



**“But it is just also fun to fiddle around with that”**

**An analysis of the identities synthetic biologists  
construct at outreach activities**

**Paulien Poelarends, BSc**

**Wageningen, August 2013**





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## **Preface**

After following with great enthusiasm the course biology in high school, I decided to start with the bachelor biology in Wageningen in 2007. A minor in communication made me realize that it would be great to combine communication and biology in my master. Therefore, I decided to continue with the master Applied Communication Science. This master gave me the opportunity to combine communication and biology during my internship and during this master thesis.

In the summer of 2012, I started proposal writing and turned to focus on synthetic biology and in closer detail on the international student competition within the field of synthetic biology: iGEM.

After several meetings with my supervisor from the Strategic Communication Group Hedwig te Molder I found a second supervisor in the field of synthetic biology Mark van Passel. The first meeting we had together was full of energy. In the meetings that followed, either with Hedwig te Molder or Mark van Passel or both supervisors together I received useful feedback and the inspiration I needed to continue my research.

This was a busy year, in which I had to keep attention on my thesis in combination with a part-time job. The enthusiasm and useful feedback of both supervisors gave me the energy to finish my master thesis. Hedwig te Molder and Mark van Passel, thank you both for guiding and inspiring me.

Wageningen, August 2013



## **Abstract**

The conversations scientists have with their (non-scientific) public are being criticised and the role of the scientists in these conversations has changed. Besides these conversations, there are also popularizing science activities at which scientists interact with the public; however, these are under-researched. In this study, students that joined the international synthetic biology student competition iGEM were followed at debates and during popularizing science festivals to find out how they present themselves and doing science in the conversations with their public. Discursive psychology is used to analyse these conversations, a method that defines conversations as the primary arena of human action, which makes it possible to find out how the iGEM members construct their identity in talk. This study reveals several new insights in the interactions between scientists and their publics. The iGEM members presented themselves as knowledgeable during the popularizing science festivals. Furthermore, the synthetic biologists constructed an informal atmosphere and presented themselves as careful. At the different activities that were analysed, the iGEM members constructed their work as something not to be afraid of. The implications of these insights for the dialogue between science and society are discussed and recommendations are formulated to inspire (future) scientists to improve the conversations with their publics.

Keywords: identity, discursive psychology, synthetic biology, popularizing science activities

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## **1. Introduction**

This thesis is about how young scientists present themselves and science in the conversations they have with different publics. There is a focus on scientists working in the research field synthetic biology. Many people are enthusiastic about this emerging field, while others raise their concerns (De Vriend, Van Est, & Walhout, 2007). For this study, student teams of the synthetic biology competition iGEM, which stands for international Genetically Engineered Machine competition, are followed during their outreach activities. For instance, iGEM teams attend debates, give presentations at other organisations and visit science festivals. During these activities, the iGEM members have dialogues with members of the general public and politicians that are interested in the work of the iGEM teams. These activities of iGEM teams are only a small selection of the different communication activities that inform and make the public aware about developments in science.

### **1.1 Informing the public**

In the Netherlands, the public is regularly informed about the results and developments of scientific research. Citizens can employ different information sources to inform themselves about science. For instance, they can read books about science written for the more general public, watch television programs about science, read magazines that report about scientific news such as the Dutch magazine "Kijk", read newspapers with special items about science and view research results on the websites of the universities. These communication channels are a small selection of the different channels that inform the public about developments in the scientific world. Most of these channels can be described as one-way communication channels, which are communication activities intended to inform the receivers instead of creating a dialogue with them. These channels are aimed at the general audience; therefore, they can be seen as ways to popularize science (e.g. Davis, 2007).

### **1.2 Public engagement activities**

Next to these one-way communication channels, which are mainly used to inform the public about the developments and results of scientific research, there are activities organized that aim to engage the public in decision making around science. In this report, these activities are referred to as public engagement activities. This type of activities are seen as a way to bring social and ethical issues in the debates around technological decision making, they give the public the possibility to reflect on the innovation process (Bouwman & te Molder, 2009) and to incorporate the needs and desires of future users into new technologies (Veen, te Molder, Gremmen, & van Woerkum, 2012). Engaging the public has become a preferred method of governments around the world and is seen as a way to increase trust and to restore the relation between science and society (Dijkstra & Gutteling, 2012).

Research organisations have different reasons to involve the public. For instance, to give the taxpayer the opportunity to talk about the research they paid for (Marris & Rose, 2010). Public engagement activities are also compulsory for research proposals seeking funding from for example the European Union.

These public engagement activities are a field of interest for several researchers. For example, scientists have analysed the dialogues between the participants of public engagement activities to find out what the obstacles are when discussing ethics (Felt, Fochler, Muller, & Strassnig, 2009) and what position scientific expertise has in the dialogue (Kerr, Cunningham-Burley, & Tutton, 2007).

### **1.3 Popularizing science in an interactive way**

Next to these public engagement activities, interactive activities are organized to make the public more aware about the developments in science. Examples of such activities are science cafes, internet blogs



and stands on music festivals, such as Lowlands, where scientists talk about their work. These activities can also be defined as ways to popularize science, as they are aimed at the general public (Davis, 2007). These interactive activities to popularize science are initiated or organised by different individuals, groups and organisations.

#### **1.4 Conversations shape the identity of science**

The identity of science as perceived by the public is constantly influenced by the above-mentioned one-way communication channels and interactive communication activities. In organisational studies it is argued that the identity of an organisation is formed during the conversations between the members of an organisation and people from outside that organisation (Scott & Lane, 2000). According to this perspective, science can be seen as an organisation or institution, where the identity of science is formed by the interactions between members of the scientific community and others. Thus, the identity of science is shaped to a great extent by the conversations between scientists and the public.

The identity of science may be of better quality if the dialogues scientists have with the public are improved. A great challenge, since there are numerous informal and formal conversations between science and society all over the world.

#### **1.5 Changing roles for scientists**

The ideas about how scientists should communicate with society are changing (Mogendorff, te Molder, Gremmen, & van Woerkum, 2012). In the past, science communication was seen as a way to improve the relation between science and society by informing the public. The scientists had the task to inform the ignorant public about their research field, as it was said that public doubts are created by the knowledge deficit of the public (Sturgis & Allum, 2004). Nowadays, scientists not only have the task to give information about a certain topic, but they also have a role of spokespersons of their scientific organisation and the scientific world as a whole (Horst, 2013). The question is: how are scientists dealing with their new role?

#### **1.6 Research focus**

The scientists' "new role" has an influence on the numerous conversations scientists have with others and on the identity of science as a whole. This study focuses on the real life conversations scientists have with others to find out how scientists are dealing with their new role and how they are presenting science; in this case, the conversations iGEM team members have during outreach activities. Relatively little research has been done on these "real life conversations" of scientists. For instance, other studies used interviews or questionnaires to find out how scientists are dealing with their role in the conversations they have with others.

The perspective of discursive psychology is used to analyse the real life conversations of iGEM members. In discursive psychology, talk is seen as a toolbox for action (te Molder, 2012). By analysing everyday talk and writing, researchers try to understand what kind of actions people perform while interacting (Potter & Wiggins, 2007). In everyday conversations, people achieve all kinds of actions such as constructing a certain identity or trying to avoid responsibility for a story or fact, they tell to others. By using discursive psychology, scientists try to find out what talk does, not what is reflected in talk (Veen, Gremmen, te Molder, & van Woerkum, 2010).

In discursive psychology naturalistic data are analysed, which means that the researcher takes no part in the conversations, to avoid that he or she influences the conversation (Potter & Wiggins, 2007). This study aims to get a better understanding of how the iGEM members present themselves and science towards their publics when talking about their synthetic biology projects at outreach activities.



## 1.7 An introduction into synthetic biology

Scientists from all over the world are trying to understand nature. This is nothing new; Darwin and Mendel are historical examples of biologists who tried to understand the mechanisms behind nature. Scientists not only try to understand the different mechanisms behind nature, such as DNA and hormone pathways, but also try to change nature. Examples of this are the development of potatoes that can grow on salty soil or bacteria that can produce insulin. During the last decades, the understanding of DNA has increased tremendously and scientists learned how to cut and paste with DNA. This cutting and pasting is also known as genetic engineering (Collins, 2012) or genetic modification. A famous result of this kind of research is the development of bacteria that produce insulin. These bacteria were created by inserting the human genes for insulin production into the DNA of bacteria, an idea patented in 1982 (Collins, 2012). Not only bacteria can be modified; it can also be applied to organisms that consist of more than one cell. For example, it is possible to use Phytophthora-resistant genes from wild potatoes to create potatoes that are both liked by Dutch people as well as resistant against the potato disease Phytophthora by inserting these genes from wild species into the DNA of Dutch potato varieties.

The next step after genetic modification is synthetic biology, a field in which scientists build their own pieces of DNA, instead of only cutting and pasting with DNA that exists in nature (Kennislink, 2012). Synthetic biology is a research field that receives considerable attention from experts since 2004 (Gschmeidler & Seiringer, 2012) and where all kinds of scientific disciplines work together, including chemistry, chemical engineering, biology, electrical engineering and computer science (Peccoud & Isalan, 2012).

### 1.7.1 Different definitions of synthetic biology

Scientists, scientific journals and newspapers talk about synthetic biology, however, they have different definitions of synthetic biology. The new scientific journal "ACS Synthetic Biology" defines synthetic biology as a field that improves the process of genetic engineering. Furthermore, they describe synthetic biology as a discipline that needs a multidisciplinary approach (Voigt, 2012). The English Wikipedia website gives the same kind of definition: "Synthetic biology is a new area of biological research and technology that combines science and engineering. It encompasses a variety of different approaches, methodologies, and disciplines with a variety of definitions. The common goal is the design and construction of new biological functions and systems not found in nature" (Wikipedia, 2012). The Laboratory of Systems and Synthetic Biology, part of Wageningen UR, states that "synthetic biology represents the rising field of integrating large-scale genetic engineering strategies in the life sciences, with the aim to create novel functions or combinations of functions in biological machines" (Laboratory of Systems and Synthetic Biology, 2012).

### 1.7.2 Synthetic biology, a promising research field

Synthetic biology is a research field that helps to solve global challenges in areas such as health, energy production and the environment. With synthetic biology, it may be possible to let bacteria produce biofuels in an efficient way to decrease our dependence on fossil fuels in the future. Synthetic biology also has applications in medicine. Such as the development of bacteria that produce components for anti-malarial drugs (Rerimassie & Stemerding, 2012).

The students in the iGEM teams work on promising solutions as well. In 2012, the team of Wageningen tried to find solutions for better medication transport to the desired location in the body, to decrease side effects of the drug. The team from Groningen worked on a bacterium that turns red when food spoils. This can help to avoid the disposal of food when it is still edible.



### *1.7.3 Questions around synthetic biology*

Synthetic biology is a promising field. On the other hand, questions are raised as well: can synthetic biology be used for producing biological weapons (De Vriend et al., 2007)?; do organisations get extra power due to patents? and are there risks that modified organisms escape (Stemerding, de Vriend, Walhout, & van Est, 2009)? Ethical issues mentioned are: are we allowed to create life and what is life? Are synthetic cells just “things” or do we call these synthetic cells life too (De Vriend et al., 2007)?

In debates about new technologies, civil society organisations have an intermediary role by mobilizing and representing the interest of the public (Stemerding et al., 2009). After interviewing these organisations, Stemerding et al. (2009) conclude that they have different views on synthetic biology. Some describe synthetic biology as a converging science while others describe synthetic biology as “somewhat new”. The organisations defined three topics of concern: “growing commercial interest and social justice, new risks and technology fix”. By mentioning growing commercial interest and social justice, the civil society organisations raised concerns about the power and control that patents create, which can be a danger for global justice. New risks mentioned are for example escapes and mutations of modified organisms. Technology fix is described as the danger for the idea that synthetic biology can help to solve all societal problems like hunger. This may lead to discontinuation of research about the real fundamental problems of global societal problems. Besides these three topics of concern, ethical points are not mentioned, if not asked for. Stemerding et al. (2009) stress the importance of the inclusion of wider concerns in the debate like “unnaturalness” and control of food systems.

A report about synthetic biology of the [Rathenau institute](#), an organisation in the Netherlands that promotes the formation of public and political opinions about technology, states that synthetic biology research is a follow up of gene technology and biotechnology (De Vriend et al., 2007). They refer to synthetic biology as new biotechnology and elaborate on the same issues discussed in the debates around gene technology and biotechnology. The report mentions five issues that are frequently mentioned in the debate around synthetic biology. The first one is biosecurity, meaning the chance of spreading organisms in the natural world that can cause for example the spread of diseases. The second issue is the concern for biological weapons, which can be used for bioterrorism. Intellectual property and access to the technology are mentioned as well: patents can create opportunities and limitations for research. The two last issues mentioned in the report are ethical aspects and societal engagement and regulation.

### *1.7.4 Ethical issues*

The ethical issues mentioned in the Rathenau report are justice, autonomy and culture & naturalness (De Vriend et al., 2007). The aspect culture and naturalness concerns the relation between people and the non-human environment. For instance, an important issue is whether people approve changing nature. Two issues play a major role here. The first issue is whether it is allowed to reduce life to DNA. The second concerns manufacturability. From this issue questions arise such as: are synthetic cells just “things” or do we also call these synthetic cells life (De Vriend et al., 2007)?

In debates about synthetic biology where the theme “meaning of life” is discussed frequently, synthetic biologists are compared with God or are seen as the next Frankenstein (van den Belt, 2009). van den Belt (2009) argues that many people are worried that the meaning of life will change in a product of deliberate design, made from DNA.

Summarizing, synthetic biology is an emerging technology where different scientific disciplines work together on promising projects that can help to find solutions to worldwide problems in health and energy production.



Although synthetic biology is a promising field, topics such as technology fix, biosecurity and naturalness are discussed in the societal debates on synthetic biology and influence the conversations scientists have.

### **1.8 Synthetic biology in the media**

The term synthetic biology has gained rapid acceptance among academia, students, politicians and industry (Kronberger, 2012), however, the field is still relatively unknown among the public (Kronberger, Holtz, Kerbe, Strasser, & Wagner, 2009). Mandel, Braman, and Kahan (2008) conducted an online survey with 1500 respondents among a representative group of United States of America adults. Results show that 82% of the respondents did not know anything or just a little about synthetic biology, while only 2% indicated that they knew a lot about synthetic biology. Gschmeidler and Seiringer (2012) analysed the content of synthetic biology coverage in German-language print and online media for non-expert recipients over the years 2004-2009. In total 233 articles were analysed. The analysis shows that synthetic biology is still a side issue in German-language media. In 35% of the articles, the term synthetic biology is not even mentioned and 69% of the articles were placed in science/technology sections and special interest media.

The Dutch press mentioned different examples of synthetic biology. In 2008, the Volkskrant [reported](#) about bacteria that produce components for anti-malaria medication, bacteria that make biofuel from xylose and the first synthetic bacterial genome made by Craig Venter. According to the interviewed scientists, an "empty" bacteria genome may be made in the end. This can be used as a chassis for the development of bacteria that can produce all kinds of materials (Raaij, 2008). The Dutch media also pay attention to the projects of student teams that join the international synthetic biology competition iGEM.

### **1.9 iGEM**

[iGEM](#) stands for the international Genetically Engineered Machine competition. In this competition, student teams use standardized, interchangeable DNA blocks to build biological systems, for instance bacteria. What in 2003 started as a summer course where students designed biological systems, grew into an international student competition for students to work on synthetic biology. In 2012, 191 teams from 30 countries registered for the competition. According to the organisation of iGEM: "students will specify, design, build, and test simple biological systems made from standard, interchangeable biological parts. The accomplishments of these student teams during one summer are often impressive and will lead to important advances in medicine, energy, and the environment" iGEM (2012). In the same year, five Dutch universities joined the iGEM competition: Amsterdam, Eindhoven, Wageningen, Groningen and Delft (iGEM, 2012). NRC Handelsblad [reported](#) about the student project where students used yeast cells to detect tuberculosis by a breathalyzer test. They used special odour detectors that get green when detecting tuberculosis, made from DNA blocks with a known function. The team tried to build these detectors into a yeast cell in order to use these cells for the breathalyzer tests (Kooijman, 2012).

This shows that synthetic biology is an emerging field in which scientists and students try to solve problems for society.

### **1.10 Problem statement**

The ideas or vision about how scientists should communicate with society have changed (Mogendorff et al., 2012). Scientists not only have a role of giving information about a certain topic, but also as spokespersons of their scientific organisation and the scientific world as a whole (Horst, 2013). Engaging the public has become a preferred method of governments around the world and is seen as a way to increase trust and to restore the relation between science and society (Dijkstra & Gutteling, 2012). There



is more and more attention to increase and improve the conversations scientists have with non-scientists (Felt et al., 2009).

Now, all over the world scientists interact with the public via social media, public engagement activities and interactive activities that aim to popularize science. These interactions all influence how people perceive the identity of an organisation such as science (Scott & Lane, 2000). This means that scientists can play an important role in improving the identity of science via these numerous informal and formal interactions.

How do scientists deal with this new role as “spokesperson of science” in the interactions with other non-scientists? How do they present themselves? Moreover, what implications does this have for the dialogue between science and their publics?

### **1.11 Research aim & research questions**

In the conversations iGEM members have with others, during debates and science festivals, talk is used to achieve all kind of actions. To find out how iGEM members position themselves and science or doing science during these conversations, this study will analyse how iGEM members construct their identity and doing science in the conversations they have with their public at outreach activities. This report aims to answer the following research questions.

- 1) How do iGEM members construct their identity as a scientist in relation to their publics at science festivals and during debates on synthetic biology?*
- 2) How do iGEM members construct “science” and “doing science” in relation to these publics?*

By answering these two research questions, this study aims to find out what implications these insights have for the dialogue between science and their publics.

These insights help to get a more inclusive picture of the dialogue between science and society as this study will focus in detail on “real life” interactions at more popularizing science activities, besides other studies that focused on public engagement activities and/or used interviews as a primary data source.

This study may help to get a better understanding of how the identity constructions of iGEM members influence the issues discussed or not discussed in the dialogue between scientists and their publics. This hopefully inspires scientists to learn more and to be more aware about the effects actions in talk have on the conversations with their publics. In the end, the results of this paper may help to improve the interaction between science and society.

### **1.12 Thesis outline**

The theoretical basis for this report is laid out in the next chapter. The theoretical basis will elaborate on how the identity of an organisation is formed, the changing relation between science and society, the perspectives scientists have on their roles when in interaction with the public and how scientists interact with the public at public engagement activities. Chapter 3 discusses the research set-up. This chapter contains more information about iGEM, the data, the data collection and the data analysis. This chapter is followed by the results. In the final chapter, the overall conclusions and discussion are presented. The final chapter ends with the strengths and limitations of this study and presents recommendations for future research.



## **2. Theoretical framework**

In the conversations organisational members have with people outside their organisation, the identity of an organisation is formed (Cooley (1902) in Gioia, Schultz, & Corley, 2000). When looking from this perspective, science too is an organisation or institution and so the numerous interactions between members from the scientific community and others form the perceptions others have of the identity of science.

Formerly the identity was seen as the unchangeable core of the organisation. Nowadays this identity is defined as unstable and fluid and often redefined by organization members and interrelated with the image the organisation has (Gioia et al., 2000). Others define the construction and change of identity as a result of dynamic, reciprocal, and complex interactions of external and internal stakeholders (Scott & Lane, 2000).

This means that the numerous and complex formal and informal interactions scientists have with non-scientists at for example science festivals, public engagement activities and social media all influence the identity of science. Over the years, the ideas about these interactions changed. At first, science communication was aimed at educating the public. Nowadays, scientists speak of the paradigm: "science and society" (Bauer, Allum, & Miller, 2007).

### **2.1 Developments in science communication**

In the past, science media was seen as a way to improve the relation between science and society. Science media was used to educate the public about science (Nisbet & Scheufele, 2009). The idea behind what is known as the "deficit model" is that public doubts, for example about new technologies, are created by public ignorance of the ideas and relevant facts behind science. The solution to this problem, according to the model, is to fill the knowledge gap (Sturgis & Allum, 2004). In the 1960s the deficit model portrayed the public as in need of knowledge and scientific literacy as a way to let people accept science (Bauer et al., 2007). Now, the deficit model is not characterised as the solution to improve the relations between science and society anymore. Wynne (2006) argues that not the knowledge deficit, but other factors have a negative influence on the dialogue between science and society. He mentions that scientists and institutions should be aware of their role in decreasing trust in science and should understand that public questions are reasonable too. Even now, these questions remain unrecognized and unanswered.

Today, the relation between science and society is described as science and society, a paradigm that started around the mid-1990s (Bauer et al., 2007). In the science and society paradigm not only a deficit of knowledge, attitude and trust among the public exists, but the main attention goes to the deficits of the experts who have a prejudiced image about the public (Bauer et al., 2007).

### **2.2 A framework for responsible innovation**

Stilgoe, Owen, and Macnaghten (2013) argue that the management of innovation and emerging science is a big challenge for democracies. In their paper, they present a framework for responsible innovation. This framework should create a situation where public questions can be asked, discussed and answered. The framework consists of four dimensions that should be integrated in institutional settings and aims to give input in (future) discussions about the dynamic concept of responsible innovation. The four dimensions of the framework are anticipation, inclusion, reflexivity and responsiveness.

The first dimension is anticipation, which means that researchers and organisations should think and talk systematically about (potential) issues around an innovation in society to increase resilience. The second dimension mentioned is reflexivity. For responsible innovation, it is important that the institutions and





actors are reflexive. When scientists are active in public, they should reflect on their own role and their wider responsibilities. The third dimension is inclusion. In the innovation process, it is important to include new voices, something already tried with stakeholder involvement projects and public engagement activities. Activities that should be continued, but still need to be improved. For responsible innovation, responsiveness is of great importance as well according to the authors. It is important to respond to societal change such as emerging knowledge, perspectives, norms and views.

With the framework of responsible innovation, Stilgoe et al. (2013) made a step towards a better dialogue between science and society around emerging technologies, which still need to be improved according to the scientists.

### **2.3 Limitations of “science and society” in practice**

There is more attention for activities that encourage dialogue, public participation and trust (Irwin, Jensen, & Jones, 2013). Nisbet and Scheufele (2009) show in their article, that a shift is seen with the respect to the view on public engagement in the scientific community in the United States. At the same time public engagement activities are being criticized too (Irwin et al., 2013) and different studies refer to the limitations of today’s interactions between science and society (e.g. Felt et al., 2009; Marris, 2001; Veen et al., 2012).

#### *2.3.1 Public deficits still present*

Wynne (2006) reasons that organisations still make use of forms of the deficit model; organisations still have difficulties with creating a dialogue. He reasons that since the 1990s the deficit model has been reinvented many times, with a focus on different public deficits such as the understanding of scientific knowledge and trust in science. These deficits are often used as an alibi to avoid reflexive questions. In order to get more public trust in science, institutions should imagine that public questions are reasonable too and should work first on their own trustworthiness by asking themselves reflexive questions about the assumptions and imaginations they have about the public and themselves, before starting with engagement activities (Wynne, 2006). According to Bauer et al. (2007) the assumptions scientific experts have of the public are partly responsible for public distrust in science. Davies (2008a) argues that by making use of the deficit model, existing power inequalities between the public and science are maintained.

Public opposition is not caused by what kind of research scientists do, it is an opposition to the behaviour of an organisation (Wynne, 2006). As scientists and policy makers do not listen to the arguments of the public, scientists and policy makers see these issues as emotions, “protected from falsification” (Wynne, 2001). According to te Molder (2012) this opposition is caused by diffuse reasons and that it is not “a simple dislike” towards the scientific world and experts.

In the debates around genetic modification, organisations describe the public often as ignorant. Marris (2001) discovered in total seven myths of the view about the public in the debates and other documents of different institutions. An example of such a myth is: the public is either “for” or “against” GMOs. Marris (2001) reasons that institutions should be more aware of their own behaviour and the myths they communicate about the public, if they want to introduce GMOs with new policies and strategies and to make a change in public opinion possible. If still based on these myths, actions of the institutions and organisations will fail (Marris, 2001). Assumptions are also part of the agenda setting of an activity.

#### *2.3.2 Agenda setting*

Veen et al. (2012) analysed innovator-user meetings organized by the celiac disease consortium. This consortium organizes dialogues to engage the potential future users in the research development process





of saver foods for celiac disease patients and a gluten-neutralizing pill. Analysis of these activities shows that the agenda setting or the questions asked by the organisation create resistance. The participants resist the format and the presuppositions in the questions. Presuppositions mentioned are for example that patients need the pill and that this pill will help to improve their "problematic life". The analysis showed that the resistance is not made explicit, it is assumed that this is caused by the fact that participants are not sure what to expect from such an engagement meeting and do not dare to say explicitly if something feels or goes wrong. This created a difficult conversation. Resistance could have been avoided by engaging the people having celiac disease earlier in the process, even before the development of a pill. Then the company could have asked what people really want (Veen et al., 2012).

### *2.3.3 Happy science*

In the different activities organized to popularize science and technology, there is little dynamic according to te Molder (2011). She argues that the public gets in contact with only two kinds of science: happy science and science characterised as "grim". In school, the public learns about science. There, they present science when it is ready: happy science. Science is presented as a finished product; there is no reference to the turbulent way science is created.

On the other hand, there is "grim" science. Later in life, the public is confronted with all kinds of debates that only discuss the potential risks of science. To really get to know why some people seem to love science and others seem to hate science te Molder (2012) suggests that the dynamics that create these feelings by people outside these "happy" and "grim" science activities should be analysed.

### *2.3.4 Ethical issues*

Felt et al. (2009) analysed what the difficulties are for addressing ethical issues during public engagement activities. Analysis of ethical debates about genomics shows that experts have a preference for "scientific facts". Other participants also regard absence of facts about ethical issues as a reason not to discuss ethical issues. The analysed debates show two constraints that influenced the open discussions about ethics. First, all participants shared or accepted the implicit assumption that: "scientific facts are to be considered superior to "mere values". This created a superior position for scientists and when the facts were missing, the debate was displaced. Besides the preference for scientific facts, the social dynamics in the groups played an important role. In small groups, ethical issues are discussed. In the bigger groups, however, discussions they had in the smaller groups are not mentioned. According to Felt et al. (2009) this is created by "mutual taming"; controversial subjects are not discussed in order to create a stable social setting in these larger groups.

Swierstra and te Molder (2012) write that policy and technology actors only have attention for "hard" impacts. These actors treat "hard" impacts as objective, neutral and rational. There is no attention for social and ethical impacts, although the public has concerns about these issues. In the debates there is no attention for the so-called "soft" impacts of a technology, these are treated as emotional and value-laden (Swierstra & te Molder, 2012).

Besides this study on the soft and hard impacts, other studies also refer to the limitations of the current dialogue between science and society, as mentioned above. These dialogues, although criticised, shape the identity others have about science and have an influence on how others portray science and scientists.

## **2.4 How others portray scientists**

The identity of the scientist, shaped for an important part in the conversations scientists have with their public, is a subject of different studies. There are for example studies that analysed the images in



popular films of female engineers and scientists (see: Steinke, 2005) and other studies analysed for instance the public image of science and technology in Greece in 1908-1910 by analysing newspaper articles (see: Mergoupi-Savaidou, Papanelopoulou, & Tzokas, 2009). Haynes (2003) analysed the stereotypes of scientists that can be found in Western literature. She found seven stereotypes: "the evil alchemist, the noble scientist, the foolish scientist, the inhuman researcher of romanticism, the adventurer, the mad, bad & dangerous scientist and the helpless scientist". Haynes (2003) argues that although these stereotypes are presented in a simple way, they represent a message of ideas and fears that are suppressed.

Finson (2002) made an overview of different studies that analysed the perceptions students or schoolchildren have of scientists. Since 1957, studies have used written material such as questionnaires and made use of the draw-a-scientist test. In 1957, Mead and Métraux (1957) analysed essays where students talked about the image of a scientist and found the stereotype that is now seen as the classical image: "an elderly middle-aged male in a white coat and glasses who works in a laboratory, where he performs dangerous experiments" (Finson, 2002). The other studies, which Finson (2002) analysed show the same perceptions of the scientist but add perceptions as smart and making scientific wonders. Research in Australia and China shows the same classical image. More recent research showed that not only students have this image, teachers and pre-teachers have this image as well (Finson, 2002).

Finson (2002) concludes after analysing the different studies, that the stereotypical perception of the scientist is persistent. Studies showed that interventions have an immediate effect on how students perceive scientists and there is an important role for teachers and science educators to show non-stereotypical images and to make others aware of their stereotypical perception. More research is needed to leave this stereotypical image behind us and to find out how and when it is formed, what factors influence the perceptions and where they come from.

## **2.5 Scientist's perspective on the role of the scientist**

Several scientists analysed how scientists perceive their own role when interacting with others. According to some scientists, this should be a more prominent role (te Molder & Gutteling, 2003). The next paragraphs will elaborate on the results of the studies that asked scientists for example via interviews about their own role.

### *2.5.1 Scientists as representatives of science*

Horst (2013) explored the function of "representing science" by analysing how scientists consider their own role as spokesperson. By interviewing 20 scientists, three modes or roles of representing were discovered. Half of the interviewees switched roles whereas others generally used one role while speaking. The three modes of representing that were identified are "representing a field or discipline, representing the research organization and representing the institution of science". These modes of representing create three kinds of identities, an expert, a research manager and a guardian of science. Horst (2013) argues that for communication towards the general public it is important for scientists to adopt the roles of experts and guardians when acting as spokesperson of science and scientific knowledge. The role of research manager will also become more important since there is more and more competition in the scientific world.

### *2.5.2 Scientists as educators*

Other studies also tried to create a better understanding of the role of scientist in public engagement activities, by analysing how scientists see or talk about the science-society relationship. Several studies show that scientists still favour educating the public. Davies (2008) shows that, according to the



scientists in focus groups, the main purpose of communication is educating people. This conclusion is made after the analysis of seven group discussions with scientists where semi-structured interviews were conducted about ideas for and purposes of science communication. Although sometimes scientists talked about two-way communication in a positive way, public communication is mainly assumed as “simply educating people” with “no return flow”. The preference for education is also seen in another study that shows that scientists working on genetic modification are in favour of increasing communication with “non-experts”. The scientists emphasize one-way communication in order to educate people in the study of Cook, Pieri, and Robbins (2004, p. 445): “if people have enough information, they can make a ‘rational choice’ for GM”.

### *2.5.3 Scientists as empiricists*

Other studies also show that scientists still regard the public to be in need of information. Burchell (2007) interviewed 18 genetic modification crop geneticists in a time of a high debate. Of the interviewees, 16 showed the pattern of “empiricist selves” and “contingent others”, portraying their beliefs and actions as legitimate and objective. By doing this, they show that they are empiricists. While the others (the public, other science, media and NGOs) were seen as illegitimate, or portrayed as contingent others. “Others” base their beliefs on personal shortcomings and self-interest. This is also seen in the study of Cook et al. (2004), where scientists frame perspectives other than the empirical objectivity as illegitimate and regard the illegitimate perspectives as a reason not to engage with the public.

Young and Matthews (2007) show that experts view the public as a group simply incapable of understanding science, however, the public is not rejected unlike the media, which is accused of the manipulation of science communication. Experts claim that the public trusts their work. According to the experts media misrepresents the knowledge of experts and the public misinterprets it.

### *2.5.4 Different roles for scientists and the public*

Although several studies argue that scientists still make use of the deficit model (e.g. Burchell, 2007; Davies, 2008), one of these authors argues in one of her articles that there is no homogenous model scientists have about the public. (Davies, 2008a). In this particular study, in which group discussions are analysed, she shows that scientists not only talk from the perspective of the deficit model. Several scientists use also a variety of models when talking about the public. Several aspects mentioned by the scientists in the focus groups are in line with the deficit model: the public is passive, not critical, ignorant and the public fears, blames and mistrusts science (Davies, 2008a). In addition, Davies (2008a) shows that scientists also refer to other models of the public where the public is projected as differentiated and knowledgeable.

This phenomenon is also seen in the study of Dijkstra and Gutteling (2012). They analysed focus group discussions to find out what the expectations and considerations are regarding communication around genomics research from the perspective of various roles in the society, for example expert, consumer or patient. Interestingly, expert focus groups argue that the public can make good decisions without knowledge and information does not always lead to acceptance. The food experts group stress the importance of two way communication, taking emotional arguments into account and engaging actors in the communication process (Dijkstra & Gutteling, 2012).



The studies mentioned above show that scientists often think in terms of the deficit model. Sometimes the role of the scientist is explicitly seen as an educator in the discussion about, for instance, genetic modification. Other studies show that scientist assign themselves different roles when interacting. In addition to these studies, there are also studies that analysed what roles the scientists use when they are in interaction, a topic discussed in the following paragraphs.

## **2.6 An interactional perspective on the role of the scientist**

Several studies focussed on the different identities or roles used by scientists when in real life interaction with others, for instance during a public engagement activity. These studies show that scientists make identity shifts, or use different identities, while interacting.

### *2.6.1 Shifting identities to show the connection with society*

A discourse analysis of three public engagement activities about genetics shows that the most successful expert speakers made use of “hybrid positions” (Kerr et al., 2007). The experts use two identities during the analysed debates: expert and citizen or layperson. The experts referred to lay positions to show their solidarity and to create a connection with the audience; they represented lay knowledge as an adjunct to technical knowledge. In the debates, the experts often refer to lay people’s lack of knowledge.

The work of Motion and Doolin (2007) shows that scientists also make use of two identities. They analysed interviews in which scientists who work on genetic modification narrate about encounters with activists. The discursive practices show that the scientists used their scientific identity to privilege their knowledge to undermine the view of activists. They also used the identity of a member of the public. By constructing this identity, the scientists achieved to emphasize that scientists are also part of society and work for the public interest. Shifting between two identities is also reported in other studies, although in these studies, presented in the following paragraphs, identity shifts are used for another purpose.

### *2.6.2 Shifting identities to construct superiority*

The study of Dyer and Keller-Cohen (2000) analyses lectures of professors. It shows shifts in identity as well. While giving a lecture, professors use two identities: the personal and professional self. Here, shifting identity is used to present the other as dependent and less knowledgeable. The professors present themselves as experts solving the problem, when telling a story about a personal experience. This is done by presenting themselves as ordinary people first, whereupon this is compared with their other status as being knowledgeable. The professors are distancing themselves from the other non-experts first and then present themselves as superior over the other non-experts. By shifting identities one professor depicts himself as a superhero (Dyer & Keller-Cohen, 2000).

### *2.6.3 Shifting identities to construct privilege*

Mogendorff et al. (2012) show that in interviews, scientists do not only pay less attention to public knowledge, scientists even argue that they can claim whether they want to incorporate lay views or not. Interviews with 12 Dutch plant scientists were analysed to find out how discursive constructions of scientists actively shape communication between science and society. An important conclusion is that the scientists see a limited role for lay people’s view in their research. Scientists give lay people the freedom to have their own opinion, displaying their tolerance first and then prioritizing scientific knowledge. Displaying their tolerance is needed to avoid the accusation that lay views are not considered. According to Mogendorff et al. (2012) scientists do not so much position themselves as “superior knowledge producers for society” but as actors who can chose for themselves whether they want to incorporate lay views or not. This is done by presenting themselves as knowledge hybrids, having two identities. They



have knowledge as a member of the public and scientific knowledge, giving them the privilege to decide if they are willing to incorporate lay views.

#### *2.6.4 Shifting identities to present personal and informal opinions and feelings*

Padmos, Mazeland, and te Molder (2006) analysed how lay positions are used in public engagement activities around public debates on the subject Biotechnology and Food. The authors tried to find out what actions are performed by using the category "citizen" in the debates. The results of the study show an interesting phenomenon. Experts use the category "as a citizen" as a second occasion identity. First, the experts construct their initial identity as an expert. Then, during the debate, they make local, temporary category shifts to the category "citizen". Why are these actions performed? When using a category shift, space is created for reference to personal, informal and unofficial opinions. Lay participants of the events do the same. They also show their identity as an expert, before stating their opinion. Interestingly these "lay-experts" make use of the second occasion identity "citizen", to refer to personal feelings and opinions as well. This shows that the participants of the public debate regard "personal feelings, opinions and attitudes about public affairs as a characteristic feature of citizenship", according to Padmos et al. (2006, p. 290). This means that not only experts but also non-experts create a situation where it is assumed that, as an expert you do not talk about feelings, opinions and attitudes of citizens.

The studies mentioned above show that scientists make use of two identities when in interaction: the one of the scientific expert and the one of the public member. The identity shifts are used to reach different goals: to create a connection with the public, to create a privilege, to show engagement, to create opportunities to talk about feelings and emotions and to show superiority.

### **2.7 Taking a discursive psychological perspective on the science-society interaction**

Most studies that analysed interactions between science and society focus on public engagement activities. Besides these public engagement activities there are numerous occasions where scientists interact with non-scientists, such as the more popularizing science festivals. These activities have an influence on the identity of science as well, but are under-researched and little is known about the identities scientists construct at these popularizing activities.

This study will try to fill this knowledge gap by analysing the outreach activities of iGEM, which can be characterized as popularizing science activities, not used explicitly for engaging the public in decision making around synthetic biology (Davis, 2007). For this study, interactions of these outreach activities will be analysed to get to know what is really happening during these activities.

Many other studies use interviews with scientists to generate input about the conversations between science and society. By analysing real life interactions, not influenced by a researcher (Silverman, 2011), it is possible to get more insights in the conversations synthetic biologists have with non-scientists. In order to make a detailed analysis of these conversations, discursive psychology will be used. By using this perspective, this study aims to get a better understanding of how scientists position themselves and doing science during popularizing science activities and what implications this has for the dialogue between science and society. This may inspire scientists to learn more about the effects identity constructions have on the conversations with their publics at the hardly studied popularizing science activities. In the next three paragraphs, discursive psychology is introduced.

#### *2.7.1 An introduction into discursive psychology*

According to Potter (2012), one of the founders of discursive psychology, discourse is the primary arena for human action. This can be all kind of discourses: family dinners, phone calls to help lines, twitter



discussions, but also conversations between scientists and others. For instance, during “organized interactions” such as debates and “non-organized” interactions on the bus when a scientist is chatting with her or his neighbour. During these everyday conversations all kinds of actions are performed such as: building a particular identity and showing expertise.

Discursive psychology is derived from ethnography and conversation analysis (te Molder, 2012). With the analysis of everyday talk and writing discursive psychology tries to understand what people do in an interaction; what kind of actions they perform (Potter & Wiggins, 2007), what goal people want to reach with discourse, consciously or unconsciously (Aarts & Van Woerkum, 2010). The method actually tries to find an answer to the question: “what do people do with their talk or writing?” (Potter, 1996). The research questions are mostly action oriented and the conversations analysed are all kind of situations that are a part of everyday life, like family dinners and internet forum discussions (Potter & Wiggins, 2007). No hypothesis will be formulated, when using discursive psychology. The data analysed are naturalistic data. Data the researcher does play no active role in (Silverman, 2011). This is, in contrast with studies that analyse for example interviews. The research is started without presumed ideas, which allows to discover patterns in talk of for example identity constructions that are not expected beforehand (Potter & Edwards, 2001).

### *2.7.2 Analysing what talk does*

An important notion is that the data are analysed in a non-cognitive way (Potter & Wiggins, 2007). Psychology is seen as something embedded in talk (Potter & Wiggins, 2007). Discursive psychology examines conversations for how psychological themes are recurrent implicitly managed and handled. Examples mentioned of psychological themes are agency, intent, doubt, belief, prejudice, emotional investment and commitment (Edwards, 2005). By using discursive psychology researchers try to find out what talk does, not what is reflected in talk (Veen et al., 2010). Talk is seen as a social practice. Questions and answers given do not reflect the mental state of the persons in the interaction, they are used to manage social relations between speakers (Veen et al., 2012).

### *2.7.3 Three starting points of discursive psychology*

In discursive psychology, three core-starting points are essential. First, discourse is constructed. Discursive psychology is interested in how people construct their versions of the world while interacting (Potter, 1996). People give a certain construction while evaluating an event. Linguistic building blocks are used to make a particular version of the world (Potter & Wiggins, 2007). The second observation is that discourse is action oriented (Potter & Wiggins, 2007). Discursive psychology tries to find out how talk achieves things, without moving to what the underlying attitudes, ideas or emotions of the people are, or what lies behind it, or is being expressed with it (Potter, 1996). The third observation is that discourse is situated. In discourse words can only be understood by previous words and the words that follow, it is also situated in the institutional setting and situated rhetorically. To understand discourse, it is important to examine the discourse in the situational context (Potter & Wiggins, 2007).

All over the world, scientists have numerous conversations with non-scientists. These conversations shape the identity others have about science. During these conversations, scientists have to deal with a changing role: from educator of science towards a representative of science as a whole. Examples of conversations are the interactions between scientists and visitors at public engagement activities. These activities are analysed extensively. Besides the interactions during these public engagement activities, the conversations at popularizing science activities play an important role as well. In these



conversations, the scientists achieve different actions. To get insight in what is happening at these popularizing activities, which has hardly been a study subject, this study will analyse the interactions between iGEM members and others at the outreach activities of iGEM. This study will focus in detail on the real life interactions. To learn, what is happening in these interactions and what implications this has for the dialogue between science and society, discursive psychology will be used, to answer the following research questions.

- 1) How do iGEM members construct their identity as a scientist in relation to their publics at science festivals and during debates on synthetic biology?
- 2) How do iGEM members construct "science" and "doing science" in relation to these publics?



### 3. Materials and methods

In this qualitative study, conversations of iGEM members and teams during outreach activities are analysed. To get a better understanding of how iGEM members present themselves and science during these more popularizing science outreach activities.

This thesis aims to study naturalistic conversations in which the researcher does not play an active role (Mogendorff et al., 2012), to investigate what is happening in the conversations of iGEM members with non-scientists during outreach activities.

Several outreach activities of iGEM teams were visited to gather data. This chapter will start with some background information about these events. This will be followed by an explanation of the manner of data gathering. Finally, the analytical approach and an explanation of the data analysis are given.

#### 3.1 Data

iGEM, the international Genetically Engineered Machine competition, is not only about good lab results; outreach activities are highly valued also. That is why the iGEM teams organize outreach activities or visit events such as debates about synthetic biology. The iGEM teams can be defined as a group of (international) bachelor and master students who originate from different studies at possibly different universities. They use the synthetic biology approach to find solutions for a problem they define by themselves in order to win the iGEM competition.

A total of six hours of naturalistic conversations is obtained during the [Transnatural Festival](#), the [Discovery Festival](#) and the Meeting of Young Minds [2011](#) & [2012](#).

##### 3.1.1 Transnatural Festival

The first data were obtained from the Transnatural Festival. The Transnatural Festival was organized by the Transnatural Academy to: "Share knowledge and encourage dialogue amongst creators and the public" (Transnatural Academy, 2012). The festival consisted of an exhibition in NEMO (Amsterdam) and a two-day conference. The role of iGEM members was to share their project with others such as "creators". On the second day of the conference the theme was: Smart as Matter. iGEM Groningen gave a presentation about their project: the development of bacteria that colour red when food is spoiled. After the presentation, the audience and the moderator asked several questions about the project. The naturalistic conversation after the presentation between iGEM, the public and the moderator took 12 minutes. The setup of the conference was like in a lecture hall, with the two iGEM team members and the moderator in the front. The public consisted mainly of artists, scientists and others interested in science.

##### 3.1.2 Discovery Festival

The Discovery Festival was held in Eindhoven, Rotterdam and Amsterdam. The Discovery Festival profiles itself as a progressive festival where you can discover all kind of new things, regarding science, arts and music (Discovery Festival, 2013). Four of the five Dutch iGEM teams joined hands to organize a virtual lab tour in which the public of the Discovery Festival could make their own modified bacteria. The tour was called: "Cellen Hacken". For this study, the conversations between festival visitors of Discovery Festival Rotterdam and iGEM Wageningen were analysed. The tour was a big success considering the long line of festival visitors waiting to get in the virtual lab.

The virtual lab tour was set up in a classroom. On several tables all kinds of lab material was installed to construct your own modified bacteria. The tour started with a computer programme in which the public could choose which DNA they would like to buy. Then they received an envelope with the DNA after which the bacteria with the preferred characteristics could be made in the lab. At the end, visitors could





make their own fingerprint in agar to take home and they could post a new idea iGEM teams could work on next year.

A virtual tour took around 20 minutes; one iGEM team member guided the visitors. The iGEM members guided one to five visitors per tour. During the evening many tours were recorded, this resulted in more than two hours of naturalistic data.

### *3.1.3 Meeting of Young Minds 2011 and 2012*

Before the iGEM teams could go to the final iGEM Jamboree in Boston in November 2012, several regional Jamborees were held in which the best teams were selected for a trip to Boston. In 2011 and 2012, the European Jamboree was held in Amsterdam. Both years, at the evening before the Jamboree, the Rathenau Institute organized a debate about synthetic biology in Amsterdam. This, to create a debate between political youth parties and iGEM members about the future of synthetic biology.

In 2011 the European iGEM teams debated with political youth organisations from the Netherlands about the future of synthetic biology (Rathenau Instituut, 2012a). The political youth organisations were the Green Party, the reformed political youth party, the young democrats, the young socialists and Pink, the youth organisation of the animal party. Around 300 people visited the debate consisting of iGEM team members, people working in the field of synthetic biology, social scientists and people from young political parties (Rerimassie, 2013).

The debate consisted of three rounds. The political youth parties chose the topics. The three rounds were about:

1. The promises of synthetic biology
2. The regulation of synthetic biology
3. Ownership

Every round started with the statements of two political parties. Then both parties could react on each other's statement. Then the other four political parties could react on the statement. After this, there was time for the iGEM teams to ask questions or to give remarks to the young politicians. At the end of every round, there was time left for the audience to react on the debate or to ask questions. When people wanted to react they had to stand up and take place behind one of the standing tables at the back (Rerimassie, 2013).

In 2012, the meeting of young minds consisted of two rounds. Before the debate, the Rathenau institute asked the iGEM teams to make a proposal for a setup of a debate. The iGEM team of Delft designed the first round. The iGEM team of London proposed the second round. For this thesis, only the first round was analysed.

In the first round, there was discussion about the publication of the genomic sequence of the H5N1 virus, also known as bird flu, in a scientific journal and the risks for society. The debate started with a movie about the wave of media attention around this publication. Then the iGEM team of Delft started with a statement. The public could agree with a green leaflet or disagree with a red leaflet. Then the discussion started between the people on stage. The people on the stage were politicians, scientists, experts on ethical issues and iGEM Delft. Several times the public could ask questions. When the discussion on the statement was finished, the public was asked again to agree or disagree. In this way, three statements were discussed. The audience consisted of iGEM team members, people working in the field of synthetic biology, social scientists and members of young political parties.



### **3.2 Data gathering**

This study aimed to get naturally occurring data of conversations between iGEM members and others such as politicians and visitors of science festivals. Naturally occurring data were gathered to find an answer to the question: "what do people do with their talk or writing?" (Potter, 1996) and to find phenomena in the conversations (Silverman, 2011). With naturally occurring data is meant that: the data are independently of the existence of the researcher (Silverman, 2011). To make sure that the assumptions of the researcher did not influence the conversations, there was no interaction between the people interacting and the recording researcher (Potter & Wiggins, 2007).

To get these naturally occurring data of the Transnatural Festival the presentation of iGEM was visited. The whole presentation of iGEM and the discussion afterwards were recorded with a camera and tape recorder. Only the discussion is analysed, as during the presentations there was no interaction with the audience.

The recordings of the Meetings of Young Minds 2011 and 2012 were obtained with help of the Rathenau institute. The Meeting of Young Minds 2012 was visited and the set-up of the Meeting of Young Minds 2011 was discussed with one of the organizers by telephone.

At the Discovery Festival, the conversations between the festival visitors and the iGEM members were videotaped and recorded. The festival visitors were first asked permission for making the recordings. Then the researcher holding the camera and tape recorder followed the group with visitors and the iGEM member.

In total over six hours of conversations were recorded and analysed. A request for the original data can be send to the author of this report. Distribution of the original data is not possible as the researcher promised the people recorded to keep their privacy in mind. The analysis of the data and the analytic approach are explained in the following paragraphs.

### **3.3 Analytical approach**

The aim of this study is to get a better understanding of what actions in talk the iGEM members use to present themselves and science and what implications this has for the dialogue between iGEM and their publics.

Discursive psychology was used to analyse the conversations during outreach activities of iGEM in a detailed non-cognitive way. In discursive psychology the focus is not on the assumptions about how people feel or what their motivations are but on what actions are being achieved with talk and what their talk reflects (Veen et al., 2012). The focus of the analysis is on how the iGEM teams use talk to construct their own identity and how they construct science and doing science. This study does not focus on the content of what the iGEM team members are saying but on how it is said and what actions are being achieved with this (Veen et al., 2012). Discursive psychology tries to understand what people want to reach with discourse, consciously or unconsciously (Aarts & Van Woerkum, 2010). The founders of discursive psychology argue that discourse is the central part of life (Potter & Edwards, 2001).

Discursive psychology is mainly applied on naturalistic data. With this is meant that the data collected are obtained during activities people normally do, such as visiting a doctor, celebrating a birthday or visiting a festival (Potter & Wiggins, 2007). The analyst does not actively take part in the interaction by participation or initiating the conversation (Mogendorff et al., 2012). These naturalistic data are used to avoid imposing the researchers' own assumptions and categories on the data, to study life as it happens messy and seemingly complex and to analyse people in situ. This can create situations the researcher did not expect (Potter & Wiggins, 2007).



### **3.4 Data analysis**

Before the data analysis started, two research questions were proposed. In discursive psychology no hypotheses will be formulated to make it possible to analyse the data with an open mind to make it possible to find phenomena in talk the analyst did not expect beforehand (Potter & Edwards, 2001). The research questions are used to keep a focus during the data analysis.

#### *3.4.1 Transcription*

After the data collection, the conversations were transcribed first. After the transcription, repeated listening to the data and reading of the transcripts was conducted to search for phenomena in talk of identity constructions of the iGEM members (Potter & Wiggins, 2007). Repeated listening helps to find features that recur (Silverman, 2011). The selected fragments are analysed using the Jeffersonian transcription method, the symbols used can be found in appendix 1. In conversations a little sniff or a small pause can already have an influence on the conversation (Potter & Edwards, 2001), by using the Jeffersonian transcription method it was possible to make these small details visible.

#### *3.4.2 Selection of phenomena*

Atlas.ti, a software package for qualitative research was used to analyse the transcripts (Bouwman & te Molder, 2009). In the data was searched for the different discursive resources that are used by iGEM members to construct their own identity (Bouwman & te Molder, 2009). Then the identity constructions were coded and grouped in broader terms together (Kerr et al., 2007). Codes were for example “do-gooder” and “knowledge”.

In this way, different groups of identity constructions were created. The five most occurring phenomena of identity construction were selected. These groups were examined in more detail to find out what actions are achieved by these constructions, when these constructions are used and if there are differences per situation. These constructions were analysed in two steps.

#### *3.4.3 A two-step analysis*

The groups of fragments were analysed in two different ways, by examining the turn-by-turn steps and by using the rhetorical principle.

First the data are analysed by examining the turn by turn steps in conversations to create an understanding of what social actions are performed in talk (Mogendorff et al., 2012). The analysis was validated by examining the reactions of the conversation participants, as these reactions serve as a guide for the researcher (Potter & Wiggins, 2007).

The second step in analysing the data by discursive psychology was done by using the rhetorical principal. People often use certain constructions to counter real or potential alternatives (Potter, 1996). In this study, the iGEM members also deny or counter potential arguments, for instance by normalizing the work they do. In this way, they deny the potential arguments that synthetic biology is difficult or dangerous. In this report, a selection of the most frequently occurring phenomena is presented in chapter four. The presentation of the raw fragments gives the reader the possibility to follow the steps the researcher made during the analysis of the fragments and allows a check of the fragments by the readers (Potter & Edwards, 2001). After analysing, the groups of fragments the data were translated by a near-native English speaker.





8                   ze is dus daarvoor moeten we ze een beetje plagen  
                    *them so we have to tease them a little bit for that*

9 visitor1       haha  
                    *haha*

The fragment above starts with an explanation of an iGEM member about the uptake of DNA into bacteria. When talking about cells, he first describes them as "*just round spheres*". In this way, the material they work with is constructed as something not to be afraid of, especially by using the word "*just*". After this explanation, the iGEM member gives the cells agency: as if they have a life on their own. See line 6 and 7: "*because they just do not want strange DNA take in the inside because they do not know what they are bringing in if it is good for them*". By giving these cells agency, the attention is drawn away from the subject discussed.

After this, he proceeds with: "*so we have to tease them a little bit for that*". Using the words: "*tease them a little*" he relativizes the topic he works on. By using the word, "*teasing*" the iGEM member presents the work they do as something you should not take too seriously. The others start laughing after this sentence and hereby interpret this also as not too seriously.

At the Discovery Festival, the iGEM members often construct themselves as a "bricoleur", by talking about building in and with bacteria. This phenomena, of creating an identity as bricoleur, occurred only once during the Transnatural Festival. It did not occur during the Meeting of Young Minds 2011 or 2012. The following fragment is recorded at the beginning of the virtual lab tour. The iGEM member starts with an explanation of what synthetic biology is.

## Fragment 2: Discovery Festival 22 (782:786)

1 iGEM1           wij proberen op een manier euh zo te bouwen dat euh dat ze dingen gaan  
                    *we are trying to build uhm in such a way that uhm they will*

2                   produceren of zich gaan gedragen zoals wij dat willen (.3) euh dat ze  
                    *produce or behave the way we want that (.3) uhm that they*

3                   bijvoorbeeld bepaalde dingen niet doen of bepaalde dingen wel doen dus  
                    *for instance certain things don't do or do things so*

4                   dat ze bepaalde eiwitten maken of andere stoffen die wij handig vinden  
                    *that they create certain proteins of other kinds of materials that we*  
                    *find useful*

5                   hier om te hebben een van de meest belangrijkste euh oude voorbeelden  
                    *to use here one of the most important uhm classic examples*

6                   daarvan is euh penicilline dat euh is wordt wordt door een schimmel  
                    *is uh:m penicillin that uh:m is is made by a fungus*

7                   gemaakt een beetje maar te weinig in die zin euh kun je dat  
                    *a little but too little in the sense uh:m you can*

8                   optimaliseren dattie nog meer gaat maken dat soort dingen zijn ook  
                    *optimise that it will produce more those kinds of things are also*

9                   dingen die we doen↓ maar ook gewoon hele nieuwe dingen erin bouwen  
                    *things we do↓ but also just build in new stuff*

10                  die ze dus normaal niet horen te maken zoals een gele kleur of rooie  
                    *that they normally aren't supposed to be producing like a yellow*  
                    *colour or red*



- 11            kleur euh daar willen we jullie een rondje hierzo laten lopen door  
*colour uhm we want to have you walk around over here*
- 12            onze zelf geïmproviseerde lab (.5) om euh om jullie een goede uitleg  
*in our self-improvised lab (.5) to uhm give you a proper explanation*
- 13            te geven over hoe hoe het dagelijks leven bij ons dus op een typische  
*about how how in everyday life here so on a typical*
- 14            dag wij op het lab staan eigenlijk  
*day we move around in the lab actually*
- 15 visitor2   hoe doen jullie voor competitie dan?  
*what would you do for competition then?*
- 10 lines removed*
- 16 iGEM1      die dan stukjes in elkaar willen zetten want ze hebben daarzo euh een  
*who then want to put in pieces because they have got over there uhm a*
- 17            hele catalogus met wat wij noemen een soort legostukjes die je  
*whole catalogue with what we call a kind of lego bricks which you can*
- 18            allemaal in elkaar kunt zetten  
*all put together*

In this fragment, the iGEM member talks about the things they do with single-cell organisms like yeast and bacteria. In the first line of the fragment, he explains that they build these organisms in such a way that they produce or behave as the scientists want: *"build uhm in such a way that uhm they will produce or behave the way we want"*. This can be interpreted as that he constructs their work as something you build, like a house. Using this word, the work is constructed, as easy and as normal, not as something people have discussions about, like genetic modification. By this construction, the topic iGEM works on is relativized. Hereby the argument that the iGEM members are doing things you have to worry about is being denied.

After talking about classic examples, the iGEM member continues in line 9 with: *"but also just build in new stuff"*. The iGEM member constructs the new applications as something normal using two times the word *"just"* and by again mentioning the word *"build"*. By using the word *"build"* and by calling the fungus several time *"they"* the attention is drawn away from synthetic biology, the topic they were talking about. In this way synthetic biology is constructed as something you do not have to be afraid of. At the same credibility is claimed by the sentences (line 12-14): *"to uhm give you a proper explanation about how how in everyday life here so on a typical day we move around in the lab actually"*. Credibility for his story is created by referring to his category-bound activity: working in a lab, as is mentioned *"on a typical day"*. By these words, he actually constructs himself as somebody who is often working in the lab. With this, he claims entitlement to speak. A visitor responds to this claim by asking: *"what would you do for competition then?"*. With this question, the visitor claims entitlement to speak.

A few moments later, he talks about a catalogue from which you can order DNA. He does not mention DNA but talks about "Lego". Doing this, the work he does is constructed as something that can be compared with playing with toys. In this way, the iGEM member presents himself as someone who works on a normal topic.



In the following fragment the iGEM member explains that it is possible to build certain properties into bacteria. You can build these properties from DNA but you can also take these properties from organisms found in nature that already have a specific property, for instance producing penicillin.

### Fragment 3: Discovery Festival 21 (372:377)

1 iGEM1            maar eu:hh (.2) maar en dat proberen wij dus zeg maar via de natuur te  
                         but u:hm (.2) but and that is what we are sort of like through nature  
                         trying to

2                    regelen zodat het in euh nouja dan krijg je Wageningen thema (.8) op  
                         control so that it in uhm well then you get Wageningen theme (.8) in

3                    een mooie manier wordt gedaan want de natuur doet het het beste  
                         a nice way it gets done because nature does it it best

4 visitor2        haha  
                         haha

5 iGEM1            maar het is gewoon ook leuk om daar gewoon mee te knutselen  
                         but it is just also fun to fiddle around with that

6 visitor1        oke↑ leuk  
                         okay↑ cool

The fragment starts with a story of an iGEM member who tells that in Wageningen scientists first try to get certain genetic characteristics from nature. The DNA parts responsible for these genetic characteristics are used to incorporate this property in the DNA of bacteria. With this sentence: "*in a nice way it gets done because nature does it it best*", synthetic biology is constructed as more natural, hereby denying that scientists only use more "difficult synthetic things". In line 4, one of the visitors reacts with laughter. It is possible that she laughs because she finds his reaction funny; it is also possible that she reacts with laughter, as she does not take him seriously. With this laughter, she potentially denies the story of the iGEM member.

After the laughter, the iGEM member claims his expertise by talking about experiences in line 5: "*but is just also fun to fiddle around with that*". He constructs the work they do as something that is "fun" and is like "fiddling". By doing this, he presents the topic iGEM works on as "light and easy" and nice to do. After this, another visitor reacts with agreement: "okay↑ nice". This reaction of the visitor shows agreement, with the construction that the work iGEM does is fun.

### Summary

Analysis of the Discovery Festival recordings shows that the iGEM members often use words like building or fiddling. By doing this, they construct an identity as a "bricoleur". By using words as "building", the iGEM members relativize the topic they work on.

By talking about Lego and round spheres instead of DNA and cells, they give these items agency and the iGEM members draw away the attention from the topic they work on.

By using these constructions, the work iGEM does is presented as "just normal" and they deny that their work is dangerous or that it is work people should be afraid for.

During the Discovery Festival, the iGEM members talk enthusiastic about their lab activities, but do not refer explicitly to synthetic biology.



The construction of doing being just normal only occurred during the Discovery Festival. By constructing their work as something normal, they create a “relaxed” and more informal atmosphere as host of their lab at the Discovery Festival.

#### 4.2 Having good will

In the conversations analyzed, the iGEM members often present themselves as actors having good will. This phenomenon is observed at the Discovery Festival and at the Meeting of Young Minds. At the same time, the public is portrayed as having fears for the work that iGEM members do. In this paragraph, three fragments will be discussed.

The following fragment is a transcript of the Meeting of Young Minds 2011. Here one of the iGEM members presents herself and talks about the activities of her iGEM team.

#### Fragment 4: Meeting of Young Minds 2011 part 1 (45:45)

1 iGEM1 I am from Leuven thank you euh hehe euh I am Katrien (.3) and I  
2 believe that you haven't read all of our projects but I want to  
3 convert especially you but you see various ways of synthetic biology  
4 in general (.4) euh and we of KU Leuven and probably most of the teams  
5 (?) we think that human practices are very important to each on every  
6 subject we handle that's why we also organised a debate and there we  
7 learned that we want to inform people but most of us are just  
8 scientists and we are not ((inaudible)) enough to inform other people  
9 but  
10 we are really willing to do we are not just monsters creating bigger  
11 monsters or something  
12 moderator mm↓  
13 audience laughter  
14 iGEM1 we really want to inform the public and be very open a:nd you both  
15 said something o:f polities of politicians are be very behind and  
16 that's true in a fact that in Belgium for example euh we have no  
17 committee for synthetic biology we have no specific law and that's why  
18 we want to draw the attention of the whole public of every country and  
19 to say here it is (.3) euh we are very transparent (.4) that's the  
20 wonderful thing of iGEM everybody can read about our projects and we  
21 are really open for discussion if you think something is dangerous  
22 (.6) it is always possible we could think about it but (.3) we want we  
23 just hope that people will are willing to come to us and say it and  
just don't be afraid of it

The fragment starts with an introduction of the iGEM member. She continues with explaining that her iGEM team thinks that: “*human practices are very important to each on every subject we handle*”. She proves this by the following sentence in line 6: “*that's why we also organised a debate*”. By giving this example, she proves and constructs their team as a group that is already talking with the public. By doing this, she denies the argument that they are scientists who do not want to talk with the public.

Then she continues: “*want to inform people but most of us are just scientists and we are not ((inaudible)) enough to inform other people but we are really willing to do*”. In this sentence, she constructs scientists and iGEM as people who would like to inform the public.

Then she gives another construction of the scientist: being a monster. This construction is mentioned several times during the debates. By saying: “*we are not just monsters creating bigger monsters or something*” the iGEM member constructs the public as a group who sees scientists as monsters. The audience starts to laugh. With this description, she portrays the public as having fears. By doing this, she reflexively constructs herself as rational, a phenomenon also found in other studies (Locke & Edwards, 2003). The moderator reacts on this with “*mm*”; with this action, he questions the validity of this





construction. Then the audience starts to laugh, by doing this they undermine the intentions mentioned by the iGEM member or the reaction of the moderator.

In the second part of the fragment, the iGEM member starts talking about the transparency and openness of iGEM. Hereby, she again denies the opposite idea that scientists do not communicate. She constructs the public as possibly afraid to discuss about fears and to come to iGEM: *"we want we just hope that people will be willing to come to us and say it and just don't be afraid of it"*. By mentioning the word "afraid" the iGEM describes the emotions of the public as having "fears" for synthetic biology. Again, she reflexively constructs her identity as rational. She emphasizes this by displaying iGEM as caring about the public (Locke & Edwards, 2003) and helpful in informing them, for instance in line 8-9: *"inform other people but we are really willing to do"*. Good will is constructed, with this construction.

In the fragment, the iGEM member mentions the word synthetic biology twice and the open character of synthetic biology. With this sentence: *"we have no committee for synthetic biology we have no specific law and that's why we want to draw the attention of the whole public of every country and to say here it is (.3) euh we are very transparent"*, iGEM is constructed as more responsible than the government. iGEM is presented as open about everything and pro-active in informing the public, in contrast with the politicians who are portrayed as *"very behind"*.

Next fragment is from the second round of the Meeting of Young Minds 2011. In this round the regulation of synthetic biology was discussed. An iGEM member from a Belgian team shows her concerns about the idea that the government is going to regulate synthetic biology. The person who responds to this statement is a young politician of the Dutch Christian Democrats.

#### **Fragment 5: Meeting of Young Minds 2011 (143:144)**

1 iGEM1 the government can't allow it because probably it won't be some of  
2 their biggest concerns (.5) there are lots and lots of other things  
3 they are concerning (.4) andeuhm (1.0) as twenty years ago I should've  
4 told you just swallow that fungi a:nd you'll get better (.5) I believe  
5 you I would think I am crazy<sup>↑</sup> (.4) now if I say swallow that anti  
6 antibiotics (.4) you say o::h of course<sup>↑</sup> I will I mean it will get me  
7 better<sup>↓</sup> (.4) so my question is why are we so afraid for it and can't  
8 you put a little bit trust in scientists and unders different euh  
9 people not only people who are involved to the project because of  
10 course there are some economical benefits (.4) but also other (.2)  
11 parties (.5) un abandoned parties  
12 Politician well my experience also from working in the field of biology also  
13 working in the fields of euh drug development (.) is that scientists  
14 usually start with the good intentions (.3) mostly they do and ninety  
15 five percent of their cases they are going certainly right however  
16 some cases just go wrong you have medication developments (.) we have  
17 certain checks of balances in there and that's why it takes twenty  
18 before a medicine from the lab (.5) g::oes to the bedside of patients

In line 3 the iGEM member says: *"twenty years ago I should've told you just swallow that fungi a:nd you'll get better"*. By using the words *"just swallow"*, the topic is constructed, as something you just do easily, not something difficult and with positive results: *"a:nd you'll get better"*. It is constructed as a gift. By referring to: *"twenty years ago"*, she constructs the topic she is working on as something ordinary and used by everybody for twenty years. By referring to this, potential concerns are denied.

Then she proposes an answer of the public in line 5: *"now if I say swallow that anti antibiotics (.4) you say o::h of course<sup>↑</sup>"*. Stating, *"you say"*, using a generally shared experience, support is invoked for her position. This action is also recorded in the work of (Stirling & Manderson, 2011). With this sentence, the



public is constructed as having fears about synthetic biology. By drawing an analogy between antibiotics and synthetic biology, she assumes, if people hear this story, that they will be positive about synthetic biology: *"it will get me better"*.

In line 7 the iGEM member starts about trust in scientists: *"so my question is why are we so afraid for it and can't you put a little bit trust in scientists"*. First, she aligns with the public using *"why are **we** so afraid for it"*. By using *"we"*, she constructs herself as somebody from the public. After seeking alignment, she constructs herself as a scientist who is knowledgeable and who can regulate synthetic biology research. Then the sentence construction dissociates the iGEM member from the others and constructs the public as having no trust in science: *"and can't you put a little bit trust in scientists"*. By dissociating, she reflexively constructs herself as somebody who can be trusted.

In line 12, the politician responds to the direct request for trust in scientists. First, he shows his expertise by referring to his experiences in the lab: *"well my experience also from working in the field of biology also working in the fields of euh drug development"*. Interestingly, he refers to drug research and not to synthetic biology. Then he shows his appreciation for scientists and again he presents himself as having experience in line 13: *"scientists usually start with the good intentions (.3)"*. By saying this, he shows his trust in science and aligns with the story told by the iGEM member. By presenting himself as trustworthy, he also acknowledges that he is normally not against scientists. By doing this, he denies that he is always against scientists; this could make his argument against trust in science less credible.

Then he proceeds: *"mostly they do and ninety five per cent of their cases they are going certainly right however some cases just go wrong"*. He refers to his experiences that sometimes cases *"just go wrong"*. With this answer, he claims, besides being a politician, his independent access to information and his knowledgeability about the lab and hereby he claims to know more than the iGEM member does.

The following transcript is recorded at the end of the virtual tour during the Discovery Festival.

#### **Fragment 6: Discovery Festival 21 (368:382)**

1 visitor1 kunnen jullie ook andere dingen doen zoals geneesmiddelen enzo?  
*can you also do other stuff like medicine and the like?*

2 iGEM1 nou wij hebben een project bijvoorbeeld en de geneesmiddelen worden  
*we have a project for example and the medicine are*

3 ook echt worden gemaakt in organismes euh penicilline is een van de  
*really made in organisms um penicillin is one of the*

4 meest bekendste die wordt gewoon door een schimmel gemaakt die is  
*most well-known which is just made by a fungus which has been*

5 gemodificeerd eneu::h (.2) ja dat is gewoon heel erkend dat weten  
*modified and u::m (.2) yes that is well known people do not know*

6 mensen niet die denken van oh dat is bang die zijn bang voor  
*they think oh that is scary they are scared of*

7 genetische manipulatie maar dat is gewoon het verhaal ervan (.) en dat  
*genetic manipulation but that is just the story of it (.) and that*

8 is dat wordt wereldwijd gebruikt  
*it that is worldwide used*

9 visitor1 ja↓  
Yeah↓



The fragment starts with a question from the public: *"can you also do other stuff like medicine and the like?"* With this question, the visitor claims knowledgeability by already mentioning an example *"like medicine"*.

The iGEM member starts to answer but after a few words, he starts talking about the production of penicillin, which is not part of their project. While talking about penicillin he constructs the work they are doing with bacteria as something light and used worldwide. This starts in line 3 where the iGEM member says: *"um penicillin is one of the most well-known which is just made by a fungus which has been modified"*. By saying, *"just made by a fungus"*, the iGEM member constructs this as normal and natural as penicillin is made in nature by a fungus. Then he follows his sentence with: *"and u::m (.2) yes that is well known"*. With this sentence, he constructs (genetic) modification as something that is not new but as something used for a long time. By stating this the public is constructed as having fears for modification.

After this story the iGEM member gives an anecdote where he characterizes the public as uniformly ignorant, a phenomenon also observed by Cook et al. (2004). *"yes that is well known people do not know they think oh that is scary they are scared of genetic manipulation but that is just the story of it (.) and that it that is worldwide used"*. With this sentence, *"people"* are constructed as scared about genetic manipulation, which is created by a lack of knowledge. By constructing the public as uniformly ignorant the iGEM member portrays himself as quite the opposite, namely, as rational (Locke & Edwards, 2003).

He continues with *"but that is just the story of it"*. He constructs genetic modification as something light, something normal, using the word *"just"*, if you know about it then there is nothing to be scared of. In this way the iGEM member actually says: These are the facts, so I have done my task. He follows the sentence with: *"that it that is worldwide used"*. With this sentence, he constructs the topic as something used for years. This is also seen in the previous fragment where an iGEM member constructs synthetic biology (not genetic modification) as something that is already used for 20 years. After this story, the visitor only reacts with *"yes"*. This answer can be interpreted as agreement. It is also an answer that is expected after the *"closed"* story from the iGEM members about the facts around genetic manipulation. In this way, the researcher left no room for a discussion.

### **Summary**

During the Meeting of Young Minds 2011 the iGEM members constructed the public as people having fears for synthetic biology and genetic modification. At the same time, the iGEM members emphasize that this is something not to be afraid of and already done for years. The iGEM members construct the public as ignorant too, mentioning that knowledge about the work they do will help to reduce the fears of the public. In this way they portray themselves reflexively as rational and create a division between iGEM and the *"others"*. This construction of the public is emphasized by presenting their good will to explain to the public what they are doing. Sometimes these constructions are challenged by the audience of the Meeting of Young Minds.

During the Discovery Festival the public is also constructed as ignorant and having fears. At the same time synthetic biology is described as something done for years, which nobody has to be afraid of, as the scientists working on synthetic biology are rational scientists. The iGEM members also mention genetic modification as something not to be afraid of. By doing this, the iGEM members present themselves as rational actors having good will.



### 4.3 Doing being a solver of global problems

During the Meeting of Young Minds 2011, iGEM members often present themselves as people providing solutions for global problems. They talk for example about creating new ice to save the polar bears, pigs without brains and solutions for desertification. During the Discovery Festival and Transnatural Festival, the iGEM members also explained about the solutions they want to provide for global problems.

The recordings show also that visitors of the Discovery Festival and the people iGEM members discuss with at the debate have different expectations of iGEM. An example of such an expectation is seen in fragment 13, where visitors of the Discovery Festival show that they expect education about synthetic biology. In fragment 9, the visitors show another expectation: that they expect iGEM to have great ideas. This paragraph presents three fragments. The first fragment is from the Meeting of Young Minds 2011. It starts after one of the iGEM members has explained about her project. In this project, they found a solution to form ice from water, to save for instance the polar bear. Fragment 7 shows that this role the iGEM member constructs pop up questions and concerns by the politician from the young animal party PINK!.

#### Fragment 7: Meeting of Young Minds 2011 (312:328)

```
1 politician|did you say that you wanted to create new ice for the polar bears?
2 iGEM1      yeah in our project we make (.2) euh ideofrosty (?) he is our project
3            (.) and we can euh form ice from cold water
4 politician|yes
5 iGEM1      or we can prevent ice inclination (.3) so
6 politician| [are are ]
7 iGEM1      that's important (?) we can do it both from bacteria
8 Politician|so (?) so how much ice were were you planning on making (?) like
9            covering the whole North pole again (?) with ice?
10 iGEM1     if you would like it
11 audience  Laughter
12 politician|I am sorry
13 iGEM1     we would do it
14 audience  Laughter
15 politician|now I I I I
16 moderator that's great yeah
17 politician      thank you now thank you thank you very much
18 audience  [Applause ]
19 moderator      [this is something you would agree on]
20 politician|I am sorry
21 moderator this is something you would agree on right?
22 politician|well I would rather wonder what effect it would have on the global
23 climate
24 moderator mm
25 politician|if we started creating new ice caps on the on the North pole (.3) euhm
26            (.2) no I actually I I would have rather been puzzled by that but I I
27            accept the gesture (.) and I think it is very nice of you↓
28 audience  laughter
```

The fragment starts with a question of one of the politicians. With this question, the politician tries to summarize the story heard before. The iGEM member again starts explaining their project in line 2-3. With this explanation, the work of iGEM is presented as a solution for a global problem: "*we can prevent ice inclination*". In line 8, the politician appears not very certain about his thoughts as he asks: "*so how much ice were were you planning on making (?) like covering the whole North pole again (?) with ice?*". The iGEM member reacts and explains that they have an easy solution for this worldwide problem: "*if you would like it*". The audience starts to laugh and the moderator says: "*that's great yeah*". The laughter and the reaction of the public make it look like these people construct this solution as something not to worry about. For the politician the simple construction of iGEM as problem solver creates concerns.



As he starts about the problems, he foresees: “*well I would rather wonder what effect it would have on the global if we started creating new ice caps on the on the North pole*”. In between, the moderator reacts with “*mm*”, in this way he constructs the view of the politician as negative or uninteresting. This fragment shows that the construction of iGEM as solvers of worldwide problems can create concerns, however in this fragment the politician gets no space to talk about these concerns, and did not get the chance to challenge the dominant view of the iGEM member, a phenomenon also reported in the work of Kerr et al. (2007). The debate focuses mainly on the concerns around synthetic biology, by presenting herself as provider of solutions for global problems; the iGEM member denies the potential concerns or negative sides of synthetic biology.

The following fragment is recorded during the Discovery Festival. This fragment shows that visitors do not always accept the expectations iGEM members create.

### **Fragment 8: Discovery Festival 1E (158:184)**

- 1 iGEM1           dus wij proberen nu (.4) zodanig de medicijnen te verpakken (.)  
*so we are now trying to (.4) package the medicines in such a way (.)*
- 2                   dat ze alleen maar naar de tumor gaan (1.7) en dat is heel makkelijk  
*that they only go towards the tumour (1.7) and that is very easily*
- 3                   gezegd(.2) maar euh daar zijn we de hele zomer  
*said (.2) but uhm we have been the whole summer*
- 4 visitor1        maar daar zijn ze toch al heel lang mee bezig met daar soort dingen?  
*But haven't they been busy for a really long time with that kind of things?*
- 5 iGEM1           ja daar zijn ze absoluut al heel lang mee bezig  
*yes with that they have absolutely been busy for a long time*
- 11 lines removed
- 6 iGEM1           dus doordat wij ze nu verpakken (.3) kunnen de medicijnen niet op  
*so because we now package them (.3) are the medicine unable to get on*
- 7                   het lichaam (.9) waar ze niet moeten zijn  
*the body (.9) where they are not supposed to be*
- 8 visitor1        zijn dat die monoclinale antistoffen of zo?  
*are they monoclonal antibodies or something?*

The fragment starts with an explanation of the iGEM member about their project and the innovative ideas they have to develop new ways of medication transport in the body to let medication work better without side effects. In line 4 the visitor reacts: “*But haven't they been busy for a really long time with that kind of things?*”. With this reaction, the visitor claims her entitlement to speak by presenting herself as knowledgeable. By showing her knowledge, she starts to negotiate with the iGEM member. In this way, she challenges the expectations the iGEM member created. Then the iGEM member claims entitlement to speak in line 5: “*yes with that they have absolutely been busy for a long time*”. He repeats the sentence of the visitor but includes the word “*absolutely*”. By using this word, independent access is claimed. The iGEM member continues his story. Later on, again the visitor claims her authority by using scientific words: “*are they monoclonal antibodies or something?*”. This fragment shows that in the interaction between visitors and iGEM members a negotiation takes place (Davies, 2011), about the



expectations constructed. This is a contradiction with the previous fragment, where the arguments of the iGEM member are not challenged.

In fragment 9, the visitors react in a different way to the innovative ideas presented by the iGEM member. Here, in comparison with the previous fragment, the visitors accept the role the iGEM member constructs: as scientists with solutions for the future. In line 3-4, one of the visitors says: “*then we can say ye::s we used that to make vanilla for an evening (.) we know him*”.

### **Fragment 9: Discovery Festival 1B (202:229)**

```
1 visitor2    als dat mooi eu::h uitgewerkt is  
              if that gets uh::m solved correctly  
  
2 iGEM1      ja  
              yes  
  
3 visitor1    dan zegge we ja:: daar hebben we nog een avond vanille mee zitten (.)  
              then we can say ye::s we used that to make vanilla for an evening (.)  
  
4            maken die kennen we  
              we know him
```

### **Summary**

The iGEM members construct themselves as providers of solutions for global problems during the Meeting of Young Minds 2011. They are talking about the innovative ideas they work on to solve worldwide problems such as ice inclination. Although the iGEM members construct themselves as problem solvers, others raise their concerns and challenge the identity construction.

During the Discovery Festival and the Transnatural Festival, the iGEM members present iGEM also as providing solutions for global issues by talking about their projects. Sometimes these expectations created by the iGEM members are expected and accepted. At other moments, the other people in the conversation challenge the identity iGEM members construct. The reactions of the festival visitors and the others at the debate show that they have different expectations of iGEM.

### **4.4 Doing being careful**

During the Discovery Festival, it often occurred that the iGEM members constructed their identity as careful. They mention that they follow the rules, whereas others do not, and show their carefulness in the lab by talking about their safety activities in the lab back home. The iGEM members emphasize this this by wearing a lab coat during the festival.

In the first fragment, the iGEM member constructs an identity as careful and trustworthy.

### **Fragment 10: Discovery Festival 17 (718:731)**

```
1 iGEM1      ik zal verklappen dat we niet meer gewerkt hebben dan zout en appelsap  
              I can tell you now that we have not worked with little else than salt  
              and apple juice  
  
2 visitor1    ja nee zo'n vermoeden  
              yeah no such a suspicion  
  
3 iGEM1      [haha          ]  
              [haha          ]  
  
4 visitor1    en het kan nooit heel gevaarlijk zijn dus euh  
              and it can never be very dangerous so um
```





"wantons", who do not follow the rules imposed for genetic modification, which can be seen as a step before synthetic biology or a part of synthetic biology.

The following fragment is recorded during the virtual lab tour at the Discovery Festival too. An iGEM member is explaining something and in the meantime, he finds a bin they use for trash. He starts talking about how they treat trash.

### Fragment 11: Discovery Festival 17 (585:608)

1 iGEM            ohja dit is ook een afvalbak (.4) blijkbaar (.6) he (2)  
                  *oh right this is also a trash bin (.4) apparently (.6) he (2)*

2                    normaal wordt het afval allemaal verzameld in een in een apart  
                  *normally the trash is all collected in a in a separate*

3                    bakje daar gaat dan een sticker op dat moet dan eerst op 130  
                  *bin a sticker is applied to it that should first go up to 130*

4                    graden gemaakt worden (.2) dan gaat echt alles kapot gekookt  
                  *degrees (.2) then everything will get boiled up*

5 visitor1        oké↑  
                  *okay↑*

6 iGEM            en dan wordt dat ook weer allemaal apart euh afgevoerd  
                  *and then it will all be also separately euh taken away*

17 lines removed

7 iGEM            ja↑ (.7) dat zijn de goeie puntjes↓ (.7) dan moet je schuiven  
                  *yes (.7) those are the good tips↓ (.7) then you should slide*

8                    (unhearable) ja dan het DNA pakken (.9) dat is deze  
                  *(unhearable) yes then take the DNA (.9) that is this one*

9 visitor1        ja  
                  *yes*

10 iGEM           we schrijven er wel (.) wel op wat erin zit  
                  *we will write (.) what is in it*

11 visitor1        ja↓ hehe  
                  *yes↓ hehe*

12 iGEM           vooral ook echt echt heel erg belangrijk (1.1) normaal gesproken  
                  *specially because it is really really important (1.1) normally*  
                  *speaking*

13                    als er normaal gesproken een fles vloeibare gewoon een  
                  *if there normally speaking a bottle of liquids just a*

14                    vloeistof staat (.7) wat wit is en waar niks opstaat (.8) dat  
                  *liquid is (.7) which is white and has nothing on it (.8) that*

15                    wordt dan euh euh op 130 graden alles kapot gemaakt want je  
                  *gets at uhm uhm 130 degrees all destroyed because you*

16                    weet niet wat er in zit  
                  *do not know what is in it*

The iGEM member starts with making a contrast between the virtual lab tour and the work he normally does on the lab: "normally the trash is all collected in a in a separate bin". By using the word "normally",





the work they do “at home” is constructed as more careful than presented at the virtual lab tour. He also constructs the safety regulations they follow as something procedural or normal. With this construction, the iGEM member constructs himself as someone who normally takes care of safety.

Then the iGEM member explains their carefulness by mentioning several category-bound activities: “a sticker is applied to it that should first go up to 130 degrees (.2) then everything will get boiled up”. By mentioning these activities, like applying the sticker and boiling the waste at 130 degrees he shows that he has knowledge and expertise about working in a safe way. By referring to these procedures, he also emphasizes his scientific carefulness. He even gives this extra attention by saying: “then everything will get boiled up”. By saying this, he actually emphasizes that people do not have to be afraid. Interestingly, the visitors did not ask for this explanation about safety. Still the iGEM member seems to feel the need to construct himself as careful. The visitors only react with “yes” in line 5 and ask no questions. The iGEM member continues his story in line 6.

Then the iGEM member starts to talk about safety again in line 13. Once more without a direct question of the public, he constructs his identity as careful by saying: “normally if there normally speaking a bottle of liquids just a liquid is (.7) which is white and has nothing on it (.8) that gets at uhm uhm 130 degrees all destroyed because you do not know what is in it”. In this explanation he starts with “normally if there normally” in this way, safety measures are constructed as something usual, procedural and done always. By giving an example: “normally speaking a bottle of liquids just a liquid is (.7) which is white and has nothing on it (.8) that gets at uhm uhm 130 degrees all destroyed” the iGEM member shows his expertise with working in a safe way. In this way, he again constructs his identity as careful. He also constructs the work they do as something not to be afraid of by saying in line 4 and 15: “that gets at uhm uhm 130 degrees all destroyed”. By saying this, the iGEM member denies the counter argument that what the iGEM members are doing is dangerous.

## Summary

In the fragments, the iGEM members talk about their activities to “perform” synthetic biology. The iGEM members construct themselves and their activities as careful, especially during the Discovery Festival, by referring to their careful ways of working in the lab back home.

The recordings show several times that visitors expect this trustworthiness and carefulness from iGEM. However, sometimes the iGEM members talk about carefulness at the lab but the science festival visitors do not react or ask questions about this way of working. It seems that the visitors feel no tension during the Discovery Festival to worry about safety issues.

## 4.5 Doing being knowledgeable

While reading the transcripts and listening to the recordings, it became clear that the iGEM members present themselves as knowledgeable. The others they are taking to present themselves as knowledgeable as well.

During the Discovery Festival, the iGEM members construct their identity as an educator of synthetic biology, thereby claiming their knowledgeability. While reading the transcripts it became clear that the visitors of the Discovery Festival expect this role from iGEM as “educator”. At the same time, the visitors also claim their knowledgeability by asking questions and by using scientific language.

During the Transnatural Festival, the iGEM members present themselves as knowledgeable by using scientific words. The moderator and audience members challenge the story of iGEM by asking questions



in which they show their knowledge by making use of scientific terms and proposing a hypothesis. Doing being knowledgeable, is not observed frequently during the debates of the Meetings of Young Minds.

The first fragment of this paragraph is recorded during the start of one of the virtual lab tours at the Discovery Festival. The virtual lab tour is an example of a traditional power structure where a scientist presents information (Davies, 2011). In this fragment, this traditional power structure is accepted first, then contested by the visitors, and then again, the structure is refigured to the traditional power structure.

### Fragment 12: Discovery Festival 21 (200:210)

- 1 iGEM1           kennen jullie euh synthetische biologie of niet?  
*do you know uhm synthetic biology or don't you?*
- 2 visitor1       nee niet echt  
*no not really*
- 3 visitor2       nee begin maar bij het begin natuurlijk  
*no start just at the beginning of course*
- 4 visitor1       haha  
*haha*
- 5 iGEM1           nee ja? oke ja (.5) ik (.4) ik zal bij het begin beginnen euh ik ben  
*no yes? Okay yes (.5) I (.4) I shall start at the beginning uhm I am*
- 6                 Jim (.4) ik kom uit Wageningen  
*Jim (.4) I am from Wageningen*
- 7 visitor1&2     daar staat Mar  
*it says Mar*
- 8 iGEM1           he?  
*wha?*
- 9 visitor1       daar staat Marcel↓  
*it says Marcel↓*
- 10 iGEM1          Marcel (.) oh↓ ja↑  
*Marcel (.) oh↓ yes↑*
- 11 visitor1       haha  
*haha*
- 12 iGEM1          dit zijn labjassen die hebben we uit het lab gejat↓ euh (.) nou gejat  
*these are labcoats which we have stolen from the lab↓ uhm (.) well  
stolen*
- 13                 geleend maar er zijn sommige mensen die hangen hun naam dus euh (.)  
*borrowed but there some people who put their names so uhm (.)*
- 14                 jij mag me Marcel noemen als je wil  
*you can call me Marcel if you like*
- 15 visitor1       ja↓  
*yes↓*
- 16 iGEM1          euhm (.) maar ik ben euh deel van de Wageningen van het iGEM team (.)  
*uhm (.) but I am uhm part of the Wageningen of the iGEM team (.)*
- 17                 iGEM is een euh internationale met synthetische biologie (.3) e:n ik



*iGEM is an uhm international with synthetic biology (.3) an:d I'll*

18            zal even uitleggen wat synthetische biologie is  
*explain quickly what synthetic biology is*

19 visitor1    ja  
                  yes

20 iGEM1        synthetische biologie is euh (.5) bacteriën  
*synthetic biology is uhm (.5) bacteria*

7 lines removed

21            voor de computer dat nullen en enen zijn (.5) bacteriën daar ook zijn  
*for the computer those are zeroes and ones (.5) bacteria has its*

22            eigen code voor  
*own code as well*

23 visitor1    euheuh↓  
                  uhhum↓

24 iGEM1        eu:hm (.) en wat het mooie is we kunnen zelf stukjes toevoegen aan  
*u:hm (.) and the best part is that we can add pieces ourselves to*

25            die euh organisms  
*those uhm organisms*

The iGEM member starts the tour with a rhetorical question: "*do you know uhm synthetic biology or don't you?*" With this introduction, he claims entitlement to knowledge about synthetic biology. This construction can be interpreted as that he constructs his identity as someone who will educate laymen about what synthetic biology is. By asking it in a rhetorical way, he constructs the visitors as people who do not know about synthetic biology and constructs his own knowledgeability. The visitors show agreement in line 3: "*no start just at the beginning of course*" and construct themselves as layman in the field of synthetic biology. With this agreement, the visitors accept their role as layman, and show a passive role as listener saying: "*start just at the beginning*". Immediately, this passive role fades away after the introduction of the iGEM member. In line 7, the visitors challenge the story of the iGEM member: "*it says Marcel*". In line 16, the iGEM member continues his story about iGEM and synthetic biology in the traditional power structure and claims entitlement to speak. Again, the public accepts the role of iGEM as someone who explains about synthetic biology as they use words to encourage the iGEM member to continue his story in line 19 and 23: "yes" and "uhumm".

In this fragment, the iGEM member represents himself as knowledgeable. At the same time, he creates an informal atmosphere by stating his first name: "*no yes? Okay yes (.5) I (.4) I shall start at the beginning uhm I am Jim (.4) I am from Wageningen*". In line 12, he says: "*which we have stolen from the lab*". With this sentence, the iGEM member constructs himself as informal or a wanton, as he talks about stealing in this sentence, he could also have said that they borrowed the lab coats.

The data show that not only the iGEM members present themselves as knowledgeable actors. In the following fragment the visitors also claim knowledgeability by asking questions and by using scientific terms, a phenomenon recorded by Davies (2011) as well.



Fragment 13 is recorded during the beginning of the virtual lab tour at the Discovery Festival. The group guided by the iGEM member is a family: father, mother and two children. Max (~ 15 years), is the youngest of the family.

### Fragment 13: Discovery Festival 17 (328:340)

- 1 iGEM1        dus als je bijvoorbeeld (.6) euhm op dezeuh button klikt dan zie je  
*so if you for instance (.6) uhm push thisuhm button then you see*
- 2                euhm (.2) nou wat je eigenlijk hebt is een heel stuk DNA met allemaal  
*uhm (.2) what you actually have is a whole piece of DNA with all kinds  
of*
- 3                euh (.3) letters die letters coderen dus vooreuh (.) een bepaald eiwit  
*uhm (.3) letters these letters code so forah (.) a certain protein*
- 4 visitor1     he Max weet jij eigenlijk wel wat dat is euh hoeveel letters er voor  
*hey Max do you actually even know what that is uhm how many letters*
- 5                komen in genen? want dat moet je dan even vragen (.) want hij hij weet  
*there are in genes? else you should just ask it (.) because he he*
- 6                daar nog niet zoveel vanaf (.) misschien kan je wat meer vertellen  
*doesn't know a lot about it (.) maybe you can tell so more*
- 7                d'over  
*'bout it*
- 8 iGEM1        ja↑ euhm  
*yes↑ uhm*
- 9 visitor1     vooral over die die die het gen überhaupt  
*especially about that that that the gene even*
- 10 iGEM1       nou dit gen euhm (.8) hier wordt het weergegeven als euh (.4) nou wat je  
*well this gene uhm (.8) here it is displayed as uhm (.4) well what you*
- 11                normaal gesproken hier hebt is eeneuh stukje DNA wat het stuk wat erna  
*normally have here is a uhm piece of DNA that the piece that comes  
after*
- 12                komt aanzet als het ware (1.5) en euhm nou over deze sequentie (.4)  
*it activates as it were (1.5) and uhm well about this sequence (.4)*
- 13                zelf (1.7) euhm (2.3) °weet ik niet precies hoe het zit om eerlijk te  
*itself (1.7) uhm (2.3) °I'm not exactly what's it all about to be*
- 14                zijn°  
*sure°*
- 15 visitor1     ohhohoh  
*ohhohoh*
- 16 Visitor1&3haha  
*haha*
- 17 visitor2     je kan het altijd nog spelen  
*you can always act it*
- 18 visitor1     ja  
*yes*
- 19 iGEM1        jajajajaj ja



yeyeyeye yeah

20 visitor1 dat gaat lukken  
that's going to work

The fragment starts with an explanation about the program they use to order DNA. The iGEM member starts in a traditional power structure in which the scientist gives information (Davies, 2011). Knowledgeability is claimed by using scientific words: "DNA", "code" and "protein". In line 4 one of the visitors asks a question first to her son and then to the iGEM member: "*hey Max do you actually even know what that is uhm how many letters there are in genes? else you should just ask it (.) because he he doesn't know a lot about it (.) maybe you can tell so more*". By asking this question, the visitor constructs herself as someone with knowledge about science using other difficult not before mentioned words like "genes". By saying: "*because he he doesn't know a lot about it (.) maybe you can tell so more*" the visitor constructs herself as someone who knows a lot about this topic and who constructs the identity of an iGEM member as and educator. Then the iGEM member continues his story in line 10. In line 13, the iGEM member says: "*and uhm well about this sequence (.4) itself (1.7) uhm (2.3) I'm not exactly what's it all about to be sure*". By saying this, the iGEM member steps out the traditional role of the scientist as "knowledgeable educator". After this action, one of the visitors starts with "ohhohoh" and other visitors start laughing. After this confession of the iGEM member, the public still expects the traditional role of the iGEM member as someone who gives education: "*you can always act it*". When the iGEM member reacts with "yes" the visitor reassures the iGEM member that he can act like it in line 20: "*that's going to work*".

Fragment 14 is recorded at the start of the discussion at the Transnatural Festival.

#### Fragment 14: Transnatural Festival (10:18)

1 moderator they are not allowed because they are antibiotic resistant  
2 iGEM1&2 yeah hehe  
3 iGEM2 That's a part we are still working on (.2) we want to need it  
4 more time for this  
5 moderator and this this because antibiotic resistant microbes (.6) do we  
6 need to explain that? That's (.) that's not (?) yah (.2) and  
7 they are (.4) increasingly euh (.) microbes are becoming  
8 antibiotic resistant which is a big problem in the world  
9 iGEM1 Yes that's true but euh I think that these bacteria they also have euh  
10 a switch which makes them euh (.) not so well  
11 surviving inside other  
12 environments then our own so I think they are quite safe  
13 moderator So your bacteria also have a switch  
14 iGEM1 yeah  
15 moderator euh (1.2) do people get this? that you make bacteria with a  
16 switch on it how does that function  
17 iGEM2 well there are different types of switches you can just

In the fragment, first the moderator shows his knowledgeability by explaining why the bacteria made by the iGEM members during their project are not allowed: "*they are not allowed because they are antibiotic resistant*". Then in line 5 the moderator asks if this has to be explained: "*this because antibiotic resistant microbes (.6) do we need to explain that?*" In this way, the moderator aligns with the knowledge of the iGEM members and constructs the audience as people who do not know what antibiotic resistance means: as laymen.

Then one of the iGEM members reacts: "*yes that's true but euh I think that these bacteria they also have euh a switch which makes them euh (.) not so well surviving inside other environments then our own so*



*I think they are quite safe*". In this explanation, the iGEM member use words that are difficult to understand in the context of DNA such as a "switch". In this way, she claims her knowledgeability. At the same time, she does not give an answer to the question from the moderator if this has to be explained. This can be interpreted as that she constructs her identity as a scientist with authority who does not have to explain everything if there is no reason to be worried: "so I think they are quite safe". In line 15, the moderator asks: "euh (1.2) do people get this? that you make bacteria with a switch on it how does that function". In line 17, the iGEM member does not give an explanation about what a switch is but starts about the different switches that exist. With this construction, she constructs herself as a scientist with authority who does many difficult things and has knowledge. However, the moderator does not expect this role as he asks twice to explain this in more detail to the public.

In the following fragment, an audience member shows his knowledgeability during the discussion after the presentation of iGEM members at the Transnatural Festival. During this discussion, the audience often asked questions and they often proposed a hypothesis to show their knowledgeability.

#### **Fragment 15: Transnatural Festival (35:38)**

```
1 moderator   you have a question
2 audience2   yeah (.2) this euh switch of yours (.5) euh were you able to modify
3             the threshold?
4 moderator   to modify the threshold?
5 audience2   yeah I mean so I mean you talked about how many hours before (.) it
6             was perceived as being rotten (.7) so I am wondering I mean this
7             switch you have that is turned on is it turned on (.5) after half an
8             hour or? Or are you able to modify it (.3) so it mid madjustive (.7)
9             euh (.) to the state of the meat?
```

In line 2 the audience member asks a question about the switch the iGEM members were talking about. He shows his knowledgeability using scientific terms like "threshold". When the moderator asks to clarify this the audience member claims more knowledgeability by giving several hypotheses: "is it turned on (.5) after half an hour or? Or are you able to modify it (.3) so it mid madjustive (.7) euh (.) to the state of the meat?".

#### **Summary**

The iGEM members tried to construct their knowledgeability in different ways at the festivals. During the Discovery Festival, the iGEM members claimed their knowledgeability by presenting themselves as educators of synthetic biology, wearing a lab coat and by guiding the visitors at the lab tour. In this way, they made use of the traditional power structure. This role, being an educator with knowledge, was often expected and accepted by the public. Festival visitors presented their knowledge too by using scientific terms, by showing their position in science or by asking questions and proposing hypotheses. The recordings show also that the iGEM members try to create an informal atmosphere several times.

During the Transnatural Festival, the audience members and moderator challenged the story of the iGEM members by asking questions in which they showed their knowledgeability. At the same time, the iGEM members constructed themselves as an authority, as they did not answer all questions of the public. By not answering the questions, the iGEM members created a division between the audience members and themselves, as if they are on an ivory tower. The audience members and moderator treat this construction as unexpected.



## 5. Conclusion and discussion

Scientists from all over the world have numerous conversations with people that are not a member of the scientific community. All of these formal and informal conversations shape the identity of science and occur for instance at science festivals, on Twitter and at public engagement activities.

In these conversations, the role of the scientist is changing. Once, scientists were seen as people who merely educate the public about science (Sturgis & Allum, 2004). Nowadays, scientists are seen more as a spokesperson of his or her own research field and science as a whole (Horst, 2013). In the meetings between science and society the dialogue itself is getting more important, referred to as the paradigm "science and society", where not only the public but also scientists have their deficits (Bauer et al., 2007).

This study investigated how scientists are dealing with this new role, while communicating about the emerging research field synthetic biology. This is done by analysing conversations iGEM members had with others at outreach activities. These outreach activities consisted of debates and the more popularizing science festivals. The following questions were formulated at the beginning of this study.

- 1) *How do iGEM members construct their identity as a scientist in relation to their publics at science festivals and during debates on synthetic biology?*
- 2) *How do iGEM members construct "science" and "doing science" in relation to these publics?*

Discursive psychology is used to answer these questions. The three main conclusions of this study will be discussed in the following paragraph. Per conclusion, the implications for the dialogue between science and society will be discussed. Then the recommendations for iGEM members and other (future) scientists are presented in the second paragraph. In the third paragraph, the strengths and limitations of this research are written down. Recommendations for further research will be discussed in the final paragraph of this report.

### 5.1 Overall conclusions

During the debates and festivals, the iGEM members construct their identity and "doing science" in different ways. The five most frequently occurring phenomena observed are being careful, being just normal, having good will, being knowledgeable and being a solver of global problems.

This phenomenon of using different identities is reported by other studies as well, that analysed conversations between scientists and others at public engagement activities (e.g. Dyer & Keller-Cohen, 2000; Kerr et al., 2007; Mogendorff et al., 2012). These studies report about shifts scientists make between public member and scientist. In this study, this specific identity shift is not observed. The analysis of popularizing science activities and debates reveals several new identity constructions, which are, as far as known, not described in earlier studies and this gives several new insights in the dialogue between science and society.

One important insight of this study is that **at the Discovery Festival the iGEM members construct "doing science" as just normal and construct themselves as careful actors as well.**

During the lab tour at the Discovery Festival an iGEM member guides the visitors. During these tours, the iGEM members construct their work as just normal by talking about teasing bacteria and by using words



such as building and fiddling. At the same time, they present their work back home as careful as well by talking about safety regulations and protocols.

By presenting doing science as just normal the iGEM members deny that they are doing dangerous experiments. By keeping their work descriptions light minded a relaxed atmosphere is created.

The construction of doing science as just normal is not frequently observed during the Meeting of Young Minds 2011 or 2012. As far as known, other studies did not report about this phenomenon as well. By constructing doing science as just normal the iGEM members create an informal atmosphere and downgrade their authority. This is in contrast with other studies, which report about experts or scientists who present themselves on a "higher level" by constructing different identities to show superiority (Dyer & Keller-Cohen, 2000) to present themselves as empiricists (Burchell, 2007) or as actors who can make decisions by themselves to incorporate lay views or not (Mogendorff et al., 2012).

At the festivals, the visitors asked several questions. Only a few questions are asked about safety, but still the iGEM members present themselves as careful, a phenomenon not observed during the debates or by other studies. Often the iGEM members start talking about safety regulations. The iGEM members get almost no reaction when talking about safety. Perhaps, the Discovery Festival visitors expect no information about safety regulations, as the aim of the festival is to be a place where you discover all kinds of new things (Discovery Festival, 2013). This shows that settings other than debates and public engagement activities can make it possible to discuss science without involving potential dangers of the technology.

Summarizing, the construction of both identities as the same outreach activity demonstrates that the iGEM members are able to create an informal atmosphere by presenting their work as just normal. At the same time, they create a professional identity by presenting themselves as actors being careful.

What are the implications of these insights for the dialogue between science and society?

These findings show that at settings different than the public engagement activities and debates, it is possible to have an informal dialogue, in which serious issues such as safety can be discussed by the scientist. By talking about safety regulations, the iGEM members deny potential fears of the public. Research on the stereotype of the scientist showed that the public portrays the scientists as a male doing dangerous experiments (Finson, 2002). In this study, the visitors do not ask or react on safety references of the iGEM members during the Discovery Festival. It is possible that the visitors do not ask about this because the aim of the Discovery Festival is to discover new things and the visitors are not there to talk about their concerns. Therefore, it can be questioned if the informal atmosphere at the Discovery Festival is the right place to discuss about public concerns, ethical issues or soft impacts.

Another factor that can influence the issues or concerns the visitors talk about is that, by the constructions just normal and careful, the iGEM members present their work as something not to worry about. By presenting their work as light and done in a safe way, a barrier may be created for the visitors to refer to their concerns.

By both constructions, the iGEM members construct the assumption that the public fears their work. These assumptions, which form a component of the agenda setting can create resistance according to Veen et al. (2012). The presentation of the work of iGEM as just normal and safe helps to create an informal atmosphere. Depending on the public, this may create side-reactions. This shows that scientists must be careful in describing their work to avoid unwanted opposition against science.





The identity constructions discussed previously mainly occurred during the popularizing science festivals. The identities of good will and a solver of global problems occurred during the debates and during the Discovery Festival. An important insight after analysing these identity constructions is that **the iGEM members construct doing science and synthetic biology as something not to be afraid of.**

During the debates and the Discovery Festival, the iGEM members present themselves as having good will for explaining to the public that they have nothing to fear from synthetic biology and other technologies such as genetic modification. They emphasize that synthetic biology is something done for years. By doing this, they reflexively portray the public as having fears and sometimes being ignorant. Other studies that analysed conversations and interviewed scientists and experts reported that scientists portray the public as ignorant as well (Cook et al., 2004; Davies, 2008).

The iGEM members present their good will as well by presenting themselves as a provider of solutions for global problems. This is done by talking about the research projects the teams work on and other research results. The construction is in line with studies that analysed the stereotype of the scientist. Finson (2002) discussed many studies that analysed the stereotype of the scientist and showed that scientists are seen as people who make scientific wonders. Nevertheless, the identity of problem solver is sometimes rejected and challenged by the festival visitors and during the debates. At other moments it is accepted, or even expected.

Summarizing, the iGEM members present themselves as actors having good will. This identity is not always accepted and reflexively the iGEM members portray the public as having fears.

What are the implications of these insights for the dialogue between science and society?

The identity of a provider of solutions for global issues is not always accepted. The different reactions show that others in the conversations have different perceptions of the identity of the scientist. For the scientists it is important to anticipate on the reactions she or he gets when presenting a certain role, to avoid opposition for the work he or she does.

By presenting yourself as an actor having good will, the iGEM members present themselves as actors doing good things. At the same time, they present synthetic biology as something you do not have to fear. This can create a situation where the others in the conversation may not feel the opportunity anymore to present their fears or concerns as the iGEM members already deny them.

The iGEM members portray the public as having fears. By doing this, the iGEM members show their assumption that the public is afraid. For responsible innovation, the inclusion of different voices is needed (Stilgoe et al., 2013). To make the inclusion of other voices possible it is important to avoid opposition towards science or a certain technology, as wrong assumptions about the public are seen as one of the factors creating distrust in science (Bauer et al., 2007).

Besides the identities good will and solver of global problems, the iGEM members present themselves as knowledgeable actors. **During the popularizing science festivals, the iGEM members present themselves as knowledgeable and during the Discovery Festival in particular as an educator.**



At the Discovery Festival, the iGEM members present themselves as knowledgeable and merely as an educator about their project and synthetic biology. They present themselves as knowledgeable by wearing a lab coat and by introducing themselves as a guide and host during the lab tour.

The role of the scientist as educator is mentioned in other studies as well. Davies (2008) reports in her study, that scientists view science communication as educating the public. Cook et al. (2004) mention as well that scientists favour educating the public. This shows that the phenomenon of presenting yourself as an educator is not characteristic for scientists working in the field of synthetic biology and shows that the role of educator is presented at all sorts of activities, including the popularizing science festivals.

The construction of being knowledgeable was often accepted or even expected by the visitors of the Discovery Festival. The visitors presented themselves as knowledgeable actors as well, by using scientific terms and proposing hypotheses. This shows that during the Discovery Festival there was room for both iGEM members and visitors to present their knowledge. During the conversations at the Discovery Festival, the visitors did not often challenge the knowledge of the iGEM members. This is observed by Kerr et al. (2007) as well, who argue that expertise is not challenged during the public engagement activities they analysed.

During the Transnatural Festival, the setting was different. The discussion after the presentation of iGEM was analysed. The moderator introduced the iGEM members as experts. During the discussion, the iGEM members created a distance between themselves and the audience, as they used difficult words and did not answer all questions. At the Transnatural Festival, the moderator and audience constructed themselves as knowledgeable too, by using difficult words and proposing hypotheses.

Summarizing, during both science festivals the iGEM members and their publics present themselves as actors with knowledge. At the Discovery Festival, the role of educator is often accepted or even expected.

What are the implications of these insights for the dialogue between science and society?

This study shows that not only at public engagement activities but also at the more popularizing science festivals the scientists present themselves as educator as well. For this study, students of the iGEM teams are observed. These "young scientists" present themselves as educators as well, so there are no differences between other studies who focussed more on "older experts". Therefore, it can be assumed that the younger generation of scientists see their role as an educator of their research.

Dijkstra and Gutteling (2012) show, with help of focus groups, that the kind of information and the way the information is provided, by one-way communication or by a dialogue, is dependent on the role of the public. The observation that visitors accept or expect that they will get information about synthetic biology shows that the visitors saw themselves as a receiver of information in this setting and probably also expected this from the start of the tour, as the role of iGEM is accepted from the beginning. Although the visitors presented themselves as knowledgeable as well and interact with the iGEM members, the knowledge iGEM presented was not challenged and there is no reference to concerns of the visitors.

Changing the setting at the beginning of the Discovery festival may have potential for conversations about concerns, as there is already a lively conversation. By explaining at the beginning of the tour more explicitly that the visitors are free to ask "everything that pops up" the expectations of the visitors may be adjusted. Veen et al. (2012) mention that uncertainty about the setting is a barrier for people to point



out their own issues, that they are not sure if they are allowed to bring in their own issues. By referring explicitly to the fact that they could ask all sorts of questions the visitors possibly present their concerns. Although there are ways to create a better dialogue about concerns during situations such as the Discovery Festival, one can wonder if the setting of the popularizing science festivals is the right place to discuss concerns. Nevertheless, the interactions at these activities are an opportunity for the scientists to listen to the public and to find out what image and ideas the public members have about emerging technologies, such as synthetic biology. This will help scientists to become more responsive and makes anticipation easier, which is needed for responsible innovation (Stilgoe et al., 2013).

Davies (2011) argues that the set-up of the engagement activity does have an influence on the hierarchy and argues that a dialogue does not come naturally. This is also seen in the fragments. In smaller groups at the Discovery Festival there is more interaction from the side of the public than during the debates. This raises the question if you really want to fight against the role of educator or that smaller groups at the Discovery Festival already have a positive influence on the identity of science as there is a real dialogue, although not about ethics and soft impacts.

## **5.2 Recommendations for improving the dialogue between scientists and their non-scientific public**

Every day scientists communicate about their research. Besides the conversations with fellow scientists, they interact with non-scientists as well. The insights obtained during this study are used to formulate recommendations to inspire (future) scientists to improve the conversations with their non-scientific publics.

This study showed that the iGEM members often present their projects through rose-tinted glasses. By denying fears, presenting good will and presenting synthetic biology as just normal. This can create a barrier for the non-scientists in the conversation to discuss concerns. *Try to be open about potential concerns and do not deny potential concerns or fears to give others the opportunity to raise their own concerns.*

The iGEM members often constructed the public as having fears and sometimes as being ignorant. This can create opposition for science. *Try to be aware and reflect on the assumptions you have about the people you talk with and how you portray the other.*

The analysis of the Discovery Festival showed that it is possible to create an informal atmosphere with a lively interaction; however, in this atmosphere concerns of the others are hardly discussed. *Try to make use of the informal atmosphere at occasions such as science festivals as it is an opportunity for scientists to discuss about what is going on in society as these settings create a lively interaction.*

The more popularizing science festivals are probably not the best place to create deep discussions, as people are there to have fun and to discover new things. Nevertheless, you can *try to be clear about the expectations you have about the role of the other and to speak out that the others can raise all their questions or concerns.* Also at other moments, such as public engagement activities, the setting of the discussion and expectation management may help to get a deeper discussion.

## **5.3 Strengths and limitations**

The data have been analysed using discursive psychology, a perspective that made it possible to find out what is happening in the real life interactions iGEM members had with others. In discursive psychology, one researcher interprets the data. To validate the interpretations of the researcher, the rhetorical principle is applied to see what counter-explanations are undermined, the reactions of the others in the conversations are used as a proof of principle and the findings are compared with other studies that



analysed conversations. Besides this, the presentation of raw data in this report gives the reader the opportunity to follow the steps made during the data analysis.

A limitation of this research is that although the iGEM members do research, they are still students and not formal scientists yet. This makes comparison with other studies that focussed on researchers more difficult. As iGEM members are potential scientists, observing the iGEM members instead of real scientists is also strength of this research as this gives an indication of how future scientists will construct their identity and doing science.

As this research made use of discursive psychology, a way of analysing conversations extensively, four outreach activities of iGEM members are analysed. This makes it difficult to make general conclusions. If the conclusions of this research will be used in the future, it is important to keep the context in mind and to realize that this is a case study so generalisations should be made carefully.

iGEM teams from the Netherlands and abroad are observed at different outreach activities. This makes it more difficult to find phenomena as the outreach activities are different in set-up, which creates different kind of conversations that makes comparison of the outreach activities more difficult as well. On the other hand, the observations of different outreach activities showed that different set-ups create a different dialogue where the non-scientists in the conversations reacted differently on. This analysis of different outreach activities gives new opportunities and inspiration for future research.

#### **5.4 Recommendations for future research**

At the science festivals the visitors and audience members often claimed entitlement to speak, for instance by showing knowledge or by proposing a hypothesis. In future research, it may be interesting to focus on the role of the "other" in the conversations, and not on the "experts". By focussing on the perspective of the "other" it may be possible to find out in more detail what actions the visitors achieve when interacting with the expert or scientist and to find out what effect this has on the role or identity of the scientist. When you know, what actions the others try to achieve in the interaction it is possible to create a set-up of future public engagement activities with more space for these actions in talk. In this way, it may be possible to create a dialogue with equal contribution of experts and others. As (Davies, 2011, p. 76) says: "equitable dialogue does not come naturally".

One of the concerns is that only hard impacts are discussed (Swierstra & te Molder, 2012; Wynne, 2006). These "hard" impacts are objective, neutral and rational. According to these scientists, there is no attention for social and ethical impacts, although the public has concerns about these issues. Fragments of the Discovery Festival show that the visitors really try to get a dialogue with the iGEM members on topics they want to know something about when interacting in smaller groups. Future research may focus on public engagement activities in small groups. This study could focus on how and what role of the scientists creates a dialogue led by the others instead of the scientists. Different techniques of public engagement set-up can be used and analysed using discursive psychology. Again, this can be a collaboration between an iGEM team and communication specialist, having a facilitating role.

In the student competition iGEM, students are assessed for their outreach activities. The results of this study are used to discuss the role of the current iGEM team of Wageningen at future outreach activities, by using the Discursive Action Method (DAM). This method makes use of transcripts to make people aware of how they act and talk (Lamerichs, Koelen, & te Molder, 2009).

The workshop gave the iGEM students the opportunity to learn about the actions that are being achieved in talk when constructing a certain identity. It made them aware of the strength of actions in talk and it was an opportunity for them to generate ideas of how to improve the dialogue with their publics. The



students were enthusiastic and the workshop resulted in five action points the iGEM team will start to work and reflect on during the coming months. For a next study, it might be interesting to do workshops with several iGEM teams and to measure the effects of the workshop and for instance reflection meetings on the dialogues these students have with their publics. In the end, this may result in an action plan to help young scientists with talking to their publics and to reflect on these conversations in a responsible manner.



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## Appendix 1

### Key to transcription

[ text ]	Overlapping speech
(x.x)	Pause of x.x seconds
(.)	Micropause, less than 0.2 seconds
(text)	Speech unclear
↑word,↓word	Onset of noticeable pitch rise or fall
wo:rd	Colons show that the speaker has stretched the preceding sound
<u>word</u>	Emphasized
WORD	Speaker is talking louder
° text °	Speaker is talking softer
((text))	Transcriber's remarks
=	No pause between words or turns
>text<	Fast speaking

Based on Jeffersonian transcription (Jefferson, 2004) in (Mogendorff et al., 2012).