with other clusters has to be relatively large (Rokach & Maimon, 2005). The cluster progress is visualized in a dendrogram which is a tree diagram (Rokach & Maimon, 2005). The clusters that rose are firstly summarized in a one-liner grasping the debate and based on this interpreted as media frames.

Based on Matthes & Kohring (2008) Ward's method (SPSS) was chosen as the quantitative software tool to execute the hierarchical cluster analysis through. In SPSS every variable was computed as a binary value (0= absent and 1= present) and codes that hardly occurred in the articles were not included in the cluster analysis (an occurrence of less than 5%) (Matthes & Kohring, 2008; Donk et al., 2011). The optimum solution for the amount of clusters was determined by using the elbow-criteria method (Matthes & Kohring, 2008). From the agglomeration schedule was derived between which steps (stages) of merger, the coefficients differ the most. This presents how many clusters are relevant to the cluster analysis. The total mean value and standard deviation of the frames were compared to the mean values and standard deviations of each variable which determined the most important variables to the frames. Those have the most similar mean value in comparison to the total mean value of the frame (Matthes & Kohring, 2008).

A second cluster analysis was performed excluding the most prominent variables (and thereby excluding one of the frames) that occurred during the coding and subsequently merged into a relatively very strong cluster according to Ward's method. This analysis is treated as an expansion on the less strong variables in the first analysis and therefore it functions as support and a tool to elaborate more

extensively on those and strengthen their relevance (in the future) in comparison with the strong cluster. Although the generated knowledge may not be of significance in the current media discourse, it could be in the future and as PM is still developing it can be convenient to have an indication of how other actors are evaluating PM. If the (additional) clusters are characterized by an actor describing PM on the basis of risks than this could be a signal for future significant tendencies that could influence the public opinion negatively.

3.3. Research quality

Internal reliability is the consistency which enables the data collection to be take place worthy (Bryman, 2012). Matthes & Kohring (2008) explain that the reliability will be safeguarded most accurately when the conduction of the study is done with the aim to categorize variables to specific clusters with high differences between the clusters and low differences within them. Furthermore this study addresses the reliability by creating variables which are exhaustive, independent and exclusive. The clustering of the variables occurs hierarchically and systematically and because every cluster consists of multiple variables, frames could not be determined solely by one variable and are free from bias which avoids false identification of patterns. It should be mentioned that verifying the reliability of media frame analysis is difficult as the coding is done by a human researcher. To counteract this limitation multiple studies executing the same methodology have been reviewed and the coding framework is inspired on one of those. Additionally Matthes & Kohring (2008) mention that the more a specific variable is prominent, the higher its reliability (as part of a frame) is so when certain variables rise frequently from the analysis of the articles then the reliability as part of a frame increases.

The external reliability is the ability of the research design of the thesis to be executed again and that the results and the findings are the same (Bryman, 2012). The steps that need to be taken to collect data are described, the analysis tools are mentioned and the references list holds all the scientific resources that have been used which rectifies the external validity.

The internal validity holds the integrity of the conclusions (Bryman, 2012). Because this study contains subjective analysis tools the integrity cannot be entirely safeguarded although this method is more valid than the reviewed methods by

Matthes & Kohring (2008). " *First, operationally defining the elements that constitute a frame should lead to a deeper understanding of what is really measured* (Matthes & Kohring, 2008, p.275)". Moreover the frames are created through inductive steps and not determined beforehand (Matthes & Kohring, 2008).

The external validity characterizes the aim of the research to gain some generalizable knowledge to transfer to other components in the industry or to others. The found frames that are in place within the media items are not generalizable but they can serve as an example. Furthermore in combination with the influence of public opinion, they can give an indication for future prospects of other medical innovative therapies derived from genetic information when the frame is of a certain origin as economical, ethical, health or research.

4. Results

This section shows the output of Ward's method, elaborates on the how this statistical information can be interpreted and what it presents regarding the identification of frames. Two analysis were performed which each resulted in an optimum choice of two clusters based on the corresponding agglomeration schedules (table 3 and 5 in the appendix). The first analysis resulted in clusters which provided appropriate knowledge addressing the research question. The frames derived from the clusters are: "*PM: its challenges and (potential) benefits*" and "*PM: a benefit to (future) research*". The clusters that rose from the second analysis hold an indication of the frames that can become more significant in the future and are sub clusters of the first mentioned frame. Those are: "*PM: ethics meets economics*" and "*PM: practical genetics*". Primarily the results of the first analysis will be discussed and consecutively those of the second analysis will be elaborated on.

The two cluster solution of the first analysis is based on the knowledge that the difference between coefficients is the largest when progressing from stage 17 to stage 18. At stage 17 three clusters are left and at stage 18 the two remaining clusters merge together. The dendrogram (figure 1) visualizes this process.

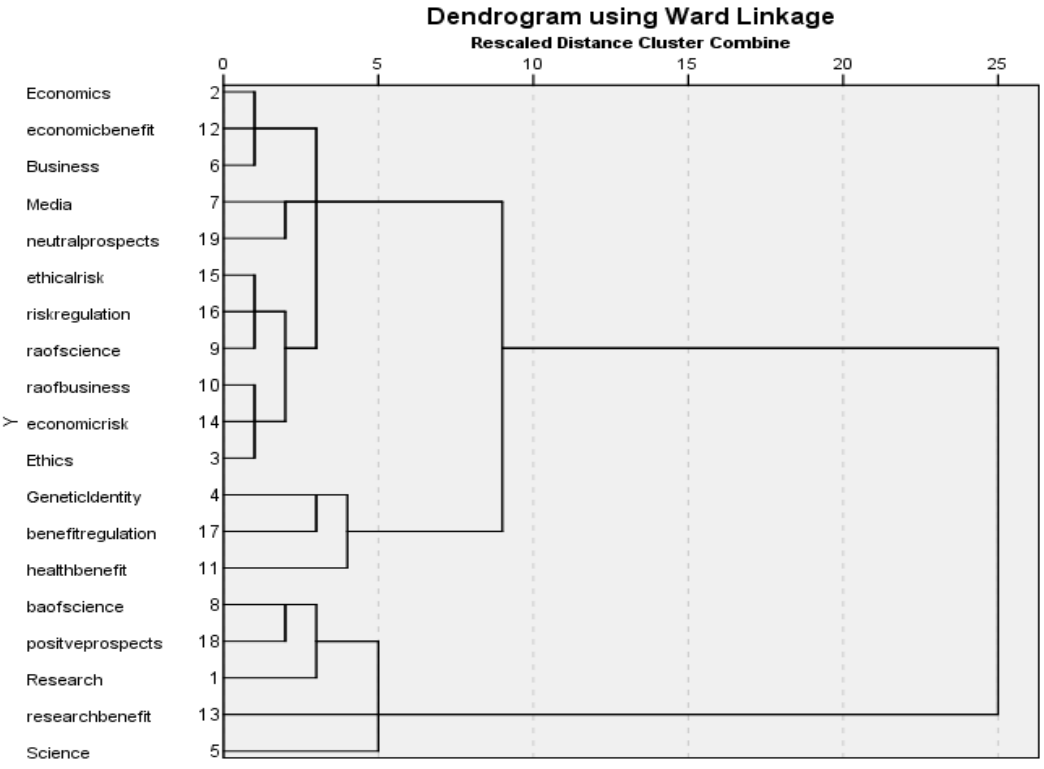

Figure 1: Dendrogram visualizing of the 1st the hierarchically cluster process

This graph shows that the upper-level cluster (Economics-healthbenefit) involves more variables and sub clusters then the lower-level (baofscience-Science) cluster. Resulting from these observations a more broad one-liner (Non-science actors on non-research topics) was determined for this cluster and as a result the more expansive frame "*PM: its challenges and (potential) benefits*". For the lower-cluster it results in a cluster with one variable for each element: actor: science, topic: research, causal attribution: benefit attribution of science, moral evaluation: research benefit, and treatment recommendation: positive prospects. This cluster could be summarized in a more precise one-liner (Science actors on positive research future) and interpreted in the specific frame "*PM: a benefit to (future) research*". The transformation of the clusters to the frames can be observed in figure 2.

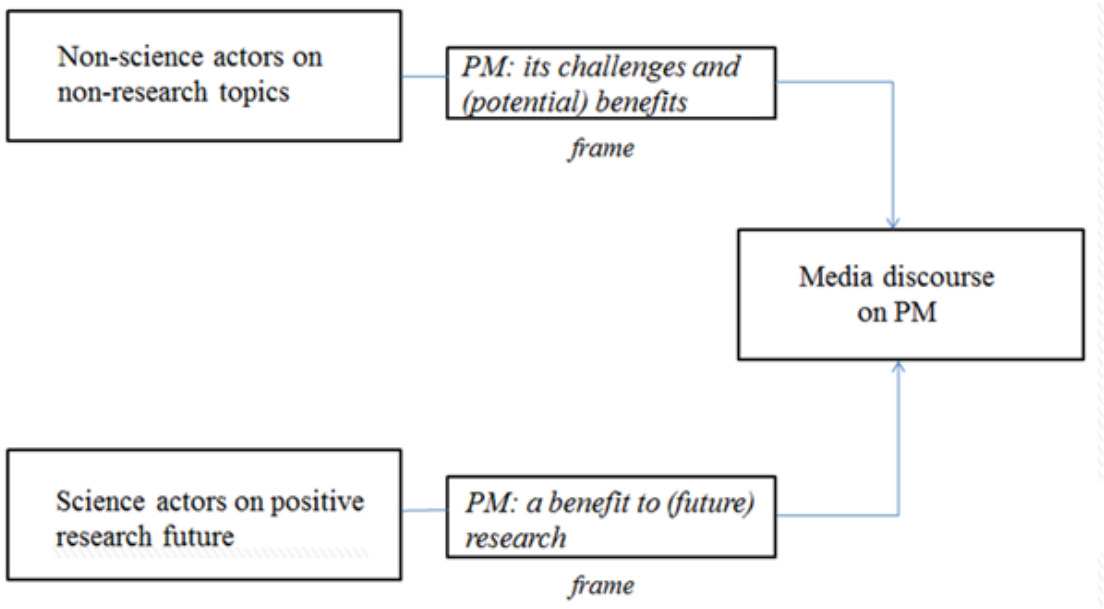

Figure 2: One-liners and frames following from upper- and lower-level cluster

In addition to the fact that the frame "*PM: a benefit to (future) research*" consisted of one variable coding for an element, those variables occurred the most frequent from all variables related to an element except for research benefits. Health benefits were more prominently discussed than research benefits. However this frame is the most important one for the current media course on PM. The frame judges PM as a positive innovative medical technology for research purposes. Furthermore PM described as a very innovative therapy path which is bringing individuals and society at large (future) benefits. PM is in particular presented as a technology that enables a lot of research to take place which will lead to better medicines and therapies in the

future. The actor science, who is prominently leading the discourse in the articles, are researchers linked to a university and specialized in microbiology, genetics, medicine, pharmacology, pathology and epidemiology. Actors active in the area of science (universities, research centers and hospitals) are responsible for these positive benefits as they are the one conducting the research, giving incentives for research on PM and acknowledging the opportunities of PM. There is a lot of emphasis on the (potential) research benefits and risks are mostly not mentioned. The risks that are mentioned seem to be from an ethical point of view. For example a scientist who has made an optimistic statement about the future of PM by promising high health benefits to cancer patients in NRC Handelsblad (2015), has got some criticism on his comment. The statement of the scientist was the following:

> *"New, precisely on the tumor of the patience tailored therapies could shrink the tumors and control them on the long term. "In 20 years cancer is a chronic disease", states cancer researcher René Bernards working at the Antoni van Leeuwenhoek one and a half year ago in the television program DeWereldDraaitDoor."*

The response of scientists are captured by the following citation which was derived from the same newspaper:

> *"He gives patients false hope."*

Overall, articles that execute this frame put high emphasis on the progression that has been made so far and highlight the breakthroughs and the expansion of the research area of PM. It is framed as a positive innovation for research with positive prospects for the future development of PM. An example of these elements follow from an article selected from the Telegraaf (2016):

> *"High blood pressure has more colors than was ever thought possible. Dozens of genetic differences have been identified."*

The importance of the variables for the frames can be derived from table 4 which is included in the appendix. For the frame "*PM: a benefit to (future) research*" the relatively order of importance of each variable to the frame is: Science, Benefit attribution of Science, Research, Positive Prospects and lastly Research benefit. For the frame "*PM: its challenges and (potential) benefits*" the values of some variables are rather dissimilar to the total mean value although they have a high cluster label. They can be more subordinate to the main cluster as they are part of a cluster which is influenced by the high related occurrence of other variables within another cluster (Matthes & Kohring, 2008). For this frame the following variables are the most important element: Genetic Identity, Business, Risk attribution of Science, Economic Benefit and Benefit Regulation. In articles that apply the frame "*PM: its challenges and (potential) benefits*", PM is evaluated by different actors and in relation to different topics which resulted in the first place a relatively neutral framing of PM.

The second analysis performed the Ward's method excluding the variables Science, Research, Benefit attribution of Science, Research Benefit and Positive Prospects. The agglomeration schedule (table 5 in the appendix) shows that as well for this analysis two clusters are the optimum solution. The corresponding dendrogram (figure 3) visualizes the hierarchically cluster process of variables.

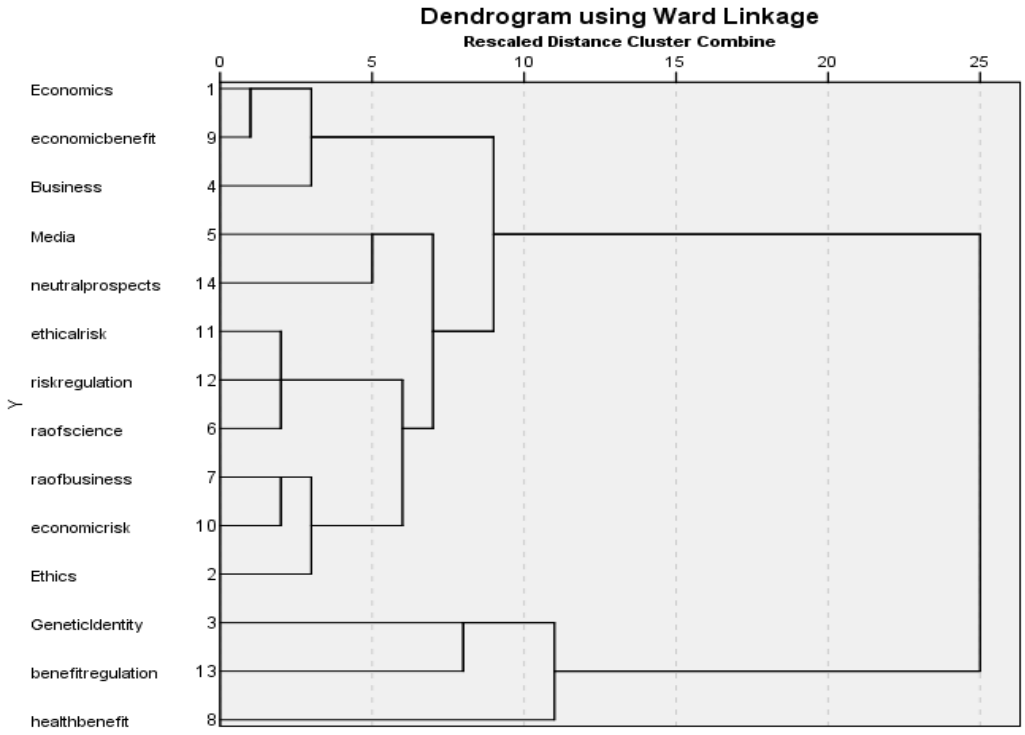

Figure 3: Dendrogram visualizing of the 2nd the hierarchically clustering process

Within the upper-level cluster (Economics-Ethics) the sub clusters are relatively more important to the main clusters than the sub-clusters to the main clusters in the first analysis. The distance between the two main clusters is less too which holds that the clusters are more equivalently strong. The upper-level cluster includes several variables for each element while the lower-level cluster (Genetic Identity-healthbenefit) consists one variable for the elements topic, treatment recommendation and moral evaluation. Overall the two clusters consist of a division between merely economics and ethics, and genetic applications. The upper-level cluster captures a weighting of the judgements by Media and Business whom focused on economical and ethical considerations. This has evolved in the one-liner 'Considerations regarding economics and ethics' and eventually in the frame "*PM: ethics meets economics*". The lower-level cluster is more concentrated on the topic of genetic identity and the practical applications of PM which led to the one-liner 'Genetic applications and health benefit' and was seized in the frame "*PM: practical genetics*". Figure 4 contemplates this in relation to the media discourse on PM.

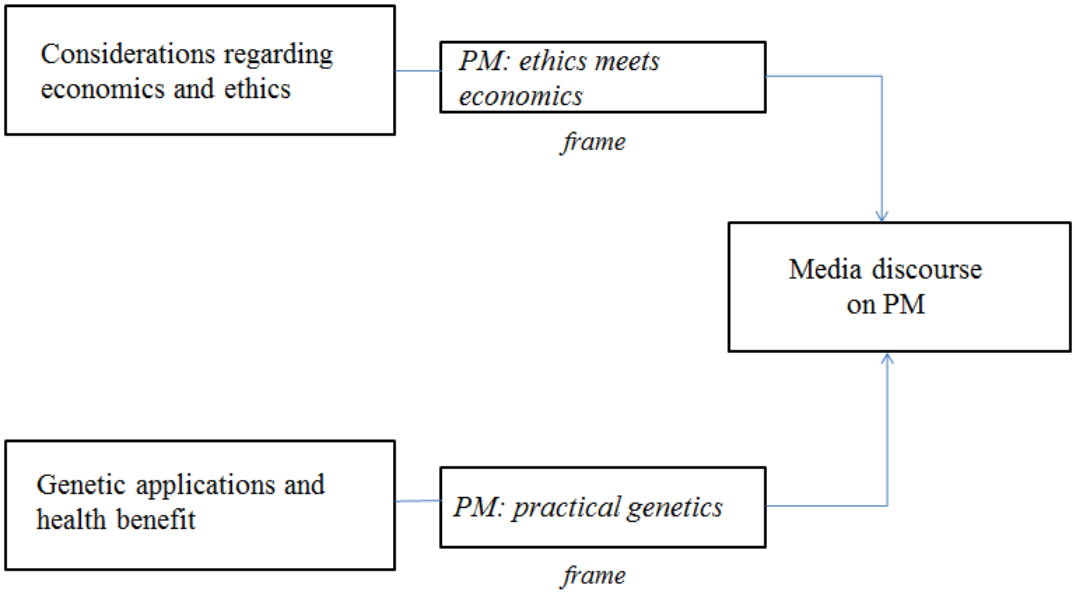

Figure 4: One-liners and frames following from upper- and lower-level cluster

The frames are rather different regarding the perspective they have on the PM discourse. The frame "*PM: ethics meets economics*" focusses on the topics economics and ethics in which emphasis is awarded to different aspects of the PM-evaluation

debate. The evaluation of PM stays rather controversial within this frame because based on table 6 (appendix) economic benefit is of more importance within the frame than ethical and economic risk while the future expectations appear to be neutral about PM or a call for risk regulation is proposed. Overall the frame elaborates on the relation between ethics and economics. The main message is that PM can create economic opportunities for business but that as a result the care that is provided by PM can lead to unequal access to it based on the price.

If economics is the central topic in the articles then business actors have the upper hand in elaborating on the features regarding this issue and which results in recalling the economic opportunities of PM for business. Business actors contain stakeholders (managers and directors) in big-pharma which are particularly interested in new innovative medical technologies, referring to biotechnology as the last similarly interesting development for investment, and to which extent PM is an (economically/financially interesting) opportunity to big-pharma. A financial-director of the biotechnology company OncoMethylome Sciences made a statement about their future with PM:

> *"At first we primarily have focused on the detection of cancer but now we want to expand to personalized medicine. This has a longer payback period but it is has a big potential."* (NRC Handelsblad, 2008)

Within this frame the other actor is media which elaborates mostly on the topic ethics and highlights the (economic and ethical) risks of PM. While doing so, media appoints science and business as the main causes of these risks. Based on these, the actor deems mostly measures for risk diminishment (no concrete regulations are proposed though) or expresses an attitude of doubt whether PM should be labelled as an promising innovative medical technology. As for ethical risk, pharmaceuticals develop expensive PM-applications which hold health benefits for relatively small patient groups, reimbursement of these through health care can be hard which leave ethical issues as the unequal accessibility of PM.

> *"An important trend in medicine is tailored medicine, which are nonetheless*

*per definition for small patient groups relevant and are mostly above average expensive. Our health care and insurance system cannot support the consequences of this scientific progress."(*NRC Handelsblad, 2015).

Media also points out the economic risks involved with the development of PM for business. For instance, PM-products as diagnostic tests are not self-evidently interesting as new market opportunities for profit purposes. They do not always seem to execute the appropriate business model in order to engage in PM which indicates an economic risk for pharmaceuticals when they consider PM as a source for new value creation.

"The invention does not fit the business model. Pharmaceuticals are used to sell pills, a diagnostic test is something totally different." (de Volkskrant, 2015)

The other frame focusses on the topic genetic identity, the health benefits as a result and to which extent regulations should be put in place to maximize these benefits. Mostly the benefits of analyzing the genetic information of a patient before a disease has revealed itself, is mentioned. PM is treated as a technology that promises health benefits because health implications caused by the disease can be avoided or reduced by taking precautionary measures. The frame also includes regulations regarding techniques that enable scientists to screen the human genome in order to reduce the unnecessarily medical harm which patience experience in the current health care system.

"A DNA-analysis can easily show which genes and therefore which enzymes deviate, say pharmacogenetics scientists like Van Schaik. So why don't we just test everybody preventively?" (de Volkskrant, 2016)

Throughout this analysis 4 frames in 2 analysis have been identified but regarding the current media discourse addressing PM, only two of them are relevant for describing the potential influence of them on the current public opinion: "*PM: a*

benefit for (future) research" and "*PM: its challenges and (potential) benefits*". The first frame can direct the public opinion to judge PM positively. A lot of emphasis is attributed to the positive impact of PM which can result in a positive perception of PM by the public as the frames that dominate the media, dominate the audience too. The second frame could temper this judgement of PM as it could be raising awareness towards possible risks while stating benefits. The expectation is that based on the theory that the audience derive their opinions from media framing, the public opinion on PM as a result of this frame will probably not influenced significantly. The awareness is maybe raised towards certain aspects of PM (ethical and economical judgements) which could temper the direction of the public opinion. As the economic benefit is the most important moral evaluation of this frame, it could direct the public to judge PM positively beside from raising awareness. Derived from this analysis, the frames currently applied in the portrayal of PM in Dutch newspapers are directing the public opinion to judge PM as positive.

5. Discussion and conclusions

In this thesis the frames applied in the portrayal of PM in Dutch newspapers were identified through a content and a hierarchical cluster analysis. The results show that the framing is merely positive and that the frames both focus on benefits. The identified frames used in the current media discourse are: "*PM: a benefit to (future) research"* and *"PM: its challenges and (potential) benefits*". Two more frame were identified, elaborating on the second frame, consisting of an indication of which frames could become more significant in the future media discourse on PM : "*PM: ethics meets economics*" and "*PM: practical genetics*". The most prominent benefit, research benefit, is caused by scientists and researchers working in hospitals, universities and research centers executing research and development. Business seems to be interested in PM as well but there are no clear signs of their contribution to the development of it. They do adopt PM products into their business but at the same time is there also the believe that the current business model within the industry is not capable of creating profit from PM. When media actors themselves are having the upper hand in the Dutch newspapers then they are mostly elaborating on the (potential) risks associated with PM.

As PM is still in an early stage of development, changes to this innovation are more easily made then in a later stage of development, in order to improve the diffusion and/or implementation of PM. From this analysis advice for counteracting frames that could lead to a negative public opinion about PM, is based on the frame "*PM: ethics meets economics*" which can rise in the future and harm the realization of PM. Economic risks as the misfit of current business models of (big) pharma with PM is acknowledged by scholars as well. Block buster business model is aligned with a small portfolio of a couple of drugs that generate a milliard dollar of annual sales each, to a business model with a large portfolio with lower annual sales. The pharmaceuticals must be made aware that these business models as well can be very profitable and even improve their profitability in the long run (Aspinall & Hamermesh, 2007; Lesko, 2007). This could be a task for policy makers by creating policy which for instance stimulate pharmaceuticals to invest in PM by providing information on PM (research or entrepreneurship) initiatives. Ethical considerations of PM are addressed by scholars as well, mostly aligned with social and legal issues. An

example is the equity and access risk envisioned by them: not all PM technologies will be reimbursed by insurance companies which will make some technologies only available to the affluent (Mardis, 2010; Joly et al. 2014). A new debate on the price of life and increased quality of life should be at the origin of the development of new PM technologies. Ethical issues that need to be addressed for every PM technology are for instance whether the PM technology is a last chance therapy to those who have no other option, to which extend it will prolong a meaningful (human) life or what the health impact of reduced drugs risk adverse effects will be.

For an emerging technology in an early development stage it is quite common that scientists are the actors leading the media discourse on emerging technologies, emphasizing the research/scientific benefits and that there is little criticism (Donk et al., 2012). This is described by the issue-attention cycle which states that in the first stage of this cycle (in which PM is currently located) the scientific benefits are the most prominent accentuated by science actors and there is little criticism. In a later development stage the expectation is that other actors will become (more) engaged as politics and they will emphasize different aspects of PM (Lee, Scheufele & Lewenstein, 2005). For the media coverage of Dutch newspapers on nanotechnology a similarly development was distinguished (Te Kulve, 2006).

However the current positive framing will continue this could lead to the media course on PM being determined as genohyping: “the exaggerated portrayal of benefits or risks associated with genetic research and the application of genetic technologies.”(Bubela & Caufield, 2004). The hype might cause expectations and hopes first to rise and evolve in high unmet expectations. If none or little of these promised benefits will become reality or it takes a long time (Brown, 2003; Master & Resnik, 2013), then the public loses interest and trust in the research environment and the innovation field (Brown, 2003; Caufield, 2004; Master & Resnik, 2013; Arentshorst et al., 2014). In 2010 the expectations of benefits and potential use of genetic testing as a result from the Human Genome Project had increased in comparison with 2002 in the Netherlands. Though in 2010 the promising benefits of PM had not proved themselves yet (Henneman et al., 2013). PM has not been able to realize practically breakthrough application on a wide scale due to the challenges (RIVM, 2016). So if this becomes a tendency, it will threat the public trust, especially

because the public loses their trust more quickly in genomics more quickly (Master & Resnik, 2013). Furthermore especially when media stories accentuate unrealistic, near future benefits than these will result in unmet expectations (Caufield, 2004). The scientist that according to his colleagues was too optimistic when stating that cancer will be a chronical disease in twenty years, illustrates the probability of PM being hyped. Without the trust and support of the public genomic research and therefore PM will not be realized (Brown, 2003). By reporting benefits and near-future breakthrough they try to collect public and political attention, and funding for their research (Caufield, 2004; Arentshorst et al., 2014).

Scientists and reporters could perform an actor-strategy in which clear communication in a realistic manner about their research and the consequences of the breakthrough to the public is pursued in order to avoid a backslash (Swierstra & Rip, 2007). The importance of this such communication is illustrated by a planning guide, created by the OECD for governments, in which the acceptance by the public of this technology is acknowledged as critical in the development of nanotechnology. One of the recommended measurement is to communicate through media channels (as newspapers) honest information, address aspects of risks and provide balanced (positive and negative) information (OECD, 2012).

A more complete representation of media framing and its influence on the diffusion activity (the second activity within the innovation process) can be accomplished by conducting a similar frame analysis including important media sources for communicating information as television, radio and the internet (Lee & Scheufele, 2006). In addition a study on the relationship between the identified media frames, opinion creation and the influence on the innovation-decision process based on the *Diffusion of Innovations* theory of Rogers (2003), would be accurate. This theory describes the attributes (complexity, compatibility, trialbility, observability and relative advantage) of which an individual makes an assessment before choosing whether to adopt an innovation or not and how this evolves in the diffusion of an innovation. The distinguished frames should be linked to the five attributes while a literature study analyzes the evaluation of the attributes regarding PM for a patient. This choice is relevant for innovation and risk managers but as well for policy managers who wish to communicate information or counteract miscommunication to

a target group to dis- or encourage a consuming behavior. In line with this innovation management theory, the innovation process can be better explained as the diffusion activity is one of the three core activities within this process.

This thesis has strived to identify the frames used in the Dutch newspapers in the portrayal of PM and the influence of these on the public perception of PM. Currently the media discourse is dominated by the "*PM: a benefit to (future) research*" frame and at a far distance the frame "*PM: its challenges and (potential) benefits*" occurs in the media. So far the public perception could be evaluated as positive. As PM is developing as an innovative medical technology journalists, scientists, policy makers and managers should be aware of the importance of media framing of PM on the public opinion. This could help PM in its mission to alleviate the burden of disease to individuals and the costs of the health care system for society at large.

6. Appendix

Table 3: Agglomeration Schedule of first analysis

Agglomeration Schedule

Stage	Cluster Combined Cluster 1	Cluster 2	Coefficients	Stage Cluster First Appears Cluster 1	Cluster 2	Next Stage
1	2	12	,000	0	0	6
2	15	16	,023	0	0	4
3	10	14	,045	0	0	5
4	9	15	,076	0	2	8
5	3	10	,121	0	3	8
6	2	6	,174	1	0	13
7	7	19	,254	0	0	10
8	3	9	,360	5	4	10
9	8	18	,473	0	0	12
10	3	7	,596	8	7	13
11	4	17	,732	0	0	14
12	1	8	,884	0	9	15
13	2	3	1,040	6	10	17
14	4	11	1,244	11	0	17
15	1	13	1,479	12	0	16
16	1	5	1,734	15	0	18
17	2	4	2,207	13	14	18
18	1	2	3,657	16	17	0

Table 4: Mean Values (M), Standard Deviations (SD), cluster number and the cluster label (number of references) of the Two Identified Frames of the first analysis

N= 51	**(M)**	**(SD)**
Cluster 1: Science on positive research future	**3,2353**	**1,54387**
Topic: Research (28)	4.1786	0.90487
Actor: Science (39)	3.5218	1.43034
Causal attribution: Benefit attribution of Science (40)	3.9697	1.01504
Moral Judgement: Research benefit (13)	4.6154	0.50637
Treatment recommendation: Positive Prospects (27)	4.3333	0.73380
Cluster 2: Non-science on non-research topics	**1,7843**	**1,56606**
Topic: Economics (4)	4.0000	0.81650
Topic: Ethics (9)	3.7778	0.97183
Topic: Genetic Identity (10)	1.8000	1.03280
Actor: Business (5)	2.6000	1.67332
Actor: Media (7)	2.7143	1.70434
Causal attribution: Risk attribution of Science (6)	4.0000	0.89443

Causal attribution: Risk attribution of Business (5)	4.2000	0.44721
Moral Judgement: Health benefit (25)	1.14167	0.8805
Moral judgement: Economical benefit (3)	2.3333	2.08167
Moral judgement: Economical risk (4)	4.5000	0.57735
Moral judgement: Ethical risk (7)	3.8571	0.69007
Treatment recommendation: Risk regulation (4)	4.2500	0.5000
Treatment recommendation: Benefit regulation (13)	2.7692	1.16575
Treatment recommendation: Neutral prospects (7)	2.8571	1.46385

Table 5: Agglomeration Schedule of the second analysis

Agglomeration Schedule 2

	Cluster Combined			Stage Cluster First Appears		
Stage	Cluster 1	Cluster 2	Coefficients	Cluster 1	Cluster 2	Next Stage
1	1	9	,000	0	0	6
2	11	12	,036	0	0	4
3	7	10	,071	0	0	5
4	6	11	,119	0	2	8
5	2	7	,190	0	3	8
6	1	4	,274	1	0	11
7	5	14	,399	0	0	9
8	2	6	,565	5	4	9
9	2	5	,757	8	7	11
10	3	13	,972	0	0	12
11	1	2	1,218	6	9	13
12	3	8	1,539	10	0	13
13	1	3	2,283	11	12	0

Table 6: Mean Values (M), Standard Deviations (SD), cluster number and the cluster label (number of references) of the Two Identified Frames of the second analysis

N=51	**(M)**	**(SD)**
Cluster3: Considerations regarding economics and ethics	**1.1961**	**1.57505**
Topic: Economics (4)	3.2500	1.25831
Topic: Ethics (9)	3.4444	1.23603
Actor: Business (5)	2.2000	1.30384
Actor: Media (7)	2.4286	1.90238
Causal attribution: Risk attribution of Science (6)	3.6667	1.21106
Causal attribution: Risk attribution of Business (5)	3.8000	0.44721

Moral evaluation: Economic benefit (3)	2.0000	1.00000
Moral evaluation: Economic risk (4)	4.2500	0.50000
Moral evaluation: Ethical risk (7)	3.4286	0.97590
Treatment recommendation: Risk regulation (4)	4.2500	0.50000
Treatment recommendation: Neutral prospects (7)	2.8571	1.46385
Cluster4: Genetic applications and health benefit	**0.9216**	**0.93473**
Topic: Genetic Identity (10)	2.2000	0.63246
Moral evaluation: Health benefit (25)	1.6667	0.70196
Treatment recommendation: Benefit regulation (13)	1.9231	0.75955

7. References

Arentshorst, M. E., Broerse, J. E., Roelofsen, A., & de Cock Buning, T. (2014). Towards responsible neuroimaging applications in health care: Guiding visions of scientists and technology developers. In *Responsible Innovation 1* (pp. 255-280). Springer Netherlands.

Aspinall, M. G., & Hamermesh, R. G. (2007). Realizing the promise of personalized medicine. Harvard business review, 85(10), 108.

Bates, S. (2010). Progress towards personalized medicine. *Drug discovery today*, *15*(3), 115-120.

Brossard, D., Scheufele, D. A., Kim, E., & Lewenstein, B. V. (2009). Religiosity as a perceptual filter: Examining processes of opinion formation about nanotechnology. *Public Understanding of Science*, *18*(5), 546-558.

Brown, N. (2003). Hope against hype-accountability in biopasts, presents and futures. *Science & Technology Studies*.

Bryman, A. (2012). Social research methods. Oxford University Press.

Bubela, T. M., & Caulfield, T. A. (2004). Do the print media "hype" genetic research? A comparison of newspaper stories and peer-reviewed research papers. *Canadian Medical Association Journal*, *170*(9), 1399-1407.

Caulfield, T. (2004). Biotechnology and the popular press: hype and the selling of science. Trends in biotechnology, 22(7), 337-339.

Chang, S. H. (2009). The influence of media frames on the public's perception of biofuels.

Cho, S. H., Jeon, J., & Kim, S. I. (2012). Personalized medicine in breast cancer: a

systematic review. *Journal of breast cancer*, *15*(3), 265-272.

Collingridge D (1980) The social control of technology. St Martin, New York

Conrad, P. (2001). Genetic optimism: Framing genes and mental illness in the news. *Culture, medicine and psychiatry*, *25*(2), 225-247.

Coveney, C. M., Nerlich, B., & Martin, P. (2009). Modafinil in the media: Metaphors, medicalisation and the body. *Social Science & Medicine*, *68*(3), 487-495.

D'angelo, P. (2002). News framing as a multiparadigmatic research program: A response to Entman. *Journal of communication*, *52*(4), 870-888.

David, C. C., Atun, J. M., Fille, E., & Monterola, C. (2011). Finding frames: Comparing two methods of frame analysis. *Communication Methods and Measures*, *5*(4), 329-351.

Donk, A., Metag, J., Kohring, M., & Marcinkowski, F. (2012). Framing emerging technologies: Risk perceptions of nanotechnology in the German press. *Science Communication*, *34*(1), 5-29.

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

Guenther, L., Froehlich, K., Milde, J., Heidecke, G., & Ruhrmann, G. (2015). Effects of valenced media frames of cancer diagnoses and therapies: Quantifying the transformation and establishing of evaluative schemas. *Health communication*, *30*(11), 1055-1064.

Henneman, L., Vermeulen, E., Van El, C. G., Claassen, L., Timmermans, D. R., & Cornel, M. C. (2013). Public attitudes towards genetic testing revisited: comparing

opinions between 2002 and 2010. *European Journal of Human Genetics*, *21*(8), 793-799.

Ho, S. S., Brossard, D., & Scheufele, D. A. (2008). Effects of value predispositions, mass media use, and knowledge on public attitudes toward embryonic stem cell research. *International Journal of Public Opinion Research*, *20*(2), 171-192.

Ho, S. S., Scheufele, D. A., & Corley, E. A. (2013). Factors influencing public risk–benefit considerations of nanotechnology: Assessing the effects of mass media, interpersonal communication, and elaborative processing. *Public Understanding of Science*, *22*(5), 606-623.

Joly, Y., Saulnier, K. M., Osien, G., & Knoppers, B. M. (2014). The ethical framing of personalized medicine. *Current opinion in allergy and clinical immunology*, *14*(5), 404-408.

de Jong, I. M., Kupper, F., Arentshorst, M., & Broerse, J. (2016). Responsible reporting: neuroimaging news in the age of responsible research and innovation. *Science and engineering ethics*, *22*(4), 1107-1130.

Kamenova, K., & Caulfield, T. (2015). Stem cell hype: media portrayal of therapy translation. *Science translational medicine*, *7*(278), 278ps4-278ps4.

Lee, C. J., Scheufele, D. A., & Lewenstein, B. V. (2005). Public attitudes toward emerging technologies examining the interactive effects of cognitions and affect on public attitudes toward nanotechnology. *Science communication*, *27*(2), 240-267.

Lee, C. J., & Scheufele, D. A. (2006). The influence of knowledge and deference toward scientific authority: A media effects model for public attitudes toward nanotechnology. *Journalism & Mass Communication Quarterly*, *83*(4), 819-834.

Lesko, L. J. (2007). Personalized medicine: elusive dream or imminent reality?. Clinical Pharmacology & Therapeutics, 81(6), 807-816.

Liebert, W., & Schmidt, J. C. (2010). Collingridge's dilemma and technoscience. *Poiesis & Praxis*, *7*(1-2), 55-71.

Mardis, E. R. (2010). The $1,000 genome, the $100,000 analysis?. *Genome medicine*, *2*(11), 84.

Marks, L. A., Kalaitzandonakes, N., Wilkins, L., & Zakharova, L. (2007). Mass media framing of biotechnology news. *Public Understanding of Science*, *16*(2), 183-203.

Master, Z., & Resnik, D. B. (2013). Hype and public trust in science. *Science and engineering ethics*, *19*(2), 321-335.

Matthes, J., & Kohring, M. (2008). The content analysis of media frames: Toward improving reliability and validity. *Journal of communication*, *58*(2), 258-279.

Mini, E., & Nobili, S. (2009). Pharmacogenetics: implementing personalized medicine. *Clinical cases in mineral and bone metabolism*, *6*(1), 17.

Moynihan, R., Bero, L., Ross-Degnan, D., Henry, D., Lee, K., Watkins, J., ... & Soumerai, S. B. (2000). Coverage by the news media of the benefits and risks of medications. *New England Journal of Medicine*, *342*(22), 1645-1650.

Nerlich, B., & Halliday, C. (2007). Avian flu: the creation of expectations in the interplay between science and the media. *Sociology of health & illness*, *29*(1), 46-65.

Petersen, A. (2001). Biofantasies: genetics and medicine in the print news media. *Social science & medicine*, *52*(8), 1255-1268.

Newell, S., Robertson, M., Scarbrough, H., & Swan, J. (2009). *Managing knowledge work and innovation*. Palgrave Macmillan

NPD Nieuwsmedia (2017). Onderzoek naar bereik van media, Retrieved June 22, 2017, from http://www.ndpnieuwsmedia.nl/bereik/

OECD. (2012). *Planning Guide for Public Engagement and Outreach in Nanotechnology*. Paris.

RIVM. (2016). *Application of personalized medicine: Opportunities and challenges for policy* No. 2015-0177). Bilthoven: National Institute for Public Health and the Environment.

Rogers, E. M. (2003). Diffusion of innovations, edn. *Free Pres., New York*.

Rokach, L., & Maimon, O. (2005). Clustering methods. In *Data mining and knowledge discovery handbook* (pp. 321-352). Springer US.

Scheufele, D. A. (1999). Framing as a theory of media effects. *Journal of communication*, *49*(1), 103-122.

Swierstra, T., & Rip, A. (2007). Nano-ethics as NEST-ethics: patterns of moral argumentation about new and emerging science and technology. Nanoethics, 1(1), 3-20.

Te Kulve, H. (2006). Evolving repertoires: Nanotechnology in daily newspapers in the Netherlands. Science as Culture, 15(4), 367-382.

Väliverronen, E. (2004). Stories of the "medicine cow": representations of future promises in media discourse. *Public Understanding of Science*, *13*(4), 363-377.

Van de Ven, A. H. (1986). Central problems in the management of innovation. *Management science*, *32*(5), 590-607.