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"Popular Culture and Science Communication on Social Network Sites – A study on edutainment in the YouTube videos *Because Science* by Kyle Hill"

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1. Table of content

2. Introduction

"RECENT DECADES have seen an intensification of science communication activities in most industrialized countries" (Felt & Fochler, 2013, p. 76) Science communication has been transforming and developing over time. One of the fields in which science communication is becoming more widespread and more diverse is on Social Network Sites (SNS). Social Network Sites in general have a big influence on people's lives nowadays. SNS have been in existence for a short period of time; they came up in the last ten years and have gained worldwide importance recently as they have become an important aspect of people's lives worldwide. (Snyder, 2012) SNS have changed science communication; it has become more responsive, participatory, discursive and faster. SNS have made it easier to reach a broad non-academic audience in comparison to classical formal scientific and scholarly communication in printed form. (Lievrouw, 2010) Many authors have understood the importance of the Internet and social media for science communication. Kling & McKim (2000) have found out that scholarly communication is shifting more and more to electronic media. "The use of electronic media to support scientific communication is one of the major shifts in the practice of science in this era." (Kling & McKim, 2000, p. 1307) Puschmann (2014) says that SNS have big influences on scholarly communication and it is used by researchers to distribute their findings frequently. It gives them more options for scholarly communication. The difficulty with science communication on SNS is that it can be difficult to reach a broad audience, because it is easy for people to ignore postings on social media if they are not interested in them. It is also difficult for people to know which sources are credible and which ones are not, which makes it difficult to differentiate between high and low quality content. (Nentwich & König, 2014) In this work, I will look at one particular form of science communication, which has the potential to reach a big audience, it is called edutainment. Edutainment programs "are guided by the aim to educate and entertain the audiences with reference to scientific ideas and processes." (Lehmkuhl et al., 2012, p. 10) Edutainment programs on SNS can face difficulties, though; one of them is that it is likely that the educational purpose is limited and the information is superficial. Another possible danger of these edutainment programs is that they only show a narrow aspect of science that primarily aims to entertain but fails to explain science in sufficient detail. It can happen that they show a specific, narrow science story, which only wants to entertain, as Felt and Fochler (2013) described. Another point is that science in media always gets filtered, selected and prepared. Science is always framed and only particular aspects are shown online. (Claessens, 2013) The science stories that are told online are almost always linear, polished and over-simplified. (Felt & Fochler, 2013)

In this work I will look at one particular edutainment format: YouTube videos of *Because Science* by Kyle Hill on the YouTube-channel Nerdist. YouTube is one of the biggest SNS worldwide, it has more than one billion users; this is a third of all the internet users. (Statistik YouTube, n.d.) And it is also used

for science communication (SciCom). With the help of pop cultural elements Kyle Hill explains scientific phenomena. Nerdist particularly aims at fans of popular culture as their target group. In the last years, popular culture has been used more and more to promote scientific content. On Social Network Sites (SNS) this has become more important in the last years, YouTube is an especially impressive example of this trend. To understand science communication on SNS with the inclusion of pop cultural elements better, I decided to use the case of *Because Science* for my study.

For some scientists YouTube videos are no real science communication. Therefore, people might think that the *Because Science* videos are not science communication at all. They could argue that the videos are more about pop culture than science. I can understand these concerns; they are not entirely unfounded. The science in the videos is often limited by the choice of subject, their length and the fact that they only show a certain view of a topic. However, I will explain why I treat them as real science communication. The reason is that Kyle Hill presents the show as science communication; the huge number of people watching his videos acknowledges this notion. "The science is absolutely the most important thing in my videos. The videos have to be fun, interesting, and have an actual link to the pop culture topic, but if I'm not teaching a general audience something there is no episode there, and I won't do it." (K. Hill, personal communication, May 4, 2016) Kyle Hill thinks that science communication becomes compelling, when it is combined with pop culture. His big following seems to prove him right. This is an aspect which I will discuss in this paper later on. People may disagree with this, but as Kyle Hill produces his videos as science communication videos, I will treat them as such. I do not draw a line between science and non-science, Kyle Hill does that by the way he talks and presents science.

In the *Because Science* videos I focus on the Star Wars videos in particular. One of the reasons for this is that Star Wars has been one of the most-popular, long-going pop cultural phenomena in the last century. The Star Wars movies are the most successful movie series ever. (Star Wars: The Force Awakens, n.d.) But the Star Wars brand does not only consist of the movies, it also includes all the elements that surround it, like computer games, television series, millions of merchandise products, costumes and more. With the new Star Wars movies, which started with 'A New Hope' in 2015, the Star Wars universe will grow even bigger over the coming years. 'Star Wars: Episode VII - The Force Awakens (2015)' made 2 billion dollars at the box office worldwide (Star Wars: The Force Awakens, n.d.) and Star Wars merchandise alone earned more than 3 billion dollars in the first three months of the release of the film. (Prasad, 2016) Star Wars Pop Culture is a phenomenon which has influenced millions of people all over the world. Millions of mass-produced merchandise products are sold worldwide. However, there is not only industrially produced pop culture, the audience often takes elements of the movies and uses them to create their own popular culture. People change mass-produced culture to a meaningful, enjoyable new creation by rewriting it. (Fiske, 1989) Fans draw pictures of their most loved characters, write new stories with the characters of the movies or discuss the latest movies in YouTube-

videos. Even if someone has not seen the Star Wars movies, most people roughly know what they are about. They have become embedded in our society; and one can find aspects of it in all parts of our society. Star Wars is present in areas which do not have anything to do with Star Wars at all; it is used for advertorials of cars, it is discussed in the sitcom *How I met your mother* and is used for science communication. As other science fiction movies, Star Wars has real-life and fictional technological and scientific aspects in it, which makes it a good start to use it for science communication. Even though these aspects are not in the center of the movies, they are an important, and much discussed part of them. The success and popularity of the movie series, as well as their use of technology and science give Star Wars a unique position, which makes it ideal to use it for science communication. The *World Heritage Encyclopedia* (n.d.) formulated it nicely:

> "The epic space opera blockbuster Star Wars borrows many real-life scientific and technological concepts in its settings. In return *Star Wars* has predicted and inspired/influenced several futuristic technologies in existence and under development. While many of these technologies are in existence and in use today, they are not nearly as complex as seen in *Star Wars*. Some of these technologies are not even considered possible in modern times. However, many of the technologies depicted by *Star Wars* parallel modern real-life technologies, though with significant differences, but still using the same concepts." (*World Heritage Encyclopedia*, n.d.)

Kirby (2009) wrote an article about how movies influence the way technologies are made a reality. By including science consultants in the movie production these "construct cinematic representations of technological possibilities as a means by which to overcome these obstacles and stimulate a desire in audiences to see potential technologies become realities." (Kirby, 2009, p. 41) In the Star Wars movies the technologies used are pictured as normal, full functioning everyday objects. (Kirby, 2009)

In science fiction many technologies and scientific aspects are used which already exist in some way in the real world, but are often still in development. Furthermore, technologies which are about to be realized in science these days or are theoretical ideas of possible future technologies are used there as usable, everyday objects. However, there are also a lot of scientific ideas and technologies in the movies that have not become reality yet. As Star Wars is part of science fiction, this is also the case for the technologies in the Star Wars movies. Science fiction, however, can stimulate our imagination; it can help us wonder about the past and future. Thinking about the future can help people better understand the present. I will show what I mean in more detail. In the Star Wars movies many of the Sci-Fi technologies that are used, are exaggerated ideas of real-life technologies. One example is common technology, like the lasers we have today. The guns used by the Stormtroopers use the same technology as we do in laser pointers; however, they are much more advanced from today's technology. This makes

it especially interesting to look at Star Wars, because very often the science and technology in the movies already exists in different ways nowadays or is still in development. This was the reason why I chose to look at the *Because Science* videos about Star Wars pop culture in particular.

Kyle Hill talks in his videos about: "Can We Have Star Wars' Lightsabers in Real Life?", for example (Hill, 2015b). The videos do not only use elements of the movies; in referring to them they refer to a wider pop cultural phenomenon surrounding Star Wars.
There is also a big audience of science enthusiasts, who like to inform themselves regularly about science. The Science and Engineering Indicators (2012) show that 42 percent of Americans are interested in science and technology, and half of all people asked claim to be at least 'moderately interested' in new scientific discoveries. The phenomena pop culture and science enthusiasts are both enormously wide-spread but are mostly seen as two separate entities. I want to look at one area where these two groups overlap.

I want to understand how pop culture and science are entangled in the videos. The *Because Science* videos are a mix of science, pop culture and entertainment, or in other words, edutainment (Lehmkuhl et al., 2012). These are fascinating combinations which blur the seemingly clear distinction between science communication, pop culture and entertainment in new ways. There is a strong and complex connection between science and pop culture that needs to be elaborated on in more detail.

I want to show in this paper how all these aspects work together in the *Because Science* videos and how the boundaries between science, non-science and pop culture are drawn through the framing of the videos. For this purpose, I analyzed nine videos of the show and conducted an interview with Kyle Hill, the producer of the show.

In this work I will show how Kyle Hill understands his videos as science communication and how he presents science in them. Moreover, I will elaborate on what role pop culture plays in them. To do so, I will use three major theories which will help me analyze the data. These theories are boundary work, frames and science story.

3. State of the Art

My study will help to enlarge and complement the existing literature and studies. To do this I will first show the state of the art of the existing literature. I will start with the public understanding of science (PUS).

3.1 Public Understanding of Science

In this part I will show possibilities and problems of scientific communication by scientific scholars, mainly done online. In this part I will talk primarily about how scientists present themselves and their work. I am aware that this is different from the way *Because Science* does science communication. *Because Science* presents scientific findings of other scientists, but nonetheless there are many similarities which makes it worth looking at. I will show why it is important to communicate scientific findings and how science communication works better in some areas than in others.

At first I will explain what PUS (public understanding of science) is. PUS is a wide and ill-defined area of study, which involves different disciplinary perspectives. Burns et al. (2003, p. 187) cites The House of Lords' 'Science and Society' report, which defines public understanding of science broadly as

> "… understanding of scientific matters by non-experts. This cannot of course mean a comprehensive knowledge of all branches of science. It may however include understanding of the nature of scientific methods … awareness of current scientific advances and their implications. Public understanding of science has become a shorthand term for all forms of outreach (in the UK) by the scientific community, or by others on their behalf (e.g., science writers, museums, event organisers), to the public at large, aimed at improving that understanding."

I am not focusing on Academia and how it uses science communication on SNS in my work, I am focusing on one YouTube series, which offers scientific content. I still think, however, it is crucial to mention scientific texts that focus on Academia and how it uses and can use SNS for promoting their work. I can use their knowledge to gain a deeper understanding for my own study.

Nentwich and König (2014) studied the potential of social network sites for academia and how it is and could be used by scholars.

> "Starting approximately around the year 2000, a growing number of social network sites (SNS) began populating the Internet, offering novel communicative possibilities; above all they link-

> up its members and map their offline networks. As this seemed to offer an attractive potential for academic communication as well […].” (Nentwich and König, 2014, p. 108)

Christensen (2007, p. 47) writes about science on the Internet: “If it is not on the web it doesn’t exist.” For a scientific work it is necessary to be available online, because this is the way people inform themselves most of the time. If a scientific paper does not exist online, it cannot be found by most people and is invisible to them. SNS were originally non-scholar but are nowadays frequently used for scholarly communication as well. SNS can be a useful tool for scientists to promote their research and it has been done more and more in recent years. (Puschmann, 2014) As there is an information overload of scientific content on the Internet, the users have to trust one of the services offered on SNS to select the information relevant for them. (Nentwich & König, 2014) This is a significant aspect; it shows that SNS have a kind of a gatekeeper position for scientific information. No one can read all published literature in science; even for scientists it can be difficult to stay well-informed in their own scientific area. SNS can help to popularize scientific work in an understandable way and keep other people informed about scientific publications.

Puschmann (2014) shows in three examples how microblogging on SNS is used to communicate different kinds of science. Microblogging is usually short in length; most of the time it is a centralized service compared to ‘normal’ blogs. The form of microblogging that is used most often is Twitter. Puschmann has found out that scientists are skeptical about the usage of SNS. He has showed in various examples that it has potential for science communication and should not be rejected. In fact, “scientists are conservative when it comes to embracing new technologies, both for internal communication and in relation to new means of engaging with the general public.” (Puschmann, 2014, pp. 101-102) This means that scientists are often unsure what to think about SNS for scientific communication purposes and some are against its use. This can make it difficult to use SNS for scientific purposes. Many scientists and policymakers still think that laypeople have a deficit in knowledge when controversies over science occur. They often think that more knowledge would help them overcome their ignorance, this is also called deficit model. This means, science communication often attempts to focus on giving more knowledge, in this way the members of the public are more likely to accept the expert’s opinion, but the deficit model has shown to be insufficient in different studies. The deficit model ignores several other factors that also shape the audiences’ opinions. (Bubela et al., 2009)

> “The deficit model is asymmetrical: it depicts communication as a one-way flow from science to its publics. Its practitioners do not try to persuade: they assume that the public is already persuaded of the value of science. […] The deficit model implies a passive public […] knowledge alone is transferred; ethical and political concerns are ruled out as irrelevant. […] In consequence, the contextual model is symmetrical: it depicts communication as a two-way flow

> between science and its publics. Its practitioners do not assume that the public is already persuaded of the value of science. They try to build trust; they do not assume that the public is already trusting. The contextual model implies an active public […] The goal is a better integration of the needs of science and its Publics" (Gross, 1994, p. 6)

In contrast to the deficit model, the contextual approach got promoted by Public Understanding of Science researchers as a new model of public understanding of science, as Gross (1994, pp. 5-6) defined them in his article. Political and ethical concerns are also relevant, but often ignored by science communicators. The deficit model is still omnipresent nowadays and this influences people who do science communication, maybe also the YouTube series *Because Science*, something I will I will try to find out in my study.

The next point I want to discuss is a different, but equally important one. People are naturally 'cognitive misers' (Bubela et al., 2009), which means if they don't want to pay close attention to science debates, they have to rely heavily on mental shortcuts, emotions and values to understand an issue, often in the absence of knowledge. People are attracted by news sources that reassure and strengthen their pre-existing beliefs. The work of Bubela et al. (2009) also shows that the majority of people writing and commenting in scientific blogs are scientists themselves or future scientists, who fail to address a broad public audience. In the blogs studied it was a closed group that discussed about science and the authors stated that science communication is a complicated field. In these science blogs the bloggers could not engage with lay people about science. (Bubela et al., 2009) Kyle Hill also comes from the academic field, he has inside knowledge about science and how scientific processes work. He also worked in the area of science communication for years. The work of Bubela et al. shows that it is important to gain more knowledge about science communication on SNS. We still know little about the mechanics of these relations. Bubela et al. (2009, p. 517) voice this statement in their paper: "The availability of science information from credible sources online does not mean the public will use it. Even more than with the traditional media, if people lack an interest in science content on the web, they can easily ignore it." To summarize it, people do almost only engage with things on the web they like and they can agree with. All other opinions can easily be wiped out of vision.

It is possible that *Because Science* can reach a broader audience than other science communication shows online, because of the focus on popular culture. Millions of people are interested in popular culture and this interest can bring people to watch his videos, but I cannot say with my study if people that are not interested in science can be reached with these programs as well. I will keep these ideas at the back of my mind, when analyzing the data.

3.2 An attempt to define science communication

In the PUS section I gave an overview of the relations between science and society. I especially looked at how the internet is used and in which way it influences the relation of scientists and the public. PUS and science communication are related fields, which also overlap from time to time. It is important and useful to know what PUS is to better understand science communication and the difference to PUS. PUS deals more with the question how science is perceived by the public and why it should be communicated. Science communication on the other hand looks at specific cases and how science is communicated in them. It deals with the question why science has to be communicated to society and how scientists communicate their own work to the public.

At first I will try to define what science communication is before talking about science communication studies in the next section. Burns et al. (2003, p. 183) have tried to define what it is by saying "Science communication (SciCom) is defined as the use of appropriate skills, media, activities, and dialogue to produce one or more of the following personal responses to science (the AEIOU vowel analogy)" Bryant (2002) cited in Burns et al. (2003, p. 191) defines science communication as "… the processes by which the culture and knowledge of science are absorbed into the culture of the wider community." According to Burns et al. (2003) the aim of science communication is to generate AEIOU: awareness, enjoyment, interest, opinions and understanding.
To itemize this, the points are:

- "Awareness, including familiarity with new aspects of science
- Enjoyment or other affective responses, e.g. appreciating science as entertainment or art
- Interest, as evidenced by voluntary involvement with science or its communication
- Opinions, the forming, reforming, or confirming of science-related attitudes
- Understanding of science, its content, processes, and social factors
  Science communication may involve science practitioners, mediators, and other members of the general public, either peer-to-peer or between groups." Burns et al. (2003, p. 191)

All of these dimensions are interrelated in different ways and in every science communication effort some of these dimensions are more important than others.

Science communication is important for modern societies to establish a broad, well-disposed picture of science to a public audience. It is not about giving more knowledge to an audience with the result that they are more likely to accept experts' opinions. Kouper (2010) writes that science communication is about promoting public engagement with science. If science communication is done properly, it helps to accomplish the following points: "1) inform their readers about scientific news, 2) explain complicated matters in a manner understandable by a lay person, 3) evaluate research findings and claims made by others, 4) articulate their position toward controversial issues." (Kouper, 2010, p. 2) In this way the audience gets a fuller and more diverse picture of science, from which they can form their

opinion. It is important that we understand SciCom in all its different ways and which implications this has for our society.

3.3 Science Communication Studies

"RECENT DECADES have seen an intensification of science communication activities in most industrialized countries [...] There is a flourishing business circulating communication models and best practice exercises." (Felt & Fochler, 2013, p. 76) Formats of science communication are always transforming and developing over time. 'Medialization of research' has developed in recent years, it is the ever-increasing presence of science in classical media and also other formats, for example, the big presence of science online. Science is becoming an increasingly large issue in all kinds of media. (Felt & Fochler, 2013)

Science is always filtered, selected and prepared, before it is published in the media for the public to see. The way science gets transformed into a newsworthy science story for the media is called 'mediascience' by Claessens (2013). "Science journalism is, very much like science, sanctioned by the real world." (Claessens, 2013, p. 93) Science communicators are not objective people, they actively reconstruct the reality into a narrative, which contributes to the diffusion of scientific knowledge. This has to be taken into consideration when dealing with any science communicator. (Claessens, 2013) Good science communication needs a few points for good quality. Science communicators should be aware of "cross-checking the sources, carrying out investigation work (which is a precursor to any science journalism work), introducing the main research being carried out in this field, and a quest for a 'certain truth'. Science journalism is, very much like science, sanctioned by the real world." (Claessens, 2013, p. 93) This has to be taken into consideration by science communicators putting out their work to the public. Among scientists and science communicators the linear model is still present. They often think that promoting science communication efforts will increase science literacy among the public, who will then be able to expand government research budgets as a consequence. This is a naive, simplistic notion. (Claessens, 2013)

Trench (2008) writes in a chapter in the *Handbook of Public Communication* about the emergence and the influence of the internet on 'pubic communication of science and technology'.

The emergence of the internet has blurred the boundaries between public and professional communication. Information that was previously only visible to other scientific scholars, is accessible for people outside of this domain in this day and age, it is 'turning science communication inside-out'. (Trench, 2008, p. 185) Nowadays more and more information about science and technology is available online for a broad audience. Public and scientific communication were formerly separated, the distinction between the two areas is getting increasingly blurred through the Internet, which has taken on an important role in internal and external science communication.

Different actors operate online to communicate science and technology. However, they can have different aims. On the one hand, there are science communication services, which are also available in print or broadcast. These kinds of services expand their work on the internet as an addition to the original science news in other formats. On the other hand, there are also services which have developed online and can only be found online. *Because Science* developed online and is only available there. Both formats can have different purposes, they can have educational, political, promotional reasons and everything in between. These actors can have different opinions and beliefs and often contradict and compensate each other's materials that they offer. Charities, museums, research and educational institutions, commercial companies, scientists or groups of scientists strengthen and contest each other online. The internet fosters collaboration and offers a great deal of possibilities for science communication, but at the same time it also creates intensified competition between different science channels. Science communicators on YouTube struggle for the audience, they are in permanent competition with other science channels. Everyone wants to get the most views. *Because Science* is no exception. Online communication of science and technology has become more diverse and has grown in number over recent years. This makes it difficult for the viewers to interpret how valid the content is, which is a big challenge for them. When searching the internet for a topic people are offered a wide range of different formats of information (articles, videos, pictures, …) and diverse scientific information. (Trench, 2008) "It takes above-average internet literacy to distinguish these different types of information and informant from each other. The challenge to internet users is intensified by the prominent presence on the web of science advocates in, and on the borders of, the scientific communities." (Trench, 2008, p. 193)

Science is often uncertain and contested inside and outside the scientific field. When science gets into the public domain, the uncertainty cannot be hidden from public view. Uncertainty in science is unavoidable, and one has to learn how to handle scientific information online. It has to become a central aspect of the public's sense-making of science stories. (Trench, 2008)
"[M]uch of the science of most interest to the public is inherently uncertain, and that science-interested publics – and perhaps even the citizenry in general – are capable and willing to handle such uncertainty." (Trench, 2008, pp. 195-196) The web makes the uncertainty of science more visible, but at the same time it provides platforms for open and public discussions of these uncertainties.
Science communicators can help to give a fuller picture of a debate. They can point to different literature and sources diverse from their own to compare different opinions on a topic. They can add information about how their own information came to be, where they drew their knowledge from and in this way they can give critical and responsible information about a topic. (Trench, 2008) "However, long-period analysis of the treatment of scientific themes by the non-specialist press shows that it presents scientific activity as largely 'progressive', as beneficial to society, and as consensual." (Bucchi, 2004, p. 110) The media tends to over-represent specific fields of science (for example biomedicine), to rely on certain

events for media coverage and not scientific priority, and to underline risks over other aspects. Mathematical discoveries normally get little attention by the media, 'newsworthy' events have to happen in order for scientific topics to be handled by the media; or scientific topics have to be linked to topics outside the scientific field. The birth of the cloned sheep 'Dolly' was given immense attention by the media, while a big announcement of significant progress in cloning four years earlier was ignored. "The 'scientific experts' selected by the mass media to comment upon a specific issue are not necessarily the ones best qualified to do so." (Bucchi, 2004, p. 110) The visibility outside of the scientific community is more important; also if the expert wants to talk about a wide range of topics, if the person themselves is interesting, and if the person can easily be justified as a good expert (for example because the person belongs to a prestigious institution or has received prestigious awards of honors). Scientific literacy of the public is often low; many people are not interested in science, but there are attempts to improve that. A certain amount of ignorance in the public is undeniable; "for instance, European surveys on the public perception of biotechnology found that more than 30 per cent of the population thought that, unlike genetically modified tomatoes, 'normal' ones do not contain genes." (Bucchi, 2004, p. 111) Many scientists see it more multilayered and criticize this approach.

> "Other studies have emphasized the complex articulation of public images of science, where a belief that astrology is a scientific discipline – classified by numerous surveys as indicative of scientific illiteracy – is often accompanied by a sophisticated understanding of science. Anything but established, moreover, is the linkage among exposure to scientific information in the media, level of knowledge, and a favourable attitude towards research. As regards biotechnology, for example, recent studies have highlighted substantial levels of scepticism and suspicion even in the best-informed sectors of the population." (Bucchi, 2004, p. 111)

The gap between lay and expert knowledge cannot be explained by a deficit of knowledge in the public. Factual knowledge is one part of lay knowledge. It also includes trust in a scientific institution and value judgments. The public often ignores scientific information, which they regard as irrelevant or useless for their everyday needs. Lay people base their actions on concrete examples and subjective experiences, which can be in contrast to experts' opinions. Lay people repeatedly decide against the experts' opinion, not because they are misinformed or irrational, but because of the experiences and information they have from different sources. They can be well-informed and still decide against the experts' opinion. (Bucchi, 2004)

"Characterised by a shift from a diffusion to a deliberation model of science communication, the past decades have witnessed a proliferation of science communication formats." (Horst & Michael, 2011, p. 283) Horst and Michael (2011) looked at science communication as an event. To understand these events

better, they used the analytical tool of 'the idiot' by Isabelle Stenger. In this way they wanted to understand, how people interact with the science communication effort.

> "A recent experiment with a science communication installation, 'The Landscape of Expectations', is used as an example that lets us trace how the 'idiotic behaviours' of visitors, which on one level make no sense, enable us to query presuppositions about the repertoire of behaviours available to the public and the assumed relations of power between experts and laypeople." (Horst & Michael, 2011, p. 283)

The most important point of this study for my own work was that the audience often does not interact and engage in the way the science communicator has expected it to do. Many people do not want to engage or use the event for purposes the scientists have intended. Furthermore, the study wanted to find out what we can learn from this so called 'idiotic behavior'. Some visitors ignored the frame of the installation. There is always behavior and engagement with the installation that is not wanted by the science communicator. Science communication is - to some degree - always about power relations between science communicators and laypeople. It is possible that the science communication is not taken seriously by the audience at all, it can be made fun of and perceived as stupid and useless.

> "More broadly, it raises the issue of the role of mimicry, parody, play-acting, and humour in the enactment of both science communication and science. Arguably, the capacity to make fun of the seriousness in science communication comprises a resource for laypeople in their interactions with experts. Although scientists and science communicators can be seen as more powerful than audiences in the communication setting (Davies, 2009), non-experts have the (quite powerful) right not to take things seriously. As such, the professional need of science communicators to avoid a perceived lack of seriousness might constitute a powerful factor in the design of engagement exercises and dialogue." (Horst & Michael, 2011, p. 300)

The communicators always try to keep that seriousness and the frame they chose as fully as they can. "The point is that these idiotic actions serve to make us aware of the contingency of the seriousness assumed in the science communication event." (Horst & Michael, 2011, p. 301) Science communicators have more power than the non-expert audience group and by not taking it seriously the audience can gain back power. Science communicators are dependent on the audience to participate in the way they have planned it. If the audience does not want to participate in the science communication, the program does not work. Their work can be responded to differently from how they have envisaged it. Unexpected outcomes can be reduced by good preparation of experienced science communicators, but can never be fully avoided. The science communication act is more fragile and dependent on the audience than we think. *Because Science* also depends on the audience. For example, if fewer people watched the show,

it would probably be canceled. Unexpected outcomes of science communication always happen, as we can see in the work of Horst and Michael. This means that we do not know exactly what the outcome of the videos will be. This has to be taken into consideration when analyzing the videos.

> "What the idiotic statements in our installation remind us is that it is impossible to avoid framing and delimitation in deliberative exercises. Perhaps, less trivially, they also point towards the need for an awareness of the organiser as a responsible actor in this framing. No matter how open and inclusive organisers try to be, they frame the event of science communication and they have to take responsibility for this framing. Whenever organisers of engagement exercises assume the role of sanitisers (as they have to) of the event of science communication, then they also must accept the responsibility for their creation of a particular form of public voice(s)." (Horst & Michael, 2011, p. 302)

3.4 Edutainment

I have shown different science communication studies and also what science communication is. I have pointed to problems and difficulties in different forms of science communication. One of the biggest problems of communicating science is reaching a broad audience. I will look at one particular form of science communication, which has the potential to reach a big audience, edutainment.

Lehmkuhl et al. (2012) researched on how science was represented in the national television programmes of eleven European countries. They structured these programs into five groups of science programs. One group, which is the most interesting for me, is the concept of edutainment program, which I will use in my work.

> "Edutainment programmes are guided by the aim to educate and entertain the audiences with reference to scientific ideas and processes. However, scientific explanations are typically only a minor part of the programme and personalities such as performers or sports stars often dominate. […] This concept accounted for 19 per cent of the total airtime." (Lehmkuhl et al., 2012, p. 10)

Lehmkuhl et al. (2012) also showed that edutainment programs were successful and people watched it. Kohring (2012) criticized Lehmkuhl et al. (2012) for only showing what the science programs were like in 2012, but they did not explain why one format was successful and others not. "What is missing are programmes that put science in the societal context and discuss the positive and negative outcomes of science as performed by social actors who are guided by interests – acceptable and non-acceptable interests." (Kohring, 2012, p. 1021)

"[T]he dominant motivation for engagement […] is that science provides new insights into what is completely unknown." That motivation is, as the authors write, "strongly connected with affective motives, e.g. feeling fascinated, inspired, surprised" (Lehmkuhl et al., 2012, p. 69). The audience gets new insights into areas that were unknown to them before and get new knowledge about science. It is notable that the respondents do not expect information from television. "Instead, respondents expect popularization and edutainment programmes from TV" (Lehmkuhl et al., 2012, p. 69 cited in Kohring, 2012, p. 1021). This study on scientific television programmes can help me understand SciCom on SNS better. I used the findings and insights to apply them to SNS and looked if there were similarities and differences. In many cases the audience does not interact and engage with the material in the way the science communicators have intended it. It is possible that the science communication is refused by the audience and not taken seriously at all. (Horst & Michael, 2011) This has to be acknowledged when looking at edutainment.

3.5 Little Science

In recent years these edutainment programmes have become more available on SNS; science channels on YouTube frequently use the format of edutainment for science communication. Almost all of them use these edutainment programmes as little science, as Lievrouw (2010) describes it. Lievrouw (2010) refers in his work to Price's (1963) classic study *Little science, big science*.

> "Derek Price traces the historical shift from what he calls little science —exemplified by early-modern 'invisible colleges' of scientific amateurs and enthusiasts engaged in small-scale, informal interactions and personal correspondence—to 20th-century big science, dominated by professional scientists and wealthy institutions, where scientific information (primarily in print form and its analogues) was mass-produced, marketed and circulated on a global scale." (Price, 1963 as cited in Lievrouw, 2010, p. 219)

Lievrouw (2010) tried to find out, if SNS and science communication on them may mean a revival of science communication in the form of little science. This trend is in contrast to the classic scientific publishing industry, which privileges formal over informal forms of science communication. "[S]tudies of scientific and scholarly communication had reified the little science–big science distinction, creating a distinction between researchers' *formal* communication (the production of documents, such as journal articles, conference papers and books) and *informal* communication (interpersonal interaction that is largely unrecorded)" (Lievrouw, 2010, p. 220). This may be a response to the 'information explosion' that can be witnessed since the early 20th century. SNS makes online SciCom more informal, immediate and provisional. SNS have the possibility and advantage to be more responsive, participatory and

discursive. They are faster and more open than classical formal scientific and scholarly communication in printed form. The networks allow science communicators to communicate more directly to the audience and react to comments quickly. SNS have blurred the clear distinctions between producer and consumer of information; this makes it possible for any Internet user to create and share content online with the whole world. (Lievrouw, 2010) "The increasingly informal, personalized, *ad hoc*, interactive, discursive, geographically distributed and self-organizing features of scientific communication online may signal something of a revival of the little science practices that Price and others described." (Lievrouw, 2010, p. 221)

Scientific information, especially documents, has grown exponentially in amount and it is too enormous and complex for humans to organize and comprehend it effectively. This new little science movement stands in contrast to the formal, classic science communication. It makes it easier for a broad audience to keep track of new scientific developments. SNS have the potential for science communication to become more personal, informal and reciprocal. They are far more open than traditional scientific publications. There is a big potential for science communication to be more accessible to a wider public and this makes it possible to debate, comment and argue about scientific developments. The author sees SNS as a possible complementary way for SciCom to the paper publications in scientific magazines and books. It is also a cheap way to communicate science - to create a Twitter or YouTube account does not cost anything.

In the end the author concludes that Social Media is no real threat for traditional science communication at the moment, but it can be an open platform to discuss and share scientific developments between scientists and amateurs. It can be a powerful tool which gives amateurs access to scientific work and the possibilities to discuss them. (Lievrouw, 2010)

As you can see in this work, the format of the *Because Science* videos is suitable and has potential for science communication. The question is how this potential is being used. The *Because Science* videos clearly make use of the format of little science; in a compensated and short way the viewers get access to scientific topics. The videos last no longer than six minutes. In a short time, you can get information about various topics, but this format is not neutral. Which scientific topics are chosen and how they are handled is chosen by the science communicator. Science communicators are not impartial people, they actively reconstruct the reality into a narrative, which contributes to the diffusion of scientific knowledge. The videos are not objective science stories, they are shaped and manipulated into specific formats. (Claessens, 2013)

3.6 Humor in Science

One aspect, which is often part of little science and edutainment is humor. It is also present in the YouTube-show *Because Science* where it is used as one element to present science. This is why I looked at the article "*Communicating through humour: A project of stand-up comedy about science"* by Pinto, Marçal and Vaz (2015). They wanted to find out how humor can be used for science communication. For this purpose, they made interviews with participants and the audience of stand-up comedy about science. The findings of their study can be helpful for my thesis. Both are new and unusual ways of science communication and they both try to entertain and offer the audience scientific knowledge. The audiences of the researched show were young, highly educated adults. The authors suggest that it is likely that only an audience that is already interested in and has knowledge of science will be reached by this way of science communication and it is possible that no broad audience can be reached. Maybe only a highly specialized audience can be reached by this method. The authors could not say for sure, if this was the case. Most people in the audience were satisfied with it and thought that they had learned something about the topic presented, but 30 percent did not agree with this statement. The interviewed performers saw stand-up comedy as a good way for science communication. Laughing was seen as a universal, enticing and easy way for communication. It can help to make the audience interested in and more open to topics they would probably not think about otherwise. It makes a more informal and relaxed way of communication possible. Formats like these can help to give a new image regarding science and scientists, as amusing, fascinating and refreshing. With this method a scientist can build a closer relationship with the audience. In all videos of *Because Science* humor is an important part.

The needed simplicity and clarity of the performance is also a limitation for the stand-up science comedians. On the one hand, it attracts the audience, on the other hand, the topics are presented in a trivial, one-dimensional and oversimplified way. Complex topics cannot be handled by this format. It is difficult to be scientifically accurate, short in length and funny at the same time. To oversimplify topics can lead to misinterpretations by the audience, especially when irony or sarcasm is used. This means the content has to be presented carefully and clearly. This study shows that the format has advantages, but also limitations, which can become a problem, when not done right. Stand-up comedy about science "has the advantage of establishing a close relationship with the audiences, which may be explained by the use of humour, informal language and generally talking to the audience as equals." (Pinto et al., 2015, p. 790) The authors stress the potential of the format and open questions, if it is a good way to communicate and if this form could be a kind of gateway to other, more traditional forms of education about science. (Pinto et al., 2015)

The results can be adopted for my own research. It is a different way of science communication, but also similar to YouTube videos; both have the aim to educate and entertain (edutain) at the same time. The formats have similar limitations and possibilities (be simple and short, but not boring and misleading). In the end, the authors concluded that this form of science communication could be seen as

communication in the tradition of the deficit-model. (Pinto et al., 2015) The basic assumption with this format is that the audience does not know about science and has to learn more. This assumption could be negated, when looking at the audience of the stand-up comedy.

3.7 Popular Culture

In my work I will look at one way of doing edutainment and little science that involves pop culture. *Because Science* uses pop culture as a starting point to discuss scientific topics. This makes it important to discuss what pop culture is in the videos.

Popular culture is a complicated term. In the field of culture studies there are hundreds of articles and books on the topic of pop culture, which has different concepts and definitions. This is why it is important to show how pop culture is seen by different authors. In this way we get a better idea of what pop culture is and what it means for other scholars. After that I will show which definition of pop culture I have chosen as most useful for my study.

John Storey (2006) gives six definitions of popular culture in his book.
1) In a wide definition popular culture is extensively liked and favored by many people. This is too vague and includes millions of items and phenomena to be a meaningful definition, but it is a good starting point to understand popular culture.
2) In another definition, popular culture can be seen as everything that is not high culture, the leftovers of it or inferior culture. High culture has to be difficult and this difficulty excludes specific audiences and ensures the exclusivity as high culture. The rest, which is not high culture, is popular culture. This distinction is not as clear as it might suggest. High and pop culture are not fixed over time and space. The concept of what is high culture and what is pop culture can change from one category to another and can blur this seemingly clear distinction.
3) Popular culture can also be defined as 'mass culture'. In this way popular culture is only produced for commercial sale. "It is mass produced for mass consumption." (Storey, 2006, p. 6) It sees consumption as a passive activity, the audience are consumers. As a result, mass culture as defined in this sense is often equated with American culture.
4) In this definition pop culture is seen as culture by the people for the people. It can also be seen as 'authentic' folk culture. One problem with this approach is that it is not clear who is included in 'the people' and it cannot explain properly the commercial side of popular culture, which is an important factor of this kind of culture.
5) This definition builds upon the concept of hegemony by the Italian Marxist Antonio Gramsci. It is about power relations between dominant groups and subordinate groups in society, which lead to a

dominant culture and a subordinate culture. These two groups negotiate and exchange what pop culture is.

6) Postmodern culture does not see any difference between high culture and popular culture anymore. In the book the author gives the example of the relation between commercial advertising on television and pop music. Many songs have become popular and got into the charts after they were used in advertisements. As commercialization and culture have become entangled and the distinction blurred, it is difficult to tell the difference between the two. (Storey, 2006, p. 6)

All of these definitions of popular culture have opportunities and difficulties to explain social phenomena. All of them have in common that popular culture developed as a result of industrialization and urbanization; popular culture can only exist in and depends on a society with a capitalist economy. (Storey, 2006)

Fiske (1989) writes in his book *Understanding Popular Culture* that pop culture is made out of two parallel, separate economies: financial and the cultural economy. Financial economy means the circulation of wealth; money is exchanged against commodities. In the cultural economy the audience becomes the producer of meanings and pleasure, which circulate in society. "In a consumer society, all commodities have cultural as well as functional values." (Fiske, 1989, p. 27) Society is also structured by class, age, gender, race and others, which all have different dimensions of power. People form cultural alliances with different social groups. John Fiske relates his ideas of popular culture to Gramsci's concept of hegemony, it builds on his ideas. "The original commodity (be it a television program or a pair of jeans) is, in the cultural economy, a text, a discursive structure of potential meanings and pleasures that constitutes a major resource of popular culture. [...] meanings can be produced, reproduced, and circulated only in that constant process that we call culture." (Fiske, 1989, p. 27) People take the texts or commodities of the cultural industry and use them to create a new popular culture. "The culture of everyday life lies in the creative, discriminating use of the resources that capitalism provides." (Fiske, 1989, p. 28)

Primary or original texts are entities (in my case the Star Wars movies) produced by the cultural industry, which are used by the audience or fans to produce their own culture of everyday or popular culture. These original texts can be changed and are changed by the audience into popular culture. The raw material of the original texts is transformed into new, separate ways of popular culture. People take the commodities of mass culture which they consume and actively produce new forms of popular culture which are in the end similar to the original popular culture and at the same time different. This new pop culture addresses also a partly different audience, which can overlap with the original audience. People change mass-produced culture into meaningful, pleasurable new creations by rewriting it. People do not

passively consume industrial popular culture, but can themselves be active producers of popular culture. (Fiske, 1989) In this way Kyle Hill is also a producer of popular culture.

For my work it is also important to think, at least to some extent, about fandom for a better understanding of the content that Kyle Hill offers on *Because Science*. Fandom is a part of popular culture and Kyle Hill claims himself to be a nerd or a geek. (Meadors, 2014) He offers his content on Nerdist, which particularly aims at fans of popular culture as their target audience. The *Because Science* videos have strong connections to fandom. And the videos themselves can be seen in a way as a fan production site. Fiske (1992) categorizes fan productions into three areas, which are more analytical than actual distinctions. He calls them semiotic productivity, enunciative productivity, and textual productivity. All of this productivity takes place between everyday life of fans and mass-produced cultural commodity.

"*Semiotic productivity* is characteristic of popular culture as a whole rather than of fan culture specifically. It consists of the making of meanings of social identity and of social experience from the semiotic resources of the cultural commodity." (Fiske, 1992, p. 37)

Enunciative productivity "is the use of a semiotic system (typically, but not exclusively, verbal language)" (Fiske, 1992, p. 37) "The styling of hair or make-up, the choice of clothes or accessories are ways of constructing a social identity and therefore of asserting one's membership of a particular fan community." (Fiske, 1992, p. 38)

Textual productivity – Fans produce their own texts that they circulate. "Fans produce and circulate among themselves texts which are often crafted with production values as high as any in the official culture." (Fiske, 1992, p. 39) What is more, they are normally not aimed to make any money and are not marketed. (Fiske, 1992)

In this way *Because Science* is set apart from other fan productions, it is marketed and made to earn money. *Because Science* cannot be seen as being just a fan production, but it is one important aspect. The videos can be looked at by considering their semiotic, enunciative and textual aspects.
Jenkins (1992) proposes a conception of fans as active readers of popular texts (the Star Wars films for example). The readers reread the texts in a way that fits their own interests. People's values and taste have great influence on how the texts are going to be read. In the *Because Science* videos Kyle Hill uses and reads the texts for science communication purposes. He chooses and decides what he wants to use and how he wants to do that. The text only becomes meaningful when it is used, the readers rework the material, which they borrow from the text to integrate it into their own experience. The reader does not take the position intended by the author, but takes their own position and cuts parts of the original text to fabricate new and unknown creations. Bits and pieces are taken out of the original and rearranged

with new elements to create a new pop culture. Jenkins sees no difference between readers and writers. Kyle Hill is a reader of popular texts and also a producer of his own popular texts. The fans make the commodity their own property, but they are still aware that those commodities do not belong to them. They are in the "'borderlands' between mass culture and everyday life and that constructs its own identity and artifacts from resources borrowed from already circulating texts." (Jenkins, 1992, p. 3) Kyle Hill and his videos are also in this 'borderland'. I will treat Kyle Hill's work itself as rewritten, new pop culture from the mass-produced, industrial texts that Kyle Hill uses in his videos.

There are examples of readers rereading mass-produced pop culture texts for science communication purposes. For instance, the Facebook page '*I Fucking Love Science'* wrote about 'The Science Behind The Most Gruesome Deaths In Game of Thrones'. (Hazma, n.d.) In the blog '*The Big Blog Theory'* by Saltzberg (2011) the scientific facts that are addressed in the series The Big Bang Theory are discussed scientifically and explained. The book '*The Science of Superheroes'* (Gresh and Weinberg, 2003) explains scientific facts and refers to comic books and superheroes all the time in their explanations. These are examples to show how popular texts can be reread by an audience and reinterpreted for science communication purposes.

3.7.1 Popular Cultural Capital

When Kyle Hill uses popular culture in his videos, he shows that he has popular cultural capital in the pop cultural topics he talks about. The concept of popular cultural capital is one aspect which I will use in my work to better understand Kyle Hill's position towards pop culture. In the videos and the interview, I will use this idea to be able to better analyze Hill's knowledge of pop culture and how he uses it.

Fiske (1992) uses the concept of cultural and economic capital and habitus of Bourdieu (1984) to discuss fandom. Every person has cultural and economic capital, which can be higher or lower and can change over time. The change of one of these capitals also changes the habitus of a person and the status of a person in a social group. Fiske expands Bourdieu's concept with the categories of gender, class and age to show how popular culture capital is distributed by subordinate social groups. Fiske uses Bourdieu's model in a different way than him to analyze 'popular cultural capital' formed by subordinate social groups. This popular cultural capital defines status of the people in a fan-community. If you have no popular cultural capital, you cannot be part of the community; you need fan knowledge so to speak. Kyle Hill shows his knowledge and his membership of the group in his videos. In the next chapter I will show the research gap in the literature I have presented so far.

3.8 Research gap in the literature

In the literature chapter I have pointed out what authors think science communication should be and how it should be done. I have also examined how scientists used to do science communication in the past. In this process I have focused on SNS and edutainment formats. Every author has another focus in their work and most authors only talk about my research topics science communication on SNS in a general way. Felt & Fochler (2013), as well as Trench (2008) say that science is gaining more importance in new media. A broad audience is getting more information online. This makes it necessary to better understand this phenomenon. Bubela et al. (2009) write about scientific blogs and how they are used by scientists for their communication. Burns et al. (2003) show what they think SciCom should be and what it should do. Claessens (2013) discusses what is important for good science journalism and that science communicators actively reconstruct the reality into a narrative, which contributes to the diffusion of scientific knowledge. Bucchi (2004) explain how science is presented in the media and Horst and Michael (2011) look at science communication as an event. Lehmkuhl et al. (2012) do research on how edutainment programs on television are used, but how edutainment programs are used on SNS is a completely new field and I have not found any literature on that. Claessens (2013) says that science is always filtered, selected and prepared, before it is published in the media for the public to see. Claessens explains how he thinks science communication should be, but not what it is actually like.

All these studies throw a new light on my research, but most of them only touch one or two of the topics science communication, SNS, YouTube and pop culture. None of these authors discuss all of the relevant topics for my research. All these studies lead to suggestions about how SciCom on YouTube might be. They show me important aspects I have to consider for my own study. In my research I have to compare the findings of the authors to my own. The authors show possibilities and problems of science communication online, but they only give me ideas of what they could be in my case.

As I have showed in my state of the art discussion, science communication channels on SNS have been using the format of edutainment more frequently in the last years. (Lievrouw, 2010) However, this new technology has been studied very little. I have not found any studies that look explicitly at edutainment formats on SNS or YouTube. This is a gap in the scientific literature. Another aspect which is not studied a lot, is little science on SNS. Lievrouw (2010) writes about the possibilities and advantages of little science, but he cannot show if these possibilities are utilized by science communicators on SNS or if science communicators work similar to traditional science communication in this new area. I have not found any studies that could prove or disprove this. With my study I want to find out if I can agree with the notions of Lievrouw and the other assumptions of the authors I have written about.

SNS are a phenomenon of the last years and their importance has grown enormously in this period. At the same time, SciCom on SNS has also been growing. Nonetheless, SciCom on SNS and YouTube are

fields that are rarely researched. There is not much literature on this aspect, even though it is gaining more importance in our society.

Until today science and pop culture have largely been seen as two separated fields, which are not studied together. The literature on popular culture of Fiske (1989, 1992) and Storey (2006) are very different from the literature on science communication by other authors. They have very little to do with each other. There are many studies about science communication or pop culture, but almost never about both. This field of study is a blind spot for researchers. This is what I want to change with my study. In the next chapter I am going to present my research questions to show my focal points.

4. Research Questions

As one can see in the state of the art, great science communication studies around social network sites exist, but there is no literature about science communication on YouTube and how Star Wars popular culture might be used for science communication. This is the case even though Star Wars is one of the biggest, long-ongoing pop cultural phenomena in the last century with a potentially huge audience group. In science fiction many technologies and scientific aspects are used which already exist in some way in the real world, but are often still in development in our society nowadays. Through its imagined futuristic science and technology Star Wars pop culture gives a specific frame to science communication which is different from other formats. The popularity and the sci-fi content give Star Wars a unique position for science communication, which is used by quite some science communicators. Regardless of this fact it has been ignored by science communication researchers up to this day. From the literature alone it is not clear how pop culture can influence science communication. Every week hundred thousands of people watch the *Because Science* videos and it is largely ignored by researchers. However, it is important to understand this social phenomenon, which has influence on hundred thousands of people worldwide. To do this I will show the focus of my study with my research questions. My main research question is:

How does Kyle Hill use the pop culture-focused YouTube-show *Because Science* as a vehicle for science communication?

Kyle Hill uses a special way of making science communication - he uses pop cultural elements to communicate science. How he combines the different aspects to create one coherent show is of interest for me. The intermediate area between pop culture and science is difficult to determine. It is an unknown area, which is not totally fixed, but is shifting. I want to analyze the videos and make it clearer and more understandable how these areas relate to each other in the videos. Another aspect is that YouTube is a new way to communicate science. It is little researched and gives new possibilities but also poses difficulties to science communicators, which makes the topic interesting to study.

- **What role does Star Wars Popular Culture play in the videos and how do they help to portray scientific knowledge?**

In my research I focused on Star Wars pop culture related in science communication-videos. It will be studied how Star Wars pop culture and science are connected in the videos. In every video Kyle Hill uses pop culture as a starting point to discuss science. References to pop culture are made throughout

the video. Pop culture is also used as an example to explain scientific theories and futuristic technologies. I am interested in how all these aspects help to portray science in the videos.

- **How does Kyle Hill communicate and present science and science communication in the videos and in the interview and what are the similarities and differences between them?**

I will conduct an interview with Kyle Hill and analyze nine of his videos to understand how Kyle Hill presents science in the videos through language, gesture, references, jokes, inclusion of video-, picture- and audio-material and all other aspects which present science in a way. I also want to find out how Kyle Hill describes and talks about science in the interview and if this is different from how he presents science in the videos; Kyle Hill's notion of science is fascinating for me.

- **How does my study fit into the literature about science communication?**

I have read diverse studies about science communication, about the difficulties and advantages of doing it online and offline. I want to find out how my case and the use of pop culture are different from other cases I have read about. I want to know how the show *Because Science* is connected to other science communication efforts and what the differences to other studies are. What can we learn from this study about pop culture and SciCom, and how can it be integrated into other science communication practices? And what implications do the findings of my study have on other science communication efforts?

- **Can pop culture be a good tool to communicate science?**

My aim is to find out the difficulties and benefits of using pop culture for science communication. After having analyzed all my data, I want to elaborate on whether pop culture can be used in a good way to communicate science or not. In the end I will not only talk about *Because Science*, I will discuss if and in which ways different pop cultures can be used to discuss scientific topics and in consequence why it does not work for other topics.

5. Theories and Concepts

The theories and concepts in this section will help me analyze and explain the material in a profound way. I will refer to different studies, which have given me a good insight into my topic, they have helped me understand it better and answer my research questions, which I have presented above, in a profound way.

5.1 Science Communication in the media

At first I will discuss science communication in the media. Kouper (2010) writes that science communication is about promoting public engagement with science. The study of Kouper looked at scientific blogs and communication in posts and comments. "It is hypothesized that to facilitate public involvement in the discussions about science, science bloggers need to engage in the following activities (called *modes of participation* henceforth): 1) inform their readers about scientific news, 2) explain complicated matters in a manner understandable by a lay person, 3) evaluate research findings and claims made by others, 4) articulate their position toward controversial issues." (Kouper, 2010, p. 2) This study about science bloggers helps me to understand in which way the videos on YouTube are made. The points that Kouper mentions have similarities and overlap with the following study.

Gregory and Miller (2000) write about science in the media, claiming that it has a long and complex tradition. Science in the media changed over the years in form and content. The authors of the study have identified different points that were important for scientific publications to become scientific news. All in all, science journalism works in a similar way to non-scientific journalism, but has specific aspects. The following points are important guidelines for all kinds of scientific journalism; they will help me to see what gives science value to the news. These guidelines are relevant for magazines, television and SNS. These are:
Threshold – If events happens on a large scale, like a big earthquake, it also becomes big news. Furthermore, earthquakes raise the interest for related topics, like earthquake-proof building standards. Meaningful, relevance and constancy - The story has to have meaning for the readers in order to understand it. Is it consistent with the readers' own existing believes or attitudes? Does the story correlate with their personal interests? Co-option and composition - If a story can be linked to a story that is already in the news, it has higher chances of getting published. For example, after the Fukushima-accident more posts about nuclear power were published. What is more, these posts did not have to be directly related to Fukushima; they were related to a broader field on the topic of nuclear power. Frequency, unexpectedness, and continuity - Unexpected events and surprises are interesting to publish. Competition – Publish topics others have missed to publish. Unambiguity and negativity - Clear "good"

or “bad” news messages are published more often, little in between. Facts, sources and their reliability - News stories require: who, what, where, when, why and how. Readers enjoy facts when they are meaningful, relevant or consonant. People like to be informed about scientific findings in order to draw new information from them. Elitism and personalization - Make it around something concrete, make it personal. Stories have to be about personal experiences, not about statistics. Stories are not for everyone, but for target groups. (Gregory & Miller, 2000)

It does not matter, if science is presented in newspapers, on television or the internet, all of the shown aspects are the same. All of these points are relevant to be picked up by *Because Science* in the videos. This study helps me understand how science is portrayed on SNS and it also shows me that the YouTube videos I am looking at make use of these aspects. The methods of science communication are traditional, but to use them on social network sites is new. Gregory and Miller’s concept will be useful for me to identify different methods of how science can be depicted. I will use their findings to look at the videos more closely.

Bubela et al. (2009) also have meaningful findings on science communication, which are of high value for my study. Positive results in science are more likely to get published in the media than negative results. Studies which refute previously published research are less likely to attract a broad audience. In most cases the methods, the study design, the risks and the time in which scientific findings will bring benefits are underreported, when published by the media. (Bubela et al., 2009) I think this phenomenon will be found on SNS as well.

> “Risks are often underreported because of the difficulties of conveying probabilistic information, which is inadequately understood by most journalists and by the general public. However, it is not just probabilistic risks that are underplayed but also any broader discussion of social and ethical risks of the research.” (Bubela et al., 2009, p. 516)

These findings correlate with the research of Felt and Fochler (2013), who also write about underrepresentation of time-frames and oversimplification of scientific research results in the media. Scientists and lay people have different concepts of timeframes in which benefits of scientific findings will be delivered. It is likely that omitting timelines produce the impression in the public sphere that significant benefits are imminent, but they can take years and decades. Scientific papers are quantitative; the facts are central for them. The readers of these papers are a specialized, small audience. Media articles, on the other hand, are often based on personal reports; anecdotes are used to connect with the lay readers, which are a broad audience. The voices of affected individuals or members of the affected individuals may be presented in the articles. These connections with the audiences are important to compete with other non-scientific news stories. (Bubela et al., 2009)

5.2 Science Stories

Science communication in the media always happens in the format of science stories. The science part gets shaped and transformed through the science communicator into specific science stories, which are presented to the public. Felt and Fochler (2013) have studied how society and especially scientists in the life sciences in Austria are influenced by science stories. In their article they see science communication as a kind of storytelling activity. A particular picture about science and society is painted by the way science is presented in this type of science communication. The type of presentation or the format of a science story dependent on the platform where it is presented, nonetheless, all science stories are grounded on the same basis: "Stories need to be brief and speak to a particular audience in an entertaining manner, while simultaneously and convincingly conveying relevance." (Felt & Fochler, 2013, p. 80) But this is not enough for a science story, if a storyteller wants to keep long-term public attention.

> "It needs a more heroic plot, in which science contributes to shaping societal futures, to realizing societal values and to solving societal problems. [...] [T]he take-home message should always be what this particular research effort will do for wider society. This ties the stories told into broader accounts about progress and innovation, about how more knowledge will necessarily lead to better lives." (Felt & Fochler, 2013, p. 81)

In this way the relation between science and society is shaped in specific ways. The stories that are told are almost always linear, polished and over-simplified. Complexities and alternative solutions for problems are left out. Promises of quick scientific solutions for societal problems are often represented as if they were happening in a short time in the future and if they were easy to realize, but this is a simplified view.

Hundreds of facts are not told in science stories. It is never shown that science usually involves a lot of routine work and is always presented as continuously exciting, successful and linear, which is not the case in reality. Consequently, an incomplete and false picture of science is shown. (Felt & Fochler, 2013)

> "[S]torytelling about science participates in the creation of a rather specific and often quite narrow imaginary of research, one of a fast and successful enterprise, where science is in control and provides solutions to clearly defined societal problems. Other possible storylines that would instead address the uncertainties and contingencies of current scientific practice and its relation to society are hardly present." (Felt & Fochler, 2013, p. 87)
>
> "Telling stories about science means much more than simply giving a correct account or an attractive presentation to convince members of the public. It is about choice, about what stories are being told and which ones are left out, and in that sense also about which kind of science we frame for which kind of society." (Felt & Fochler, 2013, p. 88)

In the *Because Science* videos one kind of science story is told. It is part of my research to find out how it is told.

5.3 Frames

Every science story is told in a specific way; the selection of topics, language and the way of presenting shape the outcome. This specific way of telling a science story is called frame. "Every story has a frame." Tankard (2001, p. 101) writes in his paper. Bubela et al. (2009) agree with this statement and write that one of the most important things in science journalism is not the content, but how this content is framed. Frames are used by journalists to set science in a specific light in their articles, journalists take complex scientific findings and events and transform them into readable and appealing news reports; they transform science into science stories they think the audience wants to read. Lay people use frames in a different way, they use them as interpretative patterns to understand an issue and to discuss it. It helps them to make sense of what they are reading. Policy-makers use frames to define policy opportunities and to reach a decision in the end. Scientists, however, use frames to communicate the relevance of their scientific findings. In every one of these situations, frames are used to simplify a complex issue. People give more weight to some arguments and considerations than to others. They do it in a way that is most useful for their aim. In science communication framing is an unavoidable and necessary process. It is important for science communicators to know their different audiences. When communicating with different audiences, it is important to switch the frames, or interpretative lenses, to communicate scientific findings. This means, if you want to communicate more effectively in the media you have to switch the frame to a more suitable one. By reframing, it is important that the underlying scientific facts are still the same and remain true when transformed. This means that it is important to understand how scientific news is framed by different people. Scientists and journalists interpret and describe research processes differently. (Bubela et al., 2009)

"[N]ews framing can eliminate voices and weaken arguments, that the media can frame issues in ways that favor a particular side without showing an explicit bias." (Tankard, 2001, p. 95) The media can help make some arguments stronger and weaken others by using frames. Tankard (2001) writes in his work that the concept of media framing offers a contrast to the objectivity and bias concept that was strong in the mass communication research before. With this concept it is possible to look under the surface and show hidden assumptions. It transcends the concept of bias and objectivity, it goes beyond pro or contra, favorable or unfavorable. Framing gives new ways to look at science communication in the media.

> "Framing adds the possibilities of additional, more complex emotional responses and also adds a cognitive dimension. […] Second, framing recognizes the ability of a text – or a media presentation – to define a situation, to define the issue, and to set the terms of a debate. […] Framing also reflects the richness of media discourse and the subtle differences that are possible when a specific topic is presented in different ways. […] Much of the power of framing comes

> from its ability to define the terms of a debate without the audience realizing it is taking place." (Tankard, 2001, p. 96)

Using frames has the risk of finding only the frames I am unconsciously looking for. I might tend to find conventional or stereotypical ways of looking at the content. I try to avoid that by reflecting on my work and trying to find different ways to look at it. Three kinds of framing exist. First, a frame can be used to select and exclude parts. Second, frames can also be used to set a tone for issues or events. The presentation or interpretation of events can change by the chosen frames. And the third one is that frames can be used as a central organizing idea to build the story in a specific way and shape what is at issue. (Tankard, 2001)

"A frame is a central organizing idea for news content that supplies a context and suggests what the issue is through the use of selection, emphasis, exclusion, and elaboration." (Tankard, Hendrickson, Silberman, Bliss, & Ghanem, 1991 cited in Tankard, 2001, p. 100)

One way to use frames in your work is the "List of frames" approach. The author has identified a list of frames for a topic which are most useful to the author. The outcome is a list of 11 focal points for identifying framing:

> "1. Headlines and kickers (small headlines over the main headlines). 2. Subheadlines. 3. Photographs. 4. Photo captions. 5. Leads (the beginning of the news stories). 6. Selection of sources of affiliations. 7. Selection of quotes. 8. Pull quotes (quotes that are blown up in size for emphasis). 9. Logos (graphic identification of the particular series an article belongs to).
> 10. Statistics, charts, and graphs. 11. Concluding statements or paragraphs of articles." (Tankard, 2001, p. 100)

> The "list of frames approach focuses […] on how the issue is defined by inclusion and exclusion of certain key terms. […] The list of frames approach recommends the following steps: (1) Make the range of possible frames explicit, (2) Put the various possible frames in a manifest list, (3) Develop keywords, catchphrases and symbols to help detect each frame". (Tankard, 2001, p. 101)

The list is made for analyzing articles, but I think I can use it as a starting point for finding frames to analyze the videos. I will orientate my own work strongly to that list, but I have to adapt it for my own use to fit it to the YouTube videos. This is necessary, because the videos are different from classical newspapers.

The concept of frames will help me analyze the videos in a better and more understandable way and will assist me in making them more clearly arranged. The concept of framing shows that you can shape the

content in different ways and you can show their different aspects. *Because Science* frames science to describe questions which appear in popular culture. In this sense pop culture is the frame in which the science story is told. The scientific content is transformed into a pop cultural science story. As thousands of people watch the videos, it can be deducted that they are may be right in doing it this way. Kyle Hill has found a frame which people are attracted to. But in my work I want to go into more detail when studying the framing of science in the videos I will analyze. I want to find out which parts of science are left out and which ones are included in the videos. I want to know how science is presented through the chosen frame. To do that, it is important to understand what exactly science is in the videos of *Because Science*. This is necessary to know what Kyle Hill is talking about in the interview and the videos. For this purpose, I will talk about boundary work in the next section.

5.4 Boundary Work

One essential question in my research is, what exactly 'science' in the *Because Science* videos and the interview is. In this way I will think about boundary-work between science and non-science. Which aspects are talked about as science in the videos and the interview and which not? Are there differences between the interview and the video? And I want to find out how the boundaries are made, how Kyle Hill draws the line between science and pop culture. What elements does he use to do this? This will help me understand 'science' in the videos better.

"'Boundary-work' describes an ideological style found in scientists' attempts to create a public image for science by contrasting it favorably to non-scientific intellectual or technical activities. [...] [S]cience can be made to look empirical or theoretical, pure or applied." (Gieryn, 1983, p. 781)
The demarcation of science happens all the time in everyday practices and settings. It is created and recreated in contrast to other forms of knowledge. In every situation in which scientists talk about science, specific attributes are selected to counter them to 'non-scientific' knowledge forms. A particular form of science is created in every context, in which science is the focus, and also a contrast is made to science which is not in this context. (Gieryn, 1983)

> "Analysis of the content of these ideologies suggests that 'science' is no single thing: characteristics attributed to science vary widely depending upon the specific intellectual or professional activity designated as 'nonscience', and upon particular goals of the boundary-work. The boundaries of science are ambiguous, flexible, historically changing, contextually variable, internally inconsistent, and sometimes disputed." […] [S]cientific knowledge is at once theoretical and empirical, pure and applied, objective and subjective, exact and estimative, democratic (open for all to confirm) and elitist (experts alone confirm), limitless and limited (to certain domains of knowledge)." (Gieryn, 1983, p. 792)

Science is manifold, but when doing boundary-work, only specific attributes are made explicitly and others are shielded out. Scientists or science communicators fight for authority and appreciation. They have to use boundary-work to distinguish their work from others and science from non-science. Science is one knowledge-production site among others (like everyday knowledge or embodied knowledge) and it has to be distinguished from other forms. (Gieryn, 1983) "STS argues that science is a set of practices that are shaped by their historical, organisational and social context. It further argues that scientific knowledge is something that is constructed within those practices." (Law, 2004, p. 8) "[S]cience *produces* its realities as well as describing them." (Law, 2004, p. 10)

Boundary work in the videos does not only happen between science and non-science. In the videos there is also a boundary drawn between science and pop-culture, as well as pop culture and non-pop culture. Boundaries are actively made and created in the videos. This concept will help me understand how and when the line between science and non-science and science and pop culture is drawn and what creates the boundary. Science and pop culture are brought together in the videos, but at the same time they are separated and it is clearly pointed out which part belongs to which. In this process, science and pop culture transform and I want to understand in what ways they do so, and how Kyle Hill applies them to his narrative.

> "We also discussed how the science communicators cannot avoid sanitising the events in order to keep some form of meaningful coherence. Even a very inclusive communication event will require that the communicators strategically patrol its boundaries. The important conclusion in this context is for communicators to accept responsibility for these framings and the way in which they produce certain public voices." (Horst & Michael, 2011, p. 303)

Science communicators cannot avoid framing their work and they always try to keep a specific chosen frame of their work. Every science communicator has ideas how they want to present scientific knowledge to an audience. What is more, the chosen format influences how the content is received. Doing SciCom on YouTube with pop cultural elements, for example, has influence on the content of the work and how it will be perceived by the audience. The science communicators always draw borders, this is unavoidable and should be made clear. Therefore, the science communicator should be held responsible for this. Science communicators are performers, they frame the event in ways they want the audience to receive it and clear them of views, which do not fit into their concepts. At the same time, they try to frame and shape the public's view. How exactly this is done is part of my analysis chapter.

These theories will be helpful in analyzing my data. In the next chapter I want to find out what my data is and in which context it is embedded.

6. Material and context of my case

In this section I am going to talk about the material I used for the analysis (mainly the *Because Science* videos) and show the context of my case. This helps to classify the material and get a feeling of where the videos are presented. Furthermore, it is of use to understand better who Kyle Hill is and what he wants to achieve with his work.

6.1 Social Network Sites (SNS)

I am going to start with social network sites to get an idea of where the videos are integrated.
SNS have a big influence on people's lives nowadays. As we can see in the Social Media Report by Nielsen (2011, p. 12), "Social networking is indeed a global phenomenon. In a look across a sample of 10 global markets, social networks and blogs are the top online destination in each country, accounting for the majority of time spent online and reaching at least 60 percent of active Internet users." Social Networks are strong in America and in the whole world. "Today nearly 4 in 5 active Internet users visit social networks and blogs." (Nielsen, 2011, p. 1)

Social Network Sites (SNS) have been in existence for a short time period only; they have come up in the last ten years and gained worldwide importance recently. In the beginning of SNS they linked friends and family, they became a vast network for corporations, organizations, government, brands, newspapers, magazines, museum, communities, events, films and so on. Nowadays almost everyone and everything is on a SNS. The profiles of non-individual entities have become widespread and so have large social presences online. (Snyder, 2012)

Social Network Sites (SNS) are web-based services that allow individuals or groups of people to A) construct a profile, which is more or less public, depending on the SNS within a bounded system. B) It lists other users with whom you share a connection, and C) users can view and interlink their own lists of connections with other users' lists in the system. Beyond that it is often possible to have so-called friends and see what they do on these SNS; you can comment on other people's posts and write private massages. The features on each SNS vary from site to site. SNS allow individuals and groups of individuals to articulate and make their social networks visible. (Boyd and Ellison, 2008)

> "By any measure, media and information technologies - sociotechnical systems that support and facilitate mediated cultural expression, interpersonal interaction, and the production and circulation of information goods and services - are the backbone of social, economic, and cultural life in many societies today. They are important in themselves as cultural and technical

> artifacts [...] Indeed, it is difficult to identify any aspect of contemporary life that is not affected in some way by the development and use of media and information technologies." (Boczkowski and Lievrouw, 2008, p. 949)

6.2 YouTube

YouTube is one of the biggest SNS, it has more than one billion users. This is a third of all the internet users. A few hundred million hours of videos are watched every day. YouTube reaches more 18 to 34-year-old people than every cable-TV-network in the USA. And 80% of YouTube is watched outside the USA. It is one of the biggest websites worldwide with users from many different countries. (Statistik YouTube, n.d.) "YouTube.com - a free, public, online video archive with built-in social networking features - has created a platform for countless virtual communities, many of which are focused on transmitting knowledge in users' areas of interest and expertise." (Miller, 2012, p. 17) The Science and Engineering Indicators (2012) show that the Internet is the main source for people to learn about scientific issues, such as global climate change and biotechnology. For general information about science and technology Americans are about equally likely to rely on the Internet as on television as their primary source. In the Science and Engineering Indicators you can also see that Internet sources are of great importance for the public as a source of information about scientific topics.

James Grime (2011) is one of the producers of Numberphile, which focuses on communicating mathematics via YouTube. It is one of the biggest worldwide science communication channels on YouTube. He has written a newspaper article about science communication on YouTube and says that the number of YouTube channels dedicated to science has exploded in recent years. Furthermore, he says their quality is getting even better. Science communication on YouTube is becoming increasingly strong and it has many possibilities, which other formats do not have. YouTube makes it possible to spread knowledge to a broad audience. The audience can engage with the content how and when they want to and can adopt new knowledge without any pressure being put on them; they learn for their own enjoyment. (James Grime, 2011) This is James Grime's personal opinion, which, of course, is biased, but he has good arguments. Science communication on YouTube is much more complex than and consequently not as straightforward as James Grime phrased it. Nonetheless, for people who do not work in the scientific field it can be difficult to gain access to scientific articles and books. Even if they can get access to them, most scientific publications are written in a highly professionalized way and they contain tons of technical terms. This has the negative consequence that they are difficult to understand for non-scientific readers. This means that the internet can be a way to get information for a broad audience that has not had this opportunity before. On YouTube there are hundreds of different science channels, viewers can choose from a big variety. For example, the University of Nottingham are making a video for every element of the periodic table. Other big science communication channels are SciShow,

MinutePhysics, MinuteEarth, SmarterEveryDay, and DeepSkyVideos. These channels are visited a few thousand to a few million times each week by their audience.

Trench (2008) writes about one interesting aspect of science communication online. He states that the emergence of the Internet has blurred the boundaries between public and professional communication. It has become more difficult to distinguish the two. Science communication online is not only done by scientific institutions or scientists; several other entities do science communication nowadays. SNS have made it easy for everyone to share content online. This makes it difficult to interpret and validate the offered content as it has to be proven to the viewers that the sites are trustworthy and valid. I will consider this aspect in my analysis.

According to Burns et al. (2003) the aim of science communication is to generate AEIOU; awareness, enjoyment, interest, opinions and understanding. The question is, if the channels are able to provide the audience with all these aspects or just parts of them. It is possible that the audience gains understanding of a scientific issue, but not awareness for societal problems that come with this issue. Do they really teach all aspects of AEIOU to the audience?

> "This capability [...] [of SNS] has generated a whole new repertory of social media that combines the potential reach and visibility of traditional media channels, and the authority of published documents, with the personal involvement, engagement, and creativity of sociality and interaction, but it has been largely overlooked in the study of scientific communication." (Lievrouw, 2010, p. 224)

Because Science can reach people in the whole world with one click. This means that science communication isn't a regional topic anymore and science communication has to be thought in new ways in order to work in this world. But it has also to be considered that science in media always gets filtered, selected and prepared; science gets transformed into a newsworthy science story for the media (Claessens, 2013).

To sum up, in the last years SNS have become an international phenomenon with global impact. This is why it is necessary to investigate science and technology on SNS. Through Social Network Sites (SNS), like YouTube, SciCom it has become easier and there are more possibilities to reach an international audience. In other words, it has become more challenging and difficult to spread knowledge and to establish an opinion about scientific topics at the same time. Science communicators need to find a balance by not being too simplistic while still being entertaining for the audience.
Science and technology are present online, as I have shown above. You can also find scientific content on other channels, you can find tons of posts, photos and videos of high and low quality on the Internet.

SNS have the ability to bring the often complex scientific issues into a form, which can be understood by a broad public. Scientific videos or posts on SNS are short and written in a simple way; easy to understand for a broad audience, or in other words in the format of little science. Felt and Fochler (2013) have proven that science stories in the form of little science are often simplified and important information has to be cut out in order to be presented within a few online. Context is lost in this process. I want to see how *Because Science* offers scientific knowledge in a pop cultural way and how the possibilities, which SNS give, are used.

6.3 Nerdist and *Because Science* by Kyle Hill

The show *Because Science* is embedded in Nerdist, which offers new information about pop culture, video games, fandom conventions, popular television shows and stars. Nerdist is a YouTube channel which describes itself as follows: "Welcome to Nerdist. We've got video entertainment for all of your nerdy passions and a whole lot of funny. You are what you watch!" (Description Nerdist, n.d.) *Because Science* is one show of this channels. "BECAUSE SCIENCE with Kyle Hill discusses the secret science in your favorite fandoms. The biology of dragons? Sure. The physics of Superman's punch? You bet! Tune in each week to overthink yet another corner of pop culture." (Because Science, n.d.). By December 13th, 2016, 115 videos of *Because Science* were online on YouTube. To give an overview of the videos, as of that date 27 videos were about Science Fiction Movies and series (11 of them on Star Wars), 35 about Superhero Movies and Series, 14 about Fantasy movies and series, 7 about video games, 6 about Anime series, 6 about other fictional films or series (neither Fantasy nor Science Fiction), 10 on pop culture (no specific movies or series), 4 were mash-ups of two pop cultural movies or series, 3 were holiday themed and 3 were not related to pop culture at all. Nerdist has about 1.9 million subscribers and their videos have more than 288 million clicks on YouTube at the 23rd of January 2017 (Description Nerdist, n.d.). The videos of *Because Science* are about 3 to 6 minutes long and Kyle Hill always refers to pop culture in one way or another as a starting point to discuss different scientific stories.

The channel which offers these videos surely has influence on the audience of the show and the chosen format of the videos. A particular audience is targeted with this format. People will stumble over *Because Science*, because of their interest in the other fields of the channel. This influences the audience and which people will watch the videos. *Because Science* frames science in ways to tell specific science stories. First of all, science is used to describe questions which appear in popular culture. In this sense pop culture is the frame in which the science story is told. The scientific content is transformed into a pop cultural science story. Kyle Hill found a frame which people are attracted to. In my work I have gone into more detail and studied the framing of science in the videos I analyzed. I have found out which parts of Star Wars pop culture are left out and which are included in the videos. I focused on how science is presented by way of the chosen frame.

6.4 About Kyle Hill

To understand the case better, it is important to know who the person is that makes the videos and how he presents himself. In an interview with GeekMom (Meadors, 2014), Kyle Hill talks about his work and his ideas; he sees himself as a person between a science communicator, a journalist and a fanboy and he considers his work to be a mixture a love declaration to pop culture and science communication. "Kyle Hill is a science writer and communicator who specializes in finding the secret science in your favorite fandoms." (Because Science, n.d.). "Kyle Hill's blog at *Scientific American* fact-checks the places where pop culture rubs up against science, separating the ballast from the BS. [Bullshit]" (101 Signals, 2013). In my analysis I scrutinize his self-representation in the videos and the interview I made with him. I have also kept in mind how he himself and others present him online.

Kyle Hill is active on SNS, he is on Facebook, Twitter, Vine and Instagram. Even when he is not on a social network site, Nerdist often is and also promotes his videos on these platforms. Nerdist is also active on these SNS and also on Pinterest and Tumblr. They have a broad distribution of the videos on SNS. Kyle Hill also explains in the interview that he is trying to keep contact with the viewers of his videos, he tries to answer comments on his videos and to chat with them. He explains that close contact with the audience is important for him. I will elaborate on this point as well as I can with the given data.

About his person; he lives in Los Angeles and he did his Bachelor of Science in Civil and Environmental Engineering and his Master of Arts in Communication in Marquette University, Milwaukee. He has a background in natural and social science, which is an interesting combination. He first started writing for Scientific American in 2013 to write his science articles. He has published articles in WIRED, Slate, Popular Science, io9, The Boston Globe, Discover Magazine and managed the blog 'Student Voices' on Nature Education. He has also turned up as an expert on Al Jazeera America, Fox News, and Huffington Post Live. At Al Jazeera America he was employed as a TV science correspondent. In the year 2013, he was mentioned by WIRED magazine as one of the 20 most interesting science communicators to follow online. Momentarily he is working at Nerdist Industries as the science editor and is the host of the YouTube-show *Because Science*. His aim is to teach science by using popular culture in an entertaining and amusing way, which is compact and easy to understand. In an interview he has said that he likes to explain science to other people and tries to give them a piece of his fascination. He also claims that he tries to stay up-to-date about scientific developments. He states that being well-informed is important for him; what is more, he follows other science communicators on SNS. Finally, he maintains that he takes science communication seriously. He has made these points at an Interview

with GeekMom. (Meadors, 2014) I cannot prove or disprove those points via my analysis, consequently, I have to take them as his personal view on this issue.

Kyle Hill has found a niche in the intersection of popular culture and science. He has the ambition to bring science closer to an audience by using pop culture and in this way they can understand scientific issues better, so his claim. This is a normative justification, but the number of clicks are probably always more important than the science communication part. If the videos can get more clicks in referring to science less and more to pop culture, Kyle Hill will probably change his style of presentation. How he talks about science communication sounds generous and open-minded; he wants to give knowledge and understanding to the people that watch his videos. He presents himself as a do-gooder. This normative point has to be reflected on. A certain level of importance and seriousness is assumed in the science communication videos, which is not necessarily the case. (K. Hill, personal communication, May 4, 2016). I will discuss this in the analysis chapter.

6.5 Kyle Hill and Popular Culture

In the previous section I have shown who Kyle Hill is, in this section I will discuss what kind of pop cultures he refers to in his videos. Kyle Hill does not refer to all kinds of popular culture, he focuses on popular media and gaming culture. His strong focus lies on media culture; most videos refer to popular movies or series. The videos are built upon popular movies, series and games assuming that the audience knows them. Kyle Hill does not only focus on one single genre; in every video he looks at different commercially circulated texts, which he reconstructs into new forms in his videos. He looks at Hollywood films, American and British series and Japanese animations, which are in the genre of fictional, fantasy, science fiction, superheroes, supernatural and/or mystery. He looks at science behind superheroes as well as dragon-fire. Kyle Hill claims to be able to unravel the magic and the mysteries in these texts. By doing that, other types of texts generally get excluded and he draws boundaries to genres like non-fictional movies and series, books and comics. Every video refers to one or two pop culture groups. He shows a big variety of knowledge in different pop culture groups.

The video "Top Five Science Stories in 2014!" (Hill, 2015a) and "Top 3 Scariest THINGS in Real Life!" (Hill, 2014) are *Because Science* videos, which do not refer to popular culture at all. These videos are not in my interest for this master thesis and I neglected them. In my study I have focused only on Star Wars pop culture, which is still a vast field in itself. I analyzed 9 *Because Science* videos, which refer to Star Wars for describing scientific phenomenon. This information helps me to get a feeling for the material and to understand what I am writing about.

6.6 Considerations for Analysis

"Media and information technologies are not only artifacts in the material sense but also the means for creating, circulating, and appropriating meaning." (Boczkowski and Lievrouw, 2008, p. 955) Media and information technologies are in themselves highly cultural products and at the same time cultural products are made for these areas; they form cultural products in specific ways. Technology fosters certain kinds of activities and practices to share information and to communicate, they shape the way in which mediated communication happens. The technological components and restrictions of (in my case) YouTube influences the cultural outcome via their organizational structure. The shape of the website also influences the content that is uploaded on YouTube. (Boczkowski and Lievrouw, 2008) It is necessary to think about the devices and artifacts used, for example where the videos are posted. They influence the way the videos are made and presented. The *Because Science* videos are made for the website Nerdist and of course for YouTube. It should also be considered on which devices the videos can be watched, Smartphone, Tablet, Computer, etc. This should be considered when looking at the material. In my Master thesis it is not possible to immerse myself into this topic in detail, but I will consider these points in my analysis of the material.

6.7 Material

For my study I have analyzed nine *Because Science* videos which use Star Wars popular culture to talk about science in detail. I looked at the spoken and written texts and the visual material in the videos. I have put a strong focus on the relation between the content and popular culture, with a focus on entertainment. For analyzing I have used the method of Video Hermeneutics (Raab & Tänzler, 2006). I have chosen this channel, because it is the perfect example for my research interest. It is certainly possible that the videos I have chosen for analysis are for some unknown reasons, like different publication dates or topics, divergent from the videos I did not analyze. This possibility can never fully be avoided; I watched all Star Wars videos that the channel had until 30th April 2016, which there were nine of up to that date. I also did an Interview with Kyle Hill; I wanted to find out his ideas about working with popular culture for science communication. On May 3rd and May 17th, 2015 I sent him in two rounds of questions via email, which he responded to within about two weeks. The material I used is 'natural data', which Knoblauch et al. (2012) refers to as data which is interfered by the researcher as little as possible. These pre-existing visual representations were not produced for this study only; they had already been published on YouTube before I started watching them. I had no influence on the making of the videos of *Because Science*.

6.8 Summary of the most important videos for my analysis

In this section I summarize the most important videos for my work. This will help me and the reader of this paper to understand better what I am talking about when I refer to them in the analysis part. Only

when knowing what is shown in them is it possible to discuss some parts and to compare the videos to each other.

6.8.1 Summary of "Why Han Solo Is a Time Traveler!" (Hill, 2015d)

At the beginning of the video Kyle Hill explains how parsec is a measure for distance and not time and how it is used wrong in the first Star Wars movie. When the Millennium Falcon went on a Kessel run or a hyperjump (travel through the universe with almost the speed of light), they could go about 40 light years in a few minutes. Consequently, the people on board of that ship would age more slowly than the people outside, because when you travel fast, time passes more slowly for the people inside. This means that when Han Solo went on one Kessel run, everyone else would become 40 years older. This can be explained with the theory of relativity.

6.8.2 Summary of "How We Already Have Real TIE Fighters" (Hill, 2015e)

A tie fighter is a small, fast spaceship for short distances, which is used by the Empire to fight against the Rebellion. It has two solar panels at its sides and an eyeball-shaped cockpit in the middle. The TIE stands for Twin Ion Engine. Kyle Hill tells in the video that in space there is nothing to push off against, this means that a rocket has to push out mass on one side to push it into the other direction. We have ion engines in real life, they work by throwing out atomic particles at their back. By this the ion engine moves a little bit forward into the opposite direction. This engine needs relatively little fuel. It starts slowly, but can get up to more than 300.000 kilometers per hour. Tie fighters in the movies move fast and change their direction very often. This is impossible with the ion engines we have nowadays, but Kyle Hill concludes that we have tie fighters today. However, they do not yet work as presented in the movies.

6.8.3 Summary of "Why Kylo Ren's Lightsaber Works" (Hill, 2015f)

Kyle Hill talks about the laser sword of Kylo Ren (a main character of 'Star Wars: Episode VII - The Force Awakens (2015)') and if it is a good weapon or not. A large debate about this Star Wars tech, and if it works or not, has been going on online. The video is based upon the debate as people say that the lightsaber is not a good weapon, because it has two cross guard light sabers. People think that it is dangerous for the person with the sword and that it is a bad hand and wrist protection. This video is a response to this debate, Kyle Hill argues that it is a great weapon. He says that when you are a trained sword-man it is not dangerous for oneself and it does protect the hand from cuts. All in all, Kyle Hill thinks it is a great design.

6.8.4 Summary of "How TR-8R's Lightsaber-Blocking Baton Works" (Hill, 2016a)

In the movie 'Star Wars: Episode VII - The Force Awakens (2015)' the character Finn fights against the storm trooper TR-8R. Finn has a laser sword and TR-8R has a riot baton that can block Finn's attacks with the laser sword. Kyle Hill explains why he thinks TR-8R can block the laser sword. His explanation is that in the riot baton the current flows in the opposite direction of the laser sword. This produces a magnetic field that flows in the opposite direction of the laser sword and makes TR-8R able to block the attacks.

6.8.5 Summary of "Can Kylo Ren Lift Thor's Hammer?" (Hill, 2016b)

This video spins around the question if Kylo Ren (a main character of 'Star Wars: Episode VII - The Force Awakens (2015)') could lift Thor's hammer (a superhero character from the Marvel universe). Kyle Hill's theory is that the hammer has a nanotechnology sensing system which can detect its owner, and can change the gravitation of the hammer. Anyone who is not worthy cannot lift the hammer, says Thor's storyline. Kyle Hill therefore concludes that if Kylo Ren did not touch the hammer, he should be able to lift it with the force. But if he touched it, he would probably not be worthy and could not wield it.

6.8.6 Summary of "Why Does Darth Vader Breathe Like That?" (Hill, 2016c)

In this video Kyle Hill cites a scientific paper which uses Darth Vader as a case study for chronic respiratory failure. The authors of this paper have noticed that his breathing is slow and it increases with stress. Darth Vader constantly fights to catch breath, because he has probably suffered lifelong tissue damage to his lungs from breathing in super-heated particle-filled air for too long when he was heavily injured on the volcanic world Mustafar. As a consequence, his suit probably works as a BiPAP machine. BiPAP machines help people with this disease to breathe better by changing the pressure around the mouth.

6.8.7 Summary of "Could a Lightsaber Cut Through Captain America's Shield?" (Hill, 2016d)

Captain America (a superhero character from the Marvel universe) has a nearly indestructible shield made of the fictitious material Vibranium. Vibranium can absorb kinetic energy, which means that the

shield could block a hit from a lightsaber. But if you hold a lightsaber against Captain America's shield it might eventually melt.

In this section and the sections before I have shown what my material and the context of my material is that I will analyze. This makes it clear what I will analyze and what the peculiarities of my material are. In the next part I will show how I have tried to make sense of the material with the help of my methods to analyze it in the best way possible.

6.9 Analysis of my material

In this section I will give in an overview of how I have made sense of my data with my methods. After that I will go into more detail about my methods and show exactly how I used them to analyze my material in the methods part.
I did my video analysis with video hermeneutics. I transcribed parts of four videos in detail, which were mainly about the entanglement of Star Wars and science. I have chosen these parts of the videos, because they are different from each other to get a broader picture of my research topic. The parts in which Kyle Hill combines science with pop culture and closes the gap in between have been the most fascinating parts for me. These were also the scenes which I decided to focus on with my video analysis and to make an in-depth analysis of them. I have chosen the videos which I thought were best suited for answering my research questions. These videos were: "How TR-8R's Lightsaber-Blocking Baton Works", "Why Han Solo Is a Time Traveler!", "How We Already Have Real TIE Fighters" and "Why Kylo Ren's Lightsaber Works". I took one or two sequences of each of the four videos to compare them with each other as I will describe in the video hermeneutics part. After this process I used the knowledge I got from this first round of video analysis to make an interview with Kyle Hill via email. I also analyzed what Kyle Hill has old me and with this new knowledge I started a second round of video analysis. This round was not in-depth, but the focus was laid on the comparison the results already found with other videos and the interview to see, if there are any differences and similarities between them. In this process I analyzed five more videos, which I did not analyze in such detail, but more on a general level. This helped me to analyze the connections between popular culture and science communication in the best possible way.
In the whole process I analyzed nine videos, which are all Star Wars videos the show had up to 30th April 2016. By doing so I got insights about how and what knowledge is given to the audience of the show of *Because Science*.

I put the transcribed video parts into ATLAS.ti and began to give them codes, as the method of grounded theory demands. I chose codes which I found useful and began to interpret the transcribed parts. When looking at the small bits and pieces of the video you can see many details, but some elements cannot be

seen in the small parts, like the full dynamic, composition and impression of the video in general. That is why I compared the small parts to the whole videos and afterwards to all videos and the interview to get a fuller picture.

I also conducted an online interview with Kyle Hill. I wanted to do an interview via Skype, but Kyle Hill was too busy. I sent him my questions via email, which I got back after a week. The disadvantage of this approach was that I could not ask follow-up questions and explain unclear parts in the questions. Not all answers I got were satisfying, I would have loved to ask him my questions in more detail face to face. This was not directly possible, for that reason I analyzed the interview and came up with follow-up questions, which I sent him again via email. I tried to explain in this second round more explicitly what my focus was and tried to challenge the most interesting answers of the first round. When I received the answers of the second round of questions, I coded and analyzed them again and included them in my analysis.

7. Methods

Media shape by the images used, sounds and the spoken and written texts how science is received by an audience. “The choice of this word rather than that one, this picture rather than that one, sparks off different sets of associated meanings which influence how we think about the thing being represented.” (Mellor, 2009, pp. 205-206)

John Law (2004) writes about social science methods in the book *After Method*. The main argument of the book is that the used methods shape social reality itself and do not only describe reality. In this sense methods are always political. Most present methods want to create clarity and accuracy. Reality is often messy, vague, contradictory and complex and most methods try to get simple explanations for social phenomena. But often, when the social realities are too messy, this is not possible. (Law, 2004) “It is that methods, their rules, and even more methods’ practices, not only describe but also help to *produce* the reality that they understand.” (Law, 2004, p. 5) Processes of social science work have been worked out for a century and are mostly taken for granted; the assumptions behind it are more or less naturalized and hidden. The methods in themselves are mostly not questioned at all. (Law, 2004) “[T]he social is taken to be fairly definite. Such is the framing assumption: that there are definite processes out there that are waiting to be discovered.” (Law, 2004, p. 6) You will find, what you are looking for. Many methods assume that there is a world out there and these methods then help us to find it, but the methods generate this world in a way. This is why it is important to reflect on your own methods and think about what opportunities they give you and which they leave out. Methods help to see a variety of aspects, but ignore other factors completely. Standard research methods have many possibilities and are good at what they do, but they are not good with fast changing, undetermined and irregular realities. (Law, 2004)

> “At any rate, if the argument works at all then we need to find ways of living in uncertainty. The guarantees, the gold standards, proposed for and by methods, will no longer suffice. We need to find ways of elaborating quiet methods, slow methods, or modest methods. In particular, we need to discover ways of making methods without accompanying imperialisms.” (Law, 2004, p. 15)

The methods define in a way what can be discovered and also show the focus of the researcher. This can help to look at certain points, but can mask others. When using my methods, it is crucial to think about these aspects. Law showed me that methods and how researchers approach them have limitations. I have inbuilt assumptions about the material I use for this work. I saw all the Star Wars movies and I am a big fan. I regard pop culture as an interesting phenomenon and I am also aware of the online and

offline Star Wars pop culture and I am partly engaged in it. For this master thesis I also watched other YouTube videos about Star Wars pop culture and science to better understand my material. I knew the show *Because Science* before I started to work on it for my master thesis. I also watched other videos of *Because Science*, which I did not analyze. These factors give me a particular position towards the material. In the videos I take pop cultural knowledge for granted, like I understand most of the references and jokes Kyle Hill makes in them. I do not question them; they are self-evident for me. I have particular knowledge and a specific position towards the material, which other people do not have. This limits how I see the material and how I interpret it, but it also gives me an advantage to understand all the references that Kyle Hill makes. It is difficult to not 'going native' and not seeing everything as normal and understandable for everyone. I try to be open and reflective and acknowledge that my knowledge influences how I analyze it. It is an unavoidable advantage and disadvantage at the same time. All these factors have influenced the analysis, but I cannot say for sure in how far it influenced what.

7.1 Video Analysis Methods

At first I will talk about video analysis methods in detail, before continuing with my other methods.

> "Video data is certainly among the most complex data in social scientific empirical research. It is multi-sensual and sequentially ordered, enclosing both diachronic and synchronic elements, e.g. speech and visual conduct, gesture, mimic expressions, representation of artefacts and the structure of the environment, as well as signs and symbols. Moreover, it represents aspects related to recording activity itself, such as the angle and the focus of the camera, the cuts, and other elements pertaining to the activity of filming and editing. Hence, video recording generates an extraordinary abundance of data, confronting the researcher with the problems of data management, retrieval and selection. This may not only cause the problem of data overload, but also raises the question of how to select sequences appropriate for further scrutiny." (Knoblauch et al., 2012, p. 14)

Thomas Luckmann (2006) writes that when wanting to find out the essence of interaction in a video it is important not to simplify and reduce the complex interaction between actors. The video itself is already an unavoidable reduction of sensory perceptions to seeing and hearing. In the videos of *Because Science* there is only one person who interacts with the viewers.

> "In my view the essence of direct interaction is, *first*, that it is a multimodal process in shared time and space, *second*, that it is reciprocal, *i.e.*, that the actions are directed at one another in accordance with the projects of the actors. The projects are based on whatever the actors know

about social life, including what they know, or think they know, about typical projects of typical actors." (Luckmann, 2006, p. 31)

Because Science is permanently available to the researcher. The researcher can experience and re-experience the videos again and again as an unseen observer. The advantage of this is that the researcher can, when watching the videos more often, pay attention to different aspects of the video not only has to rely on the first impression. This allows the analyst to take the parts and pieces apart and reduce the amount of complexity to a point that can be analyzed. Slowly the first impressions and interpretations begin to shape. When talking to other researchers, the first impressions and interpretations are altered, simplified or broadened. As a result, a first rough understanding of the content emerges. This is the first necessary step for analyzing video content, but the content of the videos still has to be transformed into publicly manageable data. The own ideas and interpretations of the videos, based on re-experiencing them have to be compared with the ideas of other researchers and have to be argued and questioned. The interpretations have to be based on efficiently identifiable evidence. In this way a reliable interpretation of a group of researchers can be established. The analyst tries to understand the interactions in the videos, based on his own knowledge about social life. The researcher makes notes about what he or she might regard as relevant for the interpretation in a transcript. Seeing and hearing are functionally related, but have to be analyzed separately. They have different meanings and significance. (Luckmann, 2006)

One important issue of video analysis is technology and how it should be considered in the analysis. The video itself contains material and technical challenges. How much should this be included in the analysis? The microphones, camera, software and post-processing of the material all have an influence on the analysis and the interpretation of the data. (Knoblauch et al., 2012) "In addition, analysing video data requires intelligent storage and cataloguing systems for raw data, powerful computer hardware and a series of software tools to digitalize, transcribe and analyze data and to present research results." (Knoblauch et al., 2012, p. 15)

7.2 Video Hermeneutics

The medial and visual worlds in the media influence our perception of the everyday world. In modern societies communication is more and more characterized by media and visual material and this has a big influence on social interaction. Being able to understand these video materials is a way to understand culture. Media is all around us and it influences how we perceive the 'natural' world. TV-programs, Hollywood-movies or computer game-worlds influence our perception of reality in an essential way; these things tend to superimpose the 'natural' percipience of our senses. For many years the focus of analysis in social sciences was on the interpretation of texts. In the last years, videos and other visual material have come more into focus, as they are an important part in our lives and therefore have to be

studied as well. (Raab & Tänzler, 2006) Videos have to be analyzed differently from texts or speech, they need a particular method to understand "the constitution of meaning and for the social construction of reality" (Raab & Tänzler, 2006, p. 86) in audio-visual materials.

Video hermeneutics is a way of making sense of video material through clear rules for transcribing and interpreting it. It offers the people that work with it methodological principals for interpretation of the video data. (Raab & Tänzler, 2006) *Video hermeneutics* is a way of "interpretative understanding of social action" in the way Max Weber (1978, p. 4) as cited in Raab & Tänzler (2006, p. 86) defined sociology. "The fundamental idea of this approach is to consider social data as manifestations of the protagonists' perception and recognition of reality as well as of their self-representation and self-interpretation. Consequently, *video hermeneutics* as a reconstruction procedure shows how facts are fabricated by human beings under certain socio-historical conditions." (Raab & Tänzler, 2006, p. 85)

The composition of the different elements of the videos reinforce each other to get a full picture. (Mellor, 2009) "[T]he meaning of a text does not arise just from its subject matter, but also from more subtle elements such as the composition of an image, the use of colour, the structure of the written text and the choice, format and order of particular words." (Mellor, 2009, p. 209) The meaning of the text could change drastically, if parts of it were changed. The camera movement, the length of the separate shots, the music in the background and the editing, all these elements come together to make the show *Because Science*.
To understand better how I used video hermeneutics to analyze my data. I will use the example of the video "Why Han Solo Is a Time Traveler" (Hill, 2015d) in this whole section. With the example of this video I will explain which parts I have chosen to analyze, why and how I analyzed them. In Appendix 2, I have put a short part of the transcription of the video, which I used for interpretation.

Words (spoken and written) and images (videos and pictures) represent meaning at two distinct levels: The layer of connotation and the layer of denotation. Denotation looks at what the image shows, on the other hand, connotation looks at how the images are shown. The connotation of image and word can strengthen and intensify each other in a way that the one helps to maintain a preferred reading of the other. On their own many interpretations of text or image would be possible, but together they minimize the possible interpretations to the most useful ones.
In the case of the Han Solo video, you can see Kyle Hill standing and talking to the camera. What you see constitutes the layer of denotation. The way Kyle Hill talks and gesticulates, how the music underlays the images, is the layer of connotation. (Hill, 2015d) To understand the meaning of the separate elements a commutation test is the best approach. By doing that you look at how the meaning of the text changes, if you leave out one element or alter it. (Mellor, 2009)

Raab and Tänzler (2006) differentiate between discursive and presentative symbolism. Discursive order can only explain things that can be communicated through words and sentences. Speech can in this way only be analyzed as a linear sequence of important elements. On the other hand, images have different symbols integrated at the same time, in other words they offer a presentative order of symbols. Many elements form the meaning of an image simultaneously. Audio-visual material is a hybrid of both forms. Videos have discursive and presentative symbolism in them. Different symbols produce meaning in videos simultaneously and in succession. Both have to be considered in my analysis. (Raab & Tänzler, 2006)

And this happens on three levels:

> "Firstly, these are *events and objects before the camera* – always accompanied by language (spoken or written, dialogues or monologues, narratives or commentaries), sounds, and music. Secondly, *camera actions* are present – the image itself is moving (changing camera positions, pan shots, moving cameras, and zooms). Thirdly, *editing techniques* mold the data– offering an opportunity to separate and to link units of meaning (cutting and montage) as well as to embellish, to pad, and to optimise the material in many ways." (Raab & Tänzler, 2006, pp. 86-87)

In the Han Solo video, the object is always the same, Kyle Hill stands in the front, you hear him talking and there is background music. The camera almost never moves; it does not zoom or turn. The camera action is therefore not important for my work. Painted pictures and video material are cut into the video afterwards, which I have to consider in my analysis. (Hill, 2015d)

"The integration and the combination of different levels of action and different symbolic forms make audiovisual recordings the most complex procedure of data-production in the social sciences." (Raab & Tänzler, 2006, p. 87) To interpret this complex, fruitful and changeable data is challenging. This is why one needs a good method to analyze it properly, for this I will use Video Hermeneutics. The authors describe three central methods to work with the data, they call it "sequentiality, parenthesis of context, and contrasting." (Raab & Tänzler, 2006, p. 87) In the following sections I will explain them in detail.

7.2.1 Sequentiality

> "At the core of video hermeneutics lies the sequential analysis. The meaning of sequentiality here is twofold. On the macro-level it means that not the whole datum – for example the film or video-record as a totality – but only key scenes are interpreted. On the microlevel it means that these key scenes are interpreted step-by-step, i.e. picture-by-picture." (Raab & Tänzler, 2006, p. 87)

After the whole material is watched, key scenes are selected for analysis. For the selection of these key scenes no clear rules are written down, but they are not random either; the researcher or researchers should decide spontaneously for parts which best fit into their research interest and research question. (Raab & Tänzler, 2006)
In my example of the Han Solo video I have chosen one part, which you can see in Appendix 2. I have done so because Kyle Hill talks to the audience as nerds in this section, which is one aspect I have analyzed in detail in the analysis part and this part is also the introduction for his explanation why hyperjumps, the way they are used in the movies, are scientifically wrong and he gives an explanation for his opinion. I focused on this scene, because pop culture is directly compared to science, which is to me the most interesting aspect of the videos. (Hill, 2015d)

> "The idea of the sequential analysis is, to conceive the motives underlying the intuitive selection of a key scene by the interpreters. The understanding of the interpreter's attraction to the key scene coincides with the attempt to reconstruct and explain the structure of the datum. The restriction to an analysis of key scenes is a consequence of the aim of providing a non-reductive and extensive interpretation of the data in all recognisable details and aspects (events and objects before the camera, camera actions, and editing techniques)." (Raab & Tänzler, 2006, p. 87)

At the micro-level the video is split up into small pieces in the successive order, where every picture is analyzed separately. Every image is described in detail in a score, as you can see in Appendix 2. The score is a way to transcribe a video into written language. To translate visual and audio data into a textual form is a necessary step, which makes it possible to interpret the data. A first translation of the audio-visual material to text is necessary, but there is a risk of losing symbols, if they are not translated correctly. The structure of the score helps to divide the material into little fragments. In the first step you separately look at the small parts and do not think about the whole video and the complex connections between the parts. Little elements are taken from the material and translated to the score. Everything that happens in the chosen key-sequence will be translated into text to get a first idea of what the meaning of this part could be. This is already the start of the interpretation. (Raab & Tänzler, 2006)
I put one small part of the video Why Han Solo Is a Time Traveler (Hill, 2015d), which I transcribed into a score, into Appendix 2 to get a better idea of how I carried out this step. I watched the sequence picture by picture and wrote everything down which caught my attention. First, I looked only at the visual data. Then I listened only to the sounds of the video. Then I did both at the same time. I watched the videos several times to recognize as plentiful details of this part as possible.

> "Due to the fundamental hybrid character of audiovisual data, the score must record all actions in their simultaneous and successive order. To realise this methodic principle all events are distinguished in their audiovisual dimensions, described en detail and noted in different columns

> in accordance with the research interests (i.e. setting, camera, body, head, speech, and music). [...] The linear *succession* of the events in the dimension of time is fixed vertically ('top-down') in the spatial dimension of the columns, which run parallel to each other. In the horizontal dimension, therefore, all events are shown in the *simultaneity* of their appearance. It is possible then to reconstruct, for example, what happens with the body or on the face of an actor while he is speaking. Thus, the interpreters are forced to look more closely at the data then is perhaps usual, and the score represents an instrument with which they can check for redundancies in the recorded data of the event at any point." (Raab & Tänzler, 2006, p. 88)

The score is an analytic tool and it can help to keep an eye on your own interpretation. It is also a tool for a third person to control and approve the steps made by the researcher. It lays open the procedure of translation and interpretation. The score helps to make this highly complex audio-visual material analyzable and better understandable; it structures it clearly arranged. The focus of the analysis has always to stand in accordance with the research topic and interest. (Raab & Tänzler, 2006) "It is obvious that the score can replace neither the real object of the analysis nor the interpretation." (Raab & Tänzler, 2006, p. 88)

7.2.2 Parenthesis of Context

Parenthesis of Context is the second step in video hermeneutics. At the beginning, image by image is analyzed and interpreted, but it is important to not only analyze the single images, but also to think of the big whole. In this process the researcher tries to stay open for different interpretations as long as possible. (Raab & Tänzler, 2006) "Sociological hermeneutics [...] serve to generate conjectures on the subject." (Raab & Tänzler, 2006, p. 89) Like in Grounded Theory the researcher tries to stay open for possible interpretations and does not focus on a hypothesis that has been formulated before. We want to understand the meaning of the data and not get a standardized explanation. The researcher takes nothing for granted. We try to free ourselves from pre-established ideas about the data. Only in this way we can

> "achieve a fresh perspective offering new and innovative insights into social reality. In short, *parenthesis of context* is the methodological technique that enables us to become conscious of and to account for the social construction of contexts, in which the recorded data gain meaning and relevance." (Raab & Tänzler, 2006, p. 89)

The researcher wants to understand what is happening, why this word is used and not another one. "Seen this way, *parenthesis of context* means that, in the first step of the interpretation, we ignore as much of our knowledge about the data as possible. We thereby achieve distance to what had seemed self-explanatory, above and beyond the image-by-image interpretation already mentioned." (Raab & Tänzler, 2006, pp. 89-90)

In this step I tried to be open for different interpretations and tried to ignore my pre-existing knowledge as far as possible. In the Han Solo example, I thought about what it could mean when Kyle Hill uses the word "nerds" or "hyperspace". I also tried to find out what it could mean that the background changed to white stripes focused to the center of the screen and back. (Hill, 2015d) Through this step I tried to get different possible interpretations, of which I could later select the most plausible ones. In this step I tried to stay open for other interpretations, which was not always easy because of my knowledge about pop culture.

7.2.3 Contrasting

When no new hypotheses for a possible meaning of the first chosen key-sequence arise, then the interpretation of this sequence is temporarily finished. This first investigation of this sequence seems accurate in this state in relation to my research interest, but for the whole data it might not be. It is necessary to look at a second sequence and compare it to the first one to get a better picture of the whole data. The second sequence should be chosen in contrast to the first one to get a broad picture of the research topic and to see if the interpretation of the first one is valid. More sequences will be analyzed in detail to see if the interpretation of this one sequence correlates with the interpretation of other sequences. I will do this until no new hypothesis comes up and only one meaning is established. When all parts of the data complement each other and generate a coherent picture of the data I can stop analyzing new sequences. Based on the theory and my empirical material the interpretation can be seen as valid and exhausted at this point. (Raab & Tänzler, 2006)

I also chose other sequences of the Han Solo (Hill, 2015d) video, which gave me a broader view of my topic. For example, I compared if Kyle Hill also refers to the audience as "nerds" in other sequences or if it only happened once. I also looked if the setting or other elements of the videos change between sequences and why. After that I compared these sequences to sequences from other videos.

I can never build a complete picture of online science communication, because I only look at one small example of science communication on SNS, which refer to pop culture. The picture will never be exhaustive in my study. In looking at the data with my methods and theories I create a particular social world. I also try to consider how my analysis is affected by my familiarity with Star Wars. I had known Star Wars many years before I started my research. This surely has influenced my work, but this also gives me the opportunity to understand Star Wars references and jokes which other people might not get. (Law, 2004) I try to get the best coherent picture of the data that I can. And in this process I try to think about my methods, theories and familiarity with Star Wars and consider what they do with my

data, how they influence and alter them. I try to stay open and reflect on them, when using them for my study.

7.3 Structured Interview

In addition to my main method video analysis, I also conducted an interview with Kyle Hill to gather additional data. This helped me get a fuller picture of my research. I wanted to understand Kyle Hill's thoughts, attitudes and opinions about his show *Because Science*. This is why I decided to do a structured interview with him. A structured interview has an ordered set of questions, which is structured according to topics and importance. I tried to formulate my questions as clearly as possible, so that he fully understands what my questions aim at. I tried to ask my questions in a way to get honest answers that are as fruitful as possible. I tried to clarify the intention of my questions and to communicate my interests clearly. (Berg, 2004) "In sum, standardized interviews are designed to elicit information using a set of predetermined questions that are expected to elicit the subjects' thoughts, opinions, and attitudes about study-related issues." (Berg, 2004, p. 69) At first I came up with a list of topics, which were the most relevant ones for my study. After that I developed my interview questions on the basis of my main research interests. I started with an open question about how Kyle Hill started this kind of work.

7.4 Grounded Theory

For the text analysis of my video and interview data I used grounded theory. "[G]rounded theory methods consist of systematic, yet flexible guidelines for collecting and analyzing qualitative data to construct theories 'grounded' in the data themselves." (Charmaz, 2006, p. 2) At first I coded different segments, which I had transcribed before. I categorized, labeled and sorted them, in order to compare the different aspects of the key-scenes with each other and with the interview. This helped me understand the role of pop culture and science in the videos. It also gave me an idea how science is framed in the videos and how the boundary between science, non-science and pop-culture is drawn. What is more, I used my findings to correlate them to the literature and findings of STS scholars of science communication. By using grounded theory all of these theories helped me to elaborate a better understanding of my data. In this process I constantly wrote notes, also called memos, about the coded texts, which assisted me in structuring ideas about the data I collected. The memos were of assistance in coding further data, which were in important to be able to analyze more deeply and get a better understanding of the coded texts. In this way I could organize my thoughts and possible interpretations of the data I already had. I started with initial coding and went further on with focused coding. During initial coding I studied little pieces of the texts, words, lines or segments. When going further to focused coding, I chose the most relevant initial codes and compared them with each other. (Charmaz, 2006)

8. Video and Interview Analysis

8.1 Introduction to Analysis

In previous sections I have shown how science communication is done and how it is analyzed by other scientists. I also talked about what difficulties and problems could occur when doing science communication. I also focused on the actual problems and difficulties that occurred in the show. In this chapter I want to find out how Kyle Hill uses the pop culture focused YouTube-show *Because Science* as a vehicle for science communication. To do this I will use the concepts of science stories, frames and boundary work to structure this chapter and make sense of all the data that I gathered. After that I will compare my findings with the literature and studies that already exist.

I am going to start this analysis by showing what Kyle Hill has said in the interview I held with him. After that I will compare his own assumptions about science communication with the material I have analyzed. I have been able to detect differences in the ideas about the videos and the actual videos. I will look in detail at what he has said, what this means and how he carries out science communication. "The science is absolutely the most important thing in my videos. The videos have to be fun, interesting, and have an actual link to the pop culture topic, but if I'm not teaching a general audience something there is no episode there, and I won't do it." (K. Hill, personal communication, May 4, 2016) This quote summarizes Kyle Hill most important assumptions about his videos. From this quote it can be derived that for him science communication is definitely the main aim of the videos. His self-proclaimed intention is to make science easily accessible and understandable to a big audience. Learning new aspects about science is in his focus, Kyle Hill claims.

"Science is nothing less than the best way of understanding our world. […] and the only way to solve life's greatest challenges." (K. Hill, personal communication, May 4, 2016) I looked into the videos how science is portrayed and how this is linked to Kyle Hill's own ideas about science. This gave me new insights into the material.

"I make sure to basically introduce what the pop culture says, and then dive into my own explanations. I'd say most videos are more than 50% science-based or involve scientific thinking or concepts." (K. Hill, personal communication, May 27, 2016) I will also discuss this point further on in my analysis and compare this to my own findings in the video data. I hope that these observations will help me to understand my analysis of the videos better and to get a deeper understanding.

8.2 Description and structure of the videos

The structure of the different episodes of *Because Science* are similar to each other. Therefore, I will give an overview. The videos can be divided into four main parts. The beginning or introduction, the middle or main part, the conclusion (which can also be seen as a section of the main part) and the end titles. In the first part the videos are referring to Star Wars pop culture. It starts with an introductory sequence, in which Kyle Hill talks about aspect of Star Wars pop culture. He poses a main question, which he will answer bit by bit during the main part of the video. The introduction ends with the title melody.

The main part is the longest part, in which Kyle Hill explains different scientific and pop cultural elements. This part can be separated into smaller parts as well, when he talks about different aspects of the main topic of the video. These small parts are different in every video. In the main part he often goes back and forth between science and pop culture, but in the small parts he always sticks to one aspect of the two. At the end of the main part there is a conclusion, in which Kyle Hill discusses what effects science has or would have on pop culture, if they are or were 'scientifically' accurate, as the videos suggest. The possible effects of science on pop culture is in the focus of this part. The conclusion ends with Kyle Hill saying: "Because Science" and the title music is played. The music sets the beginning and the end of the main part of every video.

The end titles are after the music, which is a short sequence for self-promotion and promotion, in which he recommends his own videos and other Nerdist contents. Finally, he often says in this part that the viewers can comment his videos below. In his latest videos ("Could a Lightsaber Cut Through Captain America's Shield" and "Why Does Darth Vader Breathe Like That"), Kyle Hill also discusses pop cultural questions in the end titles, which do not fit into the main part of the video itself, but are related to them. In this part he discusses similar questions to the ones he has discussed in the main part of the video, but they deviated from the main topic or are not 'scientific enough'. In the video "Could a Lightsaber Cut Through Captain America's Shield?" (Hill, 2016d), Kyle Hill says in the end titles that Captain America's shield is made of the fictional material Vibranium and this material absorbs all kinetic energy, which means that the shield would not bounce off from walls, as it does in the movies. This aspect can be interesting for fans of the movies, but does not help to answer the main question of the video: 'Could a Lightsaber Cut Through Captain America's Shield?' and do science communication. I assume that this is the reason why Kyle Hill talks about this in the end titles.

8.3 Science Stories

I will start in this section by showing my results regarding science stories. I will show my findings of the video analysis that I have done and also of the interview I made with Kyle Hill. I will compare them and show how they differ.

In the process of science being transformed into a newsworthy science story for media, also called ‘mediascience’, science is filtered, selected and prepared all the time. Science changes constantly until it becomes the science story the viewer sees at the end. (Claessens, 2013) In this section I will try to figure out how science is linked to a story that is told by the videos. Newsworthy in the context of the videos means that the scientific topic has to be combined or linked in a meaningful way to the pop cultural realm.

8.3.1 A Pop Culture - Science Story

“I want to present science and scientific concepts in a fun, digestible way using pop culture references and themes to make the content more palatable.” Kyle Hill (personal communication, May 4, 2016) This is how Kyle Hill understands his videos. For Kyle Hill it is only a science story in his videos, when science is combined with pop culture. In this way the videos are pop culture - science stories. Science is always selected in a way that it fits into a pop cultural context. On the other hand, the pop culture is selected in a way that fits into science.

To become a story, science has to be combined with interesting, hot topics in the pop cultural sphere: Science is often combined with events, release dates mostly. I will talk about this in more detail later on. The pop culture and science part are always selected so they harmonize in the videos. They are chosen in a way that they match with each other and hopefully improve each other. This works better in some videos than in others. For example, the science part in the video “How We Already Have Real TIE Fighters” can be described as, what is an Ion Engine and how does it work. Kyle Hill shows scientifically how the real engines work. The pop cultural part is to show how the tie fighters fly and maneuver in the movies. (Hill, 2015e)

These two separate parts are combined through comparing them and showing what similarities and differences they have. He shows that if the movie tie fighters would have the engines, as we have them nowadays, they would not be able to fly as they do in the movies. The pop cultural topic and the scientific topic in this video match each other well, because they are tightly linked. This improves the outcome. As this example shows, the science and pop culture parts have to match to create a useful, rounded story in the end. Through mixing pop culture and science, the story that is told changes to a completely new story. This format is not neutral, the communicator, in my case Kyle Hill, chooses the topics and actively reconstructs the reality into a narrative, which contributes to the diffusion of scientific knowledge. The videos are not objective science or pop culture stories, they are shaped and manipulated into specific formats (Claessens, 2013). It is interesting to see what kind of stories are told in the videos, which I will explore in the following.

8.3.2 Limitations and possibilities of a pop culture- science story

I will show how and what kind of pop culture-science stories are told via the videos. Furthermore, I will point out the limitations of the format of a pop culture-science story. First of all, the platform on which the story is presented influences the way the story is told. *Because Science* is presented on YouTube and vessles.com/nerdist. This means the videos are limited regarding their length and content, not all topics can be handled in this format. Only such science topics matter which can be explained in a few minutes or less; otherwise they cannot be dealt with on YouTube. What is more, the content is limited to relevance and interest in the pop cultural sphere. The videos have to be well researched, scientifically accurate, short in length and interesting at the same time. Oversimplification of topics can lead to misinterpretations by the audience. To do all this and avoid mistakes is challenging.

Kyle Hill is aware of the limitations of the format of pop culture-science stories. "No matter what I think I can teach with Captain America, at some point all science fiction breaks down into fiction." (K. Hill, personal communication, May 27, 2016) He also approaches the limitations in the video: "Well, that's my theory, at least I am trying to keep the physics of a fantasy world sound here, but just think of how the story would change if relativity was included." (Hill, 2015d) He says that the explanation he gave in this video is one of thousands of possible explanations and it is his personal, subjective opinion. Kyle Hill also says that he knows the limitations of Star Wars to discuss science. When I asked him in the interview about the limitations of his show he told me: "It's a balance between complexity and simplicity, being witty but not thorough and being a lecture but not boring." (K. Hill, personal communication, May 27, 2016) The format also has benefits, it is easily accessible by a big audience and it is easy to upload and share videos on YouTube, but the limitations are present.

Most scenes included from the Star Wars movies in the videos are loaded with action; almost all of them are fighting scenes with laser swords, laser guns or spaceships. This leads to the assumption that the scientific topics of the videos are chosen in a way that they are full of action and dynamic. From the videos it seems that laser swords are discussed, because then fighting scenes with laser swords can be shown in the videos.

Via the analysis of the videos it can be seen that the videos are simple, clear and polished, and cannot handle complex scientific topics. In the videos science gets trivial, one-dimensional and oversimplified. Uncertainties of science are not presented in the videos. Science is always shown as clear and straightforward. Science is never shown as routine work, which most of it is. It is presented as being always successful, exciting and linear. Failed science is never shown in the videos. The videos present an imaginary of research which is wrong. These findings coincide with the findings of Felt and Fochler (2013, p. 87) "Other possible storylines that would instead address the uncertainties and contingencies

of current scientific practice and its relation to society are hardly present." A specific kind of science and society is presented in the videos, as Felt and Fochler (2013) expressed it.

In the video "How We Already Have Real TIE Fighters" (Hill, 2015e) the real technology that we have nowadays, the ion engine, is compared to the sci-fi technology tie fighter. These two technologies are juxtaposed and their characteristics are compared in detail. Kyle Hill says in the conclusion: "At least we can say that we have our own real tie fighters today." (Hill, 2015e) Kyle Hill's basic assumption is that it is possible and useful to compare the real technology ion engine with the futuristic tie fighters from the movies. In the video he explains that the real ion engine does not work as in the movies, but the futuristic technology of the movies already exists nowadays. He compares this real-life technology with the science fiction technology of the movies. He uses science, as explained before, to show if the tie fighters could work as they do in the movies. The answer he gives at the end is no, the real technology could not work as shown in the movies, but they do work. He shows what is possible nowadays in science and what not. One can see how the scientific explanation is set into relation to Star Wars pop culture. This is an important part in the videos, where he mixes the seemingly separated parts and shows how they work together. He does that by showing how this real-life technology is used in the movies and what the differences are.

Kyle Hill has chosen to explain complicated technology in a short video instead of a more basic scientific concept or technology. He breaks this complicated technology down to a primitive concept without giving its context, which makes it difficult to follow his explanations. It can also be argued if tie fighters are really a good start to explain ion engines. I think that the example from Star Wars works in order to explain the basic idea of an ion engine. It gives a good introduction to this topic. They have technical and visual components in common and it is useful up to a certain level, but if you go into too much detail and look at it more closely the concept becomes difficult to understand. At first sight the video seems logic and clear, but when you try to understand it, you realize that scientific elements that would be necessary to fully understand what he is saying are not explained at all, like ions, electrons or neutrons. The video itself is not enough to understand how ion engines work and also after watching the video you can only explain it sketchily. The science part in the video is compromised and limited. In the video Kyle Hill explains what an ion engine is, how it works and how fast it can go, and he shortly talks about rocket science in general. He shows the advantages and disadvantages of this kind of rocket engine. However, when you have a closer look at the video, you can see that presuppositions are already embedded in the video and he does not go into too much detail of the topic. To fully understand the science in the video you have to have knowledge about this topic before watching the video as the knowledge you get is not enough to understand the technology. Scientific elements are not explained properly. From the videos it can be assumed that Kyle Hill is not critical about the science he presents. Science is presented in a way as if it were objective knowledge that he passes on to a lay public.

The video does not divagate from the scientific topic of the video to other scientific topics, because of its limitations. Kyle Hill can show some aspects of science in the short time of the videos and only in little detail. The videos show one scientific answer to a scientific question he has raised, for example 'How does a laser sword work?'. Kyle Hill also gives only one pop cultural answer to the pop cultural questions he poses of the thousands of possibilities. The show only represents one way of how science fiction technology might work scientifically, even though there are others as well.

My findings correlate with the findings of Bucchi (2004). "However, long-period analysis of the treatment of scientific themes by the non-specialist press shows that it presents scientific activity as largely 'progressive', as beneficial to society, and as consensual." (Bucchi, 2004, p. 110) *Because Science* does not show different scientific possibilities. The videos do not give the viewer different options they can choose from. Science is presented as great, fascinating and a clear solution for a clear problem. Science is presented as if it could tell you how things 'really' are.
The videos have clearly an over-representation of physics to other fields of science. Engineering and mathematics are also shown. Social science is not handled in the videos at all, only natural sciences. My own findings overlap with the findings of Bucchi (2004), who says that the media tends to over-represent specific fields of science over others.

I have shown above that Kyle Hill sees limitations to the format of his show, even though less than I did through analyzing it. When talking in the videos and during the interview Kyle Hill emphasizes the benefits of this format more than the difficulties. By analyzing the videos and referring to the literature I had already read I could see limitations which Kyle Hill would probably not agree with. In his interview he highlights the scientific story more than the pop cultural story, even though it seems from the video data that the pop cultural story is in some videos stronger than the scientific one.

8.3.3 Underrepresentation of risk, time-frames and possible negative outcome of science

Science stories vary in the way they present aspects of science. Possible societal or ethical risks of science are not shown in the videos and possible negative outcomes of science are not presented either. These findings are similar to what Bubela et al. (2009) discovered in their work. Also, time-frames in which scientific results could be beneficial to society, are also not offered in the videos. As Bubela et al. (2009) show in their work, scientists and lay people have different concepts of timeframes. It is likely that omitting timelines produce the impression in the public that significant benefits are imminent, but they can take years and decades. (Bubela et al., 2009) Felt and Fochler (2013) also write about the underrepresentation of time-frames. When Kyle Hill talks about a plasma ring, which is held in place

by magnets in a device called Tokamak (Hill, 2015f), he does not explain well what it is. He does not stress a time-frame for possible benefits for society, nor does he tell how the experiment is done or which risks it has. Only after researching online I have found out that a Tokamak is a fusion reactor, which might be for power generation in the future. Possible health problems cannot be estimated at this point. If realized there would be centralized high-tech reactors, which could lead to fairness problems between developed and not so developed regions. Since the sixties scientists have been working on realizing these reactors. When and if these reactors will ever work is unforeseeable. Kyle Hill does not mention any of these aspects.

8.3.4 Science presented as positive, helpful and beneficial for society

Every science story is presented in a specific way. I have tried to find out how the format of a pop culture-science story influences the way science is presented in the videos. In the following I will show my results.

The content of the show has to be prepared carefully and easily understandable for a broad audience. Science in the videos is always presented as positive, helpful and beneficial for society. This is especially the case in the video, "Why Does Darth Vader Breathe Like That?" (Hill, 2016c). This is why I will use this video as an example to illustrate this point in detail. The focus of the video is to explain pop cultural elements through science, arguing how and why Darth Vader breathes like he does in the movies. Science in this video can be seen as knowledge about health issues and medicine and how a technology works, in this case how a BiPAP machine (Bi-level positive airway pressure) works. Even though the scientific knowledge you get from this video is small. Science is rather used to explain how pop culture works, in this case why Darth Vader breathes like he does and how the suit he wears works. It cannot be said for sure, if the explanation Kyle Hill shows in the video has been intended in this way by the creators of the movies. So this scientific explanation is imposed on the movies afterwards to make sense of this character in a scientific way. What can be learned from the case is accentuated strongly, even though the knowledge we actually gain is small. In the biggest part of the video Kyle Hill argues with scenes from Star Wars movies why Darth Vader has this disease and that this case study can help medical students to better understand this disease through the example of Darth Vader. This video implies that these students will understand the disease better by this case study on Darth Vader and in the following they can treat patients better. This is why Star Wars science makes the world a better place; this message is implied in the video.

8.3.5 Presupposed knowledge

The science stories that Kyle Hill tells with his videos presuppose scientific and pop cultural knowledge from his audience. He does not explain basic knowledge; on the contrary, he discusses complicated

scientific matters. I will elaborate this point with two examples. “In space there is nothing to push off against, just well space in every direction.” (Hill, 2015e) From the videos it can be said that he supposes that the audience already knows why this is the case and does not go into detail regarding this point.

> “So here we have our ion engine. There is magnetic coils running along the engine that provides a magnetic field. And an electron gun that fires off electrons and a spencer for the atoms acting as our propellant. So, to get this working. First, the atoms are introduced into the chamber and then electrons are fired at them. When they meet, they produce an ion with a charge, when an electron is stripped from it. This is the making of a plasma.”

Next to him there is a drawing of an ion engine and Kyle Hill draws atoms, electrons and ions next to it. (Hill, 2015e).

In this part Kyle Hill presupposes that his viewers know what atoms, electrons, ions, an electron gun and plasma are. Scientific explanations stay black boxed and are not explained. He explains how an ion engine works, but not in detail. He points out that there is a magnetic field inside, but not what it does. He also does not show the interaction between the atoms and the electrons. After watching the video, it is difficult to explain how an ion engine works. If you do not have all the presupposed knowledge, you cannot fully understand what he is talking about and also the explanations that follow can be tricky.

Kyle Hill asks in the video, how you can hear a spaceship in space, but he does not answer it. “Twin Ion Engine, it’s what makes the tie fighter so nimble and what it gives it that characteristic screech through space. Wait, if you are in space how can you, how can you hear anything screeching? Are you hearing it of the point of another star ship or?” (Hill, 2015e) The way he talks in the video can lead to the assumption that he believes his audience already knows all these things. He does not, however, explain this basic scientific fact.

Kyle Hill also presupposes knowledge in the video “Why Han Solo Is a Time Traveler!” (Hill, 2015d). He presupposes that you know which movie “A new hope” is, the kessel run, all the characters he mentions from the movies and so on. If the viewers lack the knowledge what he says will not make any sense to them. At another point in the same video Kyle Hill mentions: “the fastest hunk of junk in the galaxy". (Hill, 2015d) He means a spaceship, the Millennium Falcon, but without having seen the movies the audience cannot know what he is talking about. He also presupposes that you know what a light year is when he explains what a parsec is. If you do not have that knowledge, it is difficult to understand all the aspects he refers to, both scientific and pop cultural ones.

From the analysis of the video material it can be assumed that Kyle Hill’s aim is to highlight particular scientific phenomena and not to give basic knowledge. When talking in the videos Kyle Hill black boxes

aspects he explains, like the chamber with the electrons fired at it. Kyle Hill stresses in the interview that his ideas about the show and how he does the show diverge from each other. “Going in to each episode, I don’t assume any prior knowledge of either science or pop culture, just a general familiarity with it.” (K. Hill, personal communication, May 27, 2016) From the interview with him it can be said that he thinks the he does not presuppose any knowledge from the audience, but I could show that this is not the case. This aspect helps me to better understand how he does science communication.

8.3.6 The use of sources

Another point which I have recognized by analyzing my material is that in the science stories sources are used scarcely. How scientific results have developed that are presented in the videos, is hardly ever shown. Kyle Hill hardly ever cites any sources. He does not show where he gets his information from in the videos nor how he chooses what to present. In “Why Does Darth Vader Breathe Like That” he references one scientific paper, which uses Darth Vader as a case study for lunge damage, but this is the only source he ever mentions in any of the analyzed videos. What is more, the viewer gets the impression that Kyle Hill uses this source more to justify his own work than to explain science. He validates the way he communicates science by saying that others use Star Wars for science communication as well. By using no or almost no sources in the videos, it may seem as if Kyle Hill has made up his results. You cannot easily disprove or prove his scientific arguments, because you do not know which results he refers to. Just seven videos state sources in the information part on YouTube. Two videos quote no sources so that the viewers are not able to look into more detail what he was talking about. When he cites sources, he refers to wired.com, wikipedia.com and nerdist.com.

8.3.7 Formula

Formulas are a tool to present the videos as science stories. Science in the videos is presented as finished results which cannot be challenged. This may be due to the fact that Kyle Hill does not show how his results come to be. Furthermore, he does not show any sources in the videos and does not explain how he reaches his conclusions. Science, however, is also presented as finished and incontrovertible, because Kyle Hill uses formulas to underline his argumentation. The formulas he shows are visible on the screen for only a short time and without making a break it is impossible to understand what they could mean in this short time you see them in the video. Even if you freeze the video and look at the formulas more closely, it is hard to understand them. Formulas are rather used to show that there is science in the videos than to explain it.

In the video “Why Han Solo Is a Time Traveler!” (Hill, 2015d) Kyle Hill shows the formula of the time dilation equation (see Appendix 1 for full formula). He does not explain the formula he uses and he does

not show where it comes from and what it means. If you have knowledge of the topic he is talking about, the shown formula in the video could be familiar to you. The formula itself does not help to understand the topic better. It is like a code language. He uses the formula more like a picture than a way to explain science. He applies it to underline how scientific the things he says are, but he does not explain the numbers and letters used and what they mean. It is a justification or proof for what he says. He black boxes the formula and presupposes this knowledge from the audience. This makes it difficult to fully understand and to disprove his argumentation. With the formulas he also builds up a teacher-student or expert-layperson relationship, in which he positions himself as knowing more than his audience.

8.3.8 Star Wars atmosphere

Star Wars atmosphere is the feeling that someone gets when something reminds them of the Star Wars movies and makes them think that something is part of the Star Wars universe.
Star Wars atmosphere is an important aspect of pop cultural science stories. It is necessary to build up a fully coherent story in the videos. Jokes and references to Star Wars pop culture are used in the videos. Without knowing the movies and the bigger pop cultural sphere around them it can be hard to understand the humor. As said before there is a lot of presupposed knowledge in the videos. By the inclusion of movie scenes from Star Wars, references through spoken and written language, as well as drawings and merchandise products the videos are linked to Star Wars pop culture. The setting, the music, the overall topic, all these things generate a Star Wars atmosphere. The purpose of this is probably to remind the viewer of Star Wars and they might get new knowledge about Star Wars pop culture and science. Star Wars is used in the videos as a way to get the interest of the audience and to build up a Star Wars atmosphere.

8.3.9 Merchandise products

Merchandise products are used in the videos as an entrance point and ending of a video. They help to introduce and to end a topic. They are important to build up the Star Wars atmosphere in the videos. Kyle Hill uses a plastic laser gun, a Darth Vader sweater, a trisaber (Laser sword of Kylo Ren), a plastic light saber and a costume from a Red Guard, also called redrobes, in the videos. On the one hand, he does this to add a Star Wars atmosphere to the videos and on the other hand, to introduce or end a topic.

8.3.10 Kyle Hill's use of language in the videos

Language is essential to develop a science story. The choice of words influences how science is presented and in this way which story is told.

Kyle Hill talks in his videos in an informal way using few technical terms, but a lot of humor and pop culture references. He uses very few scientific terms and abbreviations, but he does not explain them all, just a few of them. This can lead to the assumption that he finds that some terms require an explanation and some don't, probably because some terms are assumed to be easy and it is assumed that the audience already knows those terms but not others. The terms electrons, neutrons and ions, for example, are used and not explained in one video (Hill, 2015e). Which terms are explained shows what kind of audience Kyle Hill thinks about when producing his videos.

Kyle Hill talks fast in the videos; you have to be fluent in English to follow all the topics he is talking about. But it is not only about understanding English, Kyle Hill uses specific words and language, scientific and pop cultural. If you are not familiar with the topics he raises, understanding the videos is not only difficult because of the presupposed knowledge or his fast talking, but also because of the words and grammar used. He often switches between topics, which can make the videos seem casual and easy to follow, but at the same time they can also be interpreted as too fast and superficial. He uses an active and personal voice when talking. Moreover, he often uses long sentences (20-25 words).

Kyle Hill addresses the audience directly; this can be interpreted as trying to build up a close relationship with the audience. He has a subjective language; he does not talk objectively about topics. He only shows his opinion and ideas about one topic. This is especially the case in the pop culture sections. In the scientific sections his language is more objective, but not totally. All in all, he uses an inclusive language. He often uses the 'we' form in the videos to include the audience while speaking. "Well, let's figure out how Kylo Ren's lightsaber works and then figure out if he's a dummy." He creates the impression that he wants to experience and find out facts together with the audience. By doing so Kyle Hill presents himself as part of the audience who loves the Star Wars movies. When Kyle Hill refers to general knowledge about pop culture as well as science, he mostly uses the 'we' form to include the audience in his presentation. This can be interpreted as making the audience and him seemingly equal in the videos. "It just seems like from everything we know of the universe the speed of light is the universal speed limit." (Hill, 2015d) He includes the audience with 'we' and he refers to a shared common knowledge, which he assumes the audience has.
When he talks more about sophisticated scientific knowledge, he does not include the audience and uses the 'I' form. He states the science parts, as if they were hard facts or 'true' knowledge and not debatable. By using the 'I' form he distances himself from the audience as the expert. He talks as if he knows exactly what is right and he explains this to the audience, who seemingly does not know. As Kyle Hill formulated once, "let me explain with numbers" (Hill, 2015d). This seems to highlight the deficit-model approach. He presents himself as the expert and the audience as the lay people. When Kyle Hill shares his personal opinion about pop culture he also uses the 'I' form. He gives his personal explanations by saying which consequences his idea would have on the 'real' science behind the Star Wars movies.

“Well that's my theory, at least I am trying to keep the physics of a fantasy world sound here, but just think of how the story would change if relativity was included.” (Hill, 2015d) He says that the explanation he gave is one of uncountable possible explanations and his personal, subject opinion. Kyle Hill also says that he knows the limitations of Star Wars to discuss science.
In the way Kyle Hill talks in the videos he tries to be part of the audience, but at the same time he has a superior position as a scientist and an expert. He shows that he has knowledge about Star Wars pop culture, but he also shows the flaws of the movies and why science is in his view always right in the end. Kyle Hill corrects, for example, the use of the word parsec in the Star Wars movies, “a parsec is a unit of distance and not time.” (Hill, 2015d) And he explains in detail what it is and how it is measured.

Kyle Hill uses pop cultural language from the movies, like “kessel run” or “hyperjump” (Hill, 2015d), but as well from the bigger pop culture domain, like abbreviation or nicknames. He not only uses words from the movies, but also words which were established by the pop cultural sphere, like the name “traitor” for the Stormtrooper TR-8R (Hill, 2016a). Fans of the movies have given him this name. By using this language, he can show his knowledge in the pop cultural domain as well in the scientific area.

8.3.11 How Kyle Hill appears in the videos / presents himself

Kyle Hill appears in the videos as kind of cool teacher. This is partly because he includes the audience when he talks and also because of his knowledge and use of pop culture. This shapes the science story as being partly educational and partly entertaining. As he presents himself as cool and young he gives the impression that he knows what young people are interested in today. At least this is the way he presents himself in the videos. His enthusiasm about the topics he talks about is contagious. “How cool is this thing?” (Hill, 2015f) How he talks and acts in the videos makes him seem like a physics nerd who wants to make people interested in the things he loves even though Kyle Hill looks more like a hip Instagram model with highlights in his hair rather than a physics teacher. From the way Kyle Hill talks it can be seen that he is excited about what he does, that he has passion about science and pop culture and that he wants to pass this on to his audience. He seems sympathetic, even though one can argue, if his humor is funny or not.

8.3.12 Expert explains science to the audience vs. learning it together with the audience

Kyle Hill has two ways of teaching scientific knowledge to an audience, by explaining it to the viewers and by learning together with them. These are his ways of building up a science story. Kyle Hill talks about himself in the interview as if he learnt science together with the audience. “Right now, I am focused on making myself seem as accessible as possible, like we are just learning this stuff together.

That's why I will deliberately keep flubs or mistakes in my videos, or times when I just crack up – I want to stay loose and grounded." (K. Hill, personal communication, May 4, 2016) In the interview he presents his videos as a loose, fun and easy way to learn about science. As I have shown in the language section before, this is not exactly what I found out when analyzing the videos. By using the 'we' form Kyle Hill tries to make it seem like he is learning something here as well. By doing so, he presents himself as part of his audience. In the videos Kyle Hill talks and acts as if he came up with his explanations while talking. Therefore, the videos often feel like a discussion or a dialogue with an equal person. But in the end, as I have shown in the section before, he is the expert and explains how it is done right. Kyle Hill creates a sense of involvement with the audience, but if this is real involvement can be argued. He creates this involvement by discussing a topic, which people asked him to do on Twitter (Hill, 2016b) and by letting people vote on Twitter for a video topic (Hill, 2016d). However, there is doubt if this is real involvement, all in all he always chooses what he wants to do and the audience has little influence on the content. It is more a one-sided communication, even when he is framing it as a two-sided one.

Kyle Hill writes and draws on a glass wall in front of him throughout all videos. This has a connotation of a teacher writing on a board. This stands between him and his audience and separates them, however when he is not writing on the glass it is not visible for the audience. Questions are not only a tool to guide the audience through the video, as I will show later on, but they are also a tool used to control the meaning of what is seen as interesting by Kyle Hill, of what should be answered and what seems to be important. With his choice of topics, questions and references he has total control over the content and how it is presented. From my analysis I can say that it is solely Kyle Hill's own voice and assessment that dominates the discussion. Kyle Hill chooses and creates the science story he wants to tell in the way he wants to tell it.

8.3.13 Alternation

Alternation and diversion are an important part of the science stories Kyle Hill tells in his videos. Content and style often alternate in the videos. Different ways are used to do alternation in the format of the videos; picture-in-picture fade-ins, back flashes to older *Because Science* videos, drawing of scientific pictures, formulas and Star Wars elements on the screen and other full screen video material are included. Many of the scenes are shorter than 20 or 30 seconds. You can always see Kyle Hill gesticulating and talking. When he is not on the screen you see other video material and sound. There are hardly any breaks between the small sections of the videos. This gives the viewer little time to think about the content. Two parts in between are put fast-forward, probably because Kyle Hill interpreted them as boring, like when he draws on the screen.

Furthermore, the way Kyle Hill talks in the videos changes rapidly. Kyle Hill changes his voice for entertainment to get a funny tone or to imitate a character of the Star Wars movies. Jokes and changes in sounds are also tools that are used. When Kyle Hill talks about the main topic, he always splits it up into small sub-topics. He does not stay too long with the sub-topic, but he always comes back to the main topic of the video. In between he often deviates from the sub-topics to make jokes or comments, which are not relevant for the main topic at all. In one video when he talks about tie fighters, a cross-hair appears in between and targets Kyle Hill. (Hill, 2015e) It is not important for the understanding of the main topic, it is only for entertainment.

The alternation and diversion can be interpreted in two ways. On the one hand, it can be seen as a tool to loosen up the scientific content to make it less intense and more fun. This would underline the edutainment approach, which keeps the videos dynamic and interesting. This can be seen as Kyle Hill's way of presenting his science story. In this heavy topics can possibly become easier to understand. The videos become more informal. Jokes and Star Wars references are often funny and not important for the content, but for the entertainment. The videos give a lot of information in a short time so that it can be good to loosen them up from time to time. He also switches between topics, which can make the videos seem casual and easy to follow, but at the same time it can also be interpreted as too fast and superficial. The changes in topics and style can also distract from the science in the videos. His jokes and Star Wars references loosen up the atmosphere, but at the same time they make it difficult to follow the science story in the videos. The pop culture often distracts from the science parts and does not always improve it. The videos are so fast that you can hardly think about what he is saying, because he already talks about the next point.

In summary, Kyle Hill builds a coherent, well-rounded science story by using pop culture, references and jokes about Star Wars, merchandise products, presupposed knowledge, Star Wars atmosphere and his use of language, formula and alternation. The language contributes to alternation and shows what is presupposed by the audience. Alternation keeps the videos dynamic and formulas underline the scientific character of the videos. All these elements mix and form together the science story that is told in the videos. This produces a Star Wars atmosphere which draws a continuous line through all videos.

8.4 Frames

"A frame is a central organizing idea for news content that supplies a context and suggests what the issue is through the use of selection, emphasis, exclusion, and elaboration." (Tankard, Hendrickson, Silberman, Bliss, & Ghanem, 1991 cited in Tankard, 2001, p. 100)

In this part I will show how the content of the videos is framed through different elements, which I found out by analyzing the video data through the use of video hermeneutics. I begin with Star Wars pop culture as the overarching frame for science communication.

8.4.1 Star Wars pop culture as the overarching frame for science communication

"I think it's easier to learn scientific concepts and theories if you're building upon something that people already love and are passionate about: pop culture." Kyle Hill (personal communication, May 4, 2016) This is why Kyle Hill has chosen pop culture as the main frame for his videos. But how Kyle Hill wants his show to be and what it is actually like, are not always the same. In the videos Star Wars pop culture is present in every video, in some more than in others. This is especially the case at the beginning and the ending of the videos, where he introduces and concludes his statements. Star Wars pop culture can be seen as a frame, which is present in the videos at all times. It is the connecting element that bridges all the parts of the video to one full concept.

The videos can be seen as pop culture-science stories, in which the topic is introduced or built up in the beginning. Kyle Hill talks about a pop cultural technology or aspect of the movies and this is combined with a scientific aspect. Then, step by step parts of the main topic or main question of the videos are handled. Between the science parts, Kyle Hill always makes little jokes and references to the Star Wars movies and pop culture, which he probably does to loosen it up. From analyzing the videos and comparing them to the interview it can be seen that pop culture as a frame should make the science part lighter and easier to understand. As Kyle Hill (personal communication, May 4, 2016) said, he wants to "entertain and enlighten" the audience.

In one video Kyle Hill says: "Electromagnetism, that's the real force." (Hill, 2016a) In this statement he is referring to two realms, science and Star Wars at the same time and combines them in a way which can be regarded as funny. In the end the video is summarized and concluded and it is stated which impact science would have on the movies, if it were 'realistic'. In the videos Star Wars is used as a frame for science communication. In four videos this works better than in the other ones.

The question that arises is, if Star Wars pop culture is the frame of the videos or is it the content. This is difficult to answer. From my video analysis I can say that four videos use Star Wars more as a frame to communicate science and five use science more as a frame for pop culture.

From the video "Why Han Solo Is a Time Traveler!" (Hill, 2015d) I chose one part I want to show. Kyle Hill talks in the video about theory of relativity and that time is not always the same. When the Millennium falcon go on a kessel run or a hyperjump (travel through the universe with almost at the

speed of light), the people inside get from one part of the universe to another in a short period time. In doing so, the people on board of that ship would age slower than the people outside. (Hill, 2015d) After the scientific explanation of the theory or relativity, Kyle Hill says in the video:

> "To appear about 29 or 30 in the event of 'A new hope'; if he [Han Solo] did just one kessel run he would have to be born at least 70 years before that movie, because forty years would have had lapsed with just one kessel run. Although, he barely aged at all, which makes him older than Obi-wan Kenobi. If he did two before the events of the movie then he'd have to be born at least a hundred and ten years ago, which is older than the Emperor. If he did 3 he'd have to be born a hundred and fifty years before the events in the movie, making him older than the line that made C3PO and if he did four or more he'd have to be almost 200 years before the events of the movie making him older than Chewbacca, wow, Chewbacca is old." (Hill, 2015d)

In this part it can be seen how pop culture and science are tightly linked. The theory of relativity is explained using pop culture examples. Kyle Hill combines how science can directly be linked to Star Wars material from the movies and Star Wars pop culture knowledge. He makes a tight link between scientific explanation and pop culture. In the focus of this video is science and pop culture is used in this video more as an example to underline science. In the video "Why Kylo Ren's Lightsaber Works" (Hill, 2015f) science is more used as the frame to discuss pop culture. Why the sword is a good weapon is more important in the video than to explain how it could work scientifically.
We can see that it can be difficult to determine if science or pop culture frames the other one and that the focus changes from video to video.

8.4.2 Specific pop cultural questions

Kyle Hill has told me in the interview that he tries to use focused pop cultural questions as frames for his videos. He has explained that the more they are focused the better they work. "About a year ago it looked like specific pop culture videos did better than general ones (i.e., what is Captain America's shield made out of vs. are ghosts real), and I consciously moved towards hitting 'tentpole' pop culture properties." (K. Hill, personal communication, May 4, 2016) I found this statement in the interview stimulating, so I looked at this point more closely in the analysis of the videos. Through comparison of different videos, I have found out that Kyle Hill focuses in every video I analyzed at specific pop cultural questions. Through comparison of different videos, I have come to the conclusion that more specific pop cultural questions require deeper knowledge about pop culture from the producer of the show as well as from the audience than less specific ones. They also require to talk and include more pop culture in the videos (video material of Star Wars movie, …) to talk about the science of it. For example: How could a spaceship travel through space vs How does the Millennium Falcon travel through space. The

second one is a more specific pop cultural question, which Kyle Hill uses. These findings match with Kyle Hill's statement from the interview.

8.4.3 No strict separations between different pop cultures

In the section before I have shown that Kyle Hill focuses on specific pop cultural questions as frames for the videos. Even though when going through my data I have realized that there are no strict separations between different pop cultures in the videos. The frame of the videos is not solely Star Wars pop culture, but it shifts also to other entangled pop cultural fields. This leads to the assumption that Kyle Hill believes that the viewers who know Star Wars pop culture also know about other pop cultural phenomena. They are presented as connected and the audience is presented as interested in different fields of pop culture and as wanting to know the connection between the different pop cultural fields. Kyle Hill has two videos in which two different pop cultural realms get massively mixed. The two videos are "Could a Lightsaber Cut Through Captain America's Shield?" (Hill, 2016d) and "Can Kylo Ren Lift Thor's Hammer?" (Hill, 2016b). As the titles show Kyle Hill compares different futuristic and phantasy technology in these videos. He explains how these different universes could work out, if parts of them met.

8.4.4 Hot topic in cultural sphere

The science stories come out when the issue is topical, in other words, when they are hot topics in the pop cultural sphere or when a so-called hype surrounds them. This gives the frame of Star Wars pop culture an up-to-dateness. Events raise the interest of the public for specific topics. (Gregory and Miller, 2000) The interest in Star Wars is higher at the time when a new movie comes out. The release date is an important factor for the success of a video. When a new computer game or movie comes out, the *Because Science* videos that handle a topic in these realms are often released shortly before or after the release date. When 'Star Wars: Episode VII - The Force Awakens' came out in December 2015, Kyle Hill brought out videos on Star Wars during that time period. The videos should not be uploaded too early or too late. If he had dealt with Star Wars tech a few months later or earlier the interest could have been lower and probably fewer people would have watched the videos. Kyle Hill also confirmed that in the Interview I made with him: "Many times I will look at the calendar to see what movie / video game / comic is releasing that week and try to plan an episode for that." (K. Hill, personal communication, May 4, 2016)

Kyle Hill uses events, mostly release dates of movies, series or games, to discuss scientific topics. This shows that the scientific priority is not the most important factor for choosing a topic, the pop culture is. Bucchi (2004) says in his study that media tends to rely on certain events for media coverage and not

scientific priority. Scientific topics that are handled by the media have to be linked to topics outside the scientific field to be of interest for a broad public. This is the case for *Because Science*, which uses Star Wars pop culture for this purpose. “I try to think about what people will be talking about or arguing about when a new pop culture thing comes out” Kyle Hill (personal communication, May 4, 2016)

8.4.5 The importance of the Pop Cultural Sphere

Not only the release date is an important factor, but also which part of the pop cultural phenomenon, in my case Star Wars movies, Kyle Hill takes up to discuss. The videos of *Because Science* do not only use elements of the movies; in referring to them they refer to a wider phenomenon around Star Wars. This has an influence on the frame of the videos. The frame is not only Star Wars; it includes all kinds of Star Wars pop culture. The videos do not limit themselves to the Star Wars movies alone. In the videos costumes of the movies and other merchandise products are used to establish a Star Wars atmosphere. At the date of 10.03.2016 the video “Why Kylo Ren's Lightsaber Works” (Hill, 2015f) had 2.453.030 clicks. That has been the video of the *Because Science* series that has got the most clicks so far. In this video Kyle Hill talks about the laser sword of Kylo Ren and if it is a good weapon or not. This connects to a whole online and offline discussion about the laser sword, which exceeds the movies and so the videos are imbedded in the Star Wars pop culture. The central theme of this video is, ‘Let's see how this light saber works and then if it is a good design or not’. Kylo Ren’s laser sword frames the whole video. This science fiction technology is taken as a starting point and is present in all the parts of the video. Kylo Ren’s laser sword started in the movie and became a pop cultural product, which was discussed and handled in the pop cultural sphere outside the movies. It became in a way separate from the movies. In the pop cultural sphere, it became an emotional topic, which was argued about in forums online and offline. This is because fans can get really attached to the things they love. I think part of the success of this video is that it contributes and participates in this pop culture discussion, which was a hot debate at that time. Kyle Hill shows with this video that he is part of the pop culture; that he has inside knowledge about this topic and that he has popular cultural asset. He shows that he is well informed about the Star Wars movies and also about the online pop cultural sphere.

Kyle Hill says in one video: “The Internet has spoken. The coolest character in Star Wars - The Force Awaken isn’t Ray or Finn or even Poe Dameron. It’s this badass Stormtrooper right here, commonly known as TR-8R or traitor.” (Hill, 2016a) He reveals his knowledge and personal opinion about Star Wars pop culture. Kyle Hill also shows with the expression ‘commonly known as’ that the names he uses are widely used in the Star Wars pop culture. He shows that he is part of that community, who knows how to use the right words. In another video (Hill, 2015d), he explains how parsec is a measure for distance and not time and how it is already used wrong in the first Star Wars movie. Kyle Hill shows that he is well-informed and part of the Star Wars pop culture and has been for a long time, because the

fan discussions about parsec have a long tradition and were often talked about in the past. The way Kyle Hill talks and presents himself suggests that he has been part of the pop culture community for a long time. In referring to fandom discussions that happen online and offline he also shows knowledge of pop culture and that he is part of it. “I haven’t seen as much debate around a piece of Star Wars tech since Han Solo said par sec instead of literally any measurement of time.” (Hill, 2015f) This sentence is used as an entrance point to the discussion, if Kylo Ren’s laser sword has a good design or not. Kyle Hill shows via his videos that he has knowledge of the old debate and the recent one. From what Kyle Hill says in the videos it can be assumed that he is well- informed in the field of Star Wars pop culture.

What is more, his own videos, the *Because Science* show themselves have become part of the online pop culture discussions, of the pop culture community online. The videos can be interpreted in a way as Kyle Hill’s contribution to the pop culture sphere. From the analysis of the video material, it can be assumed that Kyle Hill seems to know the Star Wars pop culture field well and uses this inside knowledge to gather the most clicks; he tries to include the topics that were debated the most online into his videos.

8.4.6 Titles as frames

Not only Star Wars frames the content, the titles already give a specific frame to the videos even before the audience starts watching them. The videos have two kinds of titles, the ones that are statements and the others that are questions. All of them start with a question word at the beginning. The titles do not tell directly which pop cultural universe the videos refer to. With basic knowledge in the pop cultural field the titles refer clearly to one or two pop cultural spheres. Every title has the name of the show and the name of the producer at the end, “(Because Science w/ Kyle Hill)” (Hill, 2015a). Both kinds of titles are clear, straightforward questions or statements to open up a topic and serve as appetizers. The titles indicate that the videos will give the viewer the answers to the questions posed in the titles. I give an example: “Can We Have Star Wars' Lightsabers in Real Life?” (Hill, 2015b) The titles are the appetizers and if I want to know the answers asked I have to watch the videos. If the questions are answered properly in the videos is another point. This title also makes a connection between the life of a potential viewer or today’s science and the Star Wars movies. The word ‘real’ connects science and Sci-Fi in an easy way. Every title has a connection between science and pop culture. Here is another example for a title: “Why Han Solo Is a Time Traveler!” (Hill, 2015d) This title implies that it is a fact and if you want to find out why, you have to watch the video. The title provokes and challenges established pop cultural ‘realities’, which are taken for granted in the pop cultural sphere or at least Kyle Hill assumes that they are.

The titles are catchy and are formed in a specific way for marketing purposes. In the video "How Much Would a DEATH STAR Cost" (Hill, 2015c), the title refers only to one of five topics of the video, which Kyle Hill discusses. He talks about different aspects of the Death Star, but it seems to me that he has chosen one aspect which he regards as the most interesting one for the audience as a title. I conclude that the titles are always chosen in a way Kyle Hill hopes to gather the biggest audience with.

8.4.7 Questions as frames

This part is tightly related to the part above. The titles of the videos are often questions, as mentioned before. The video should be the answer to that question. A main question is present in every video, in three videos they are made explicit, in six videos they are implicit. Questions are also used as an entrance point to small parts of the videos. These are not always made explicit, but often. The smaller parts answer parts of the main question. These questions help to build a logical structure and lead through the videos. In the end there is a conclusion that summarizes all the topics that have been dealt with. I will show with the example of one video how questions are used to discuss science in Star Wars pop culture.

Questions in the video "How We Already Have Real TIE Fighters":

Title of the video: "How We Already Have Real TIE Fighters"

The following are questions Kyle Hill asks in this video.

"What makes a tie fighter a tie fighter?"

"So what is an Ion Engine and how does it work?"

"How strong can an engine be, if it is only throwing atomic particles out the back?"

"Want more science?" (This last question is asked after the words *Because Science* in the end titles) (Hill, 2015e)

After each question Kyle Hill gives an answer in a scientific and pop cultural sense. In this video the questions are made explicit, which is the reason why I have chosen it as an example to make my point clear. We come to the next big part of my analysis chapter, boundary work.

8.5 Boundary Work

In this section I will find out what science, pop culture and non-science is in the videos and what is not, as I described in the theory section before. I will show if I find differences between the interview, the videos and the literature on science communication and also how these differences come into being. I will also deal with the question which elements Kyle Hill uses to create these boundaries.

8.5.1 What is science in the videos and the interview and how is the notion of science created?

In this part I will try to figure out what science is and what science is not in the *Because Science* videos and the interview and how Kyle Hill has created the differences. Science is not the same in the videos and the interview, as I will show. For this purpose, I will refer to Gieryn (1983), who says that science can be many things depending on the purpose of its use; it is created and recreated in everyday practices. I have tried to find out how science is framed or imagined by Kyle Hill in the videos and how this distinguishes them from non-science. The way he sees science can be deducted from the information that he communicates to the audience. From my analysis I can say that the way Kyle Hill presents and talks about science in the videos is different from the way he does it in the interview, as I will show in this part. Kyle Hill talks in the interview about science as a vague concept, in which science is a way for world improvement. In the interview he says: "Science is nothing less than the best way of understanding our world. It's our only way out of the darkness, the only way to find ourselves, to find why we are here, and the only way to solve life's greatest challenges. Science is so important to our survival and advancement." (K. Hill, personal communication, May 4, 2016)

From analyzing the videos, I came to the conclusion that the word 'science' in the videos refers basically to every kind of knowledge, which is essential to explain how pop culture works. This is completely different from the interview. Science and technology are not seen as strictly separated fields in the videos; they are often referred to as one common block. Kyle Hill talks about them as if they were one field. Science in the videos is a quantified science; it is measurable and calculable. "Let me explain with numbers and not like a crazy person" (Hill, 2015d). In the form in which science is presented in the videos it seems like it is fixed and unchangeable. Kyle Hill creates this idea of science in the videos through inclusion of numbers, graphs, formulas and calculations.

At the same time is Kyle Hill aware that his explanation is one of thousands of possible ones. He formulates it in one video: "My favorite explanation is that […]" (Hill, 2016b) He talks in his videos about physics, chemistry, mathematics and natural sciences in general to explain natural phenomena. Social science is excluded from the videos. Applied science is more in the center than basic science. He does, however, refer to theoretical concepts of science and to practical scientific research projects. The fields of science Kyle Hill chooses to talk about influence what science is in the videos.

The videos show success stories of science; science that works can be seen. Failed science is never shown in the videos. These results correlate with the findings of Bubela et al. (2009), which say that positive results in science are more likely to get published in media than negative results. Often the methods, the study design, the risks and the time in which scientific findings will bring benefits are underreported, when it gets published in the media. This was also the case in my study. Kyle Hill's vague concept of science he expresses in the interview stands in contrast to the explicit way he talks and

presents it in the videos. Through his language and presentation Kyle Hill creates a certain image of what he considers to be science, he does that in both the videos and the interview.

8.5.2 Is science a tool to discuss pop culture?

In the section before I talked about the boundary work of science in the videos and in the interview and I will discuss only one part of this in this section, science in the videos. I will elaborate if science is a tool to discuss pop culture in the videos or the other way around and how I come to my conclusions.

Science is not the same in every video, but the science ideas in the different videos have a lot in common. In the show *Because Science*, science has been chosen as one way to discuss pop culture. But science is no more than one of many possible ways to explain pop culture. Science has gained extensive importance in our society and this is why it is the first address in our society to look at, when people search for answers. Also, Star Wars is in the realm of science fiction and in science fiction the most obvious and first way to look for explanations how the in-world logic works is science. Science fiction is full of futuristic technology and scientific concepts, which can be a good start for science communication because it gives the science communicator many possibilities to talk about science and technology.
Science in the videos is used as a tool to compare pop cultural technology to real life technology and to see the differences between them. From the videos the underlying assumption can be deduced that through science, pop culture becomes more solid and understandable. Science is a tool for argumentation about pop cultural questions. For example, "Can Kylo Ren Lift Thor's Hammer?" (Hill, 2016b)

Kyle Hill often presents his themes as strong emotional topics, which are frequently discussed by fans. As he once said, "People hate this thing [Kylo Ren's laser sword], but why?" (Hill, 2015f). In this way science is used to clarify hotly discussed topics in pop culture. The videos aim at ending these discussions. Science is in this way used as an argument, an opinion, a proof, a demonstration and a device to dominate the discussion. This is the case for all videos, even though it is stronger in the videos which focus more on pop culture and less on science. In these videos science gets downgraded to a supporting role for pop culture. On the other hand, pop culture is a tool to discuss science. It is used as a starting point for scientific explanations and to give science a pop cultural frame, as I showed in a previous section.

8.5.3 Differences between science, non-science and pop culture

In this section I attempt to distinguish between different fields that appear in the videos; I will not talk about the interview in this section. The boundaries of science, non-science and pop culture overlap and

can often not be separated. Science and pop culture are shown as if they were almost one. Through my analysis I came to the conclusion that the lines between these fields are only drawn through the knowledge and the imagination of the science communicator. Almost everything can be explained by science, when the science communicator can come up with a possible explanation for a problem, like how a technology could work in the movies. If the science communicator cannot come up with a scientific explanation (at least a theoretical one), the science communicator defines it as fantasy and pop culture. Theoretically, all things could be explained by science, if you have an idea how to do it. It seems as if the only aspect that separates science from pop culture was the imagination of the science communicator. The force of Star Wars, for example, is defined in the videos as magic and unexplainable by science, it is defined in the videos by Kyle Hill as a fictional construct. (Hill, 2016b) However, he explains other concepts of fantasy with science, like how Vibranium steel, a fictitious material which Captain America's shield is made of, works physically and explains what its melting point might be.

If it is quantifiable in any way, it is science (breath counts of Darth Vader or melting point of Vibranium). Aspects of the movies become scientific, when Kyle Hill comes up with a scientific explanation for them. In most videos it is a technology which is explained (Tie fighters, laser sword, death star, TR8R's weapon, Darth Vader's suit). In one video he explains the theory of relativity and the term parsec. In another video he discusses Darth Vader's trouble with breathing, so a health topic is discussed. Different sci-fi technologies are compared to real life ones and to other pop cultural technologies. Kyle Hill explains, for example, how a laser sword works and how much energy the death star would need to destroy a planet. He calculates how much energy such a pop cultural object would theoretically need to work as seen in the movies. Engineering, mathematics and formulas are used to describe physical phenomena. Numbers and graphs are used to underline the arguments made in the videos. Real-life scientific and technological concepts and facts are compared to hypothetical futuristic weapons or objects of Star Wars. He refers to the theory of relativity, when he talks about hyperjumps, for example. He takes technical futuristic equipment of Star Wars and explains and compares them to technologies that already exist in our real world. Some physical terms are explained to the audience and it is shown if they are used correctly in Star Wars, or not; like the term parsec.

This chapter shows that the boundary between pop culture and science is hard to draw and it seems that the only clear differentiation is the one made by the science communicator himself. Through the choice of words and explanations the boundaries between the areas are drawn.

8.5.4 Pop culture–science terms differentiation

Another interesting aspect of boundary work is that for people who do not know Star Wars it can be difficult to differentiate between Star Wars elements and terms and scientific ones in the videos. The

terms hyperspace, kessel run and hyperjump (Hill, 2015d) could be scientific and Star Wars terms, if you do not have knowledge about both fields. Terms and concepts used in pop culture and science, can lead to confusion and make it difficult to make a distinction what is science and what is pop culture. Some terms are used in both fields, but have different or slightly different meanings in each context. The borders between science and pop culture can become diffuse. Only when basic knowledge in science and pop culture is given, the content can be fully understood and allocated. The knowledge about the meaning of the terms is presupposed in the videos. How Kyle Hill uses them in the videos can show which implicit assumptions he has about the audience, which brings me to my next point.

8.5.5 Imaginaries about audience(s) of the videos

In the previous sections I have pointed out how boundary work is done in the videos and the interview and how they interact together. This boundary work reveals what kind of concepts Kyle Hill has.

> "*[S]ocial positioning of the public* can help to explain the characteristics of science programming on television [or on SNS]. In the end, this specific *idea of the public* leads to a certain media environment for science programmes and will be conserved by these media structures." (Kohring, 2012, p. 1020)

Concepts of the public exist in every show in one way or another. How Kyle Hill imagines his audience influences his outcome, how he designs and frames the show.
The viewers of the videos analyzed are likely to be Star Wars fans who want to get more information about some aspects of their favorite show. They can be fans or people that are interested in science. It is unsure, if all *Because Science* videos have the same audience. It is possible that fans of the superhero movies do not watch videos that deal with science fiction. It is also possible that people only watch single videos, because of their interest in a specific topic. Yet, it is possible that most of his audience watches his videos every week.
With my study it is impossible to tell who the actual audience of *Because Science* is, because I have no audience analysis of the channel. But by analyzing videos and the interview I can find out about the imaginaries that are fitted in the videos. Through the way Kyle Hill presents his videos and especially the science in them I can say how he imagines his audience to be like. I will combine the knowledge that I have gathered from the videos with the information from the interview with Kyle Hill to get an idea of Kyle Hill's ideas of his audience or audiences.

As mentioned before, scientific knowledge is presupposed several times in the videos. Still, the videos do not aim at a scientific community, but a lay public which already has basic knowledge in science. He explains only some terms he uses but not others. Therefore, it can be assumed that some terms are seen

as worthy of an explanation and others are not, probably because it is expected that the audience already knows those terms. The terms electrons, neutrons and ions are, for example, not explained in one video (Hill, 2015e). This leads to the assumption that the audience has at least upper school knowledge, because these subjects are only taught in secondary school. The knowledge he presupposes (for example how atoms work or what plasma is), is subject material for senior classes or even college students. To fully understand the topics Kyle Hill talks about you have to be engaged in science. Which terms are explained shows that Kyle Hill imagines his audience as having basic knowledge in science and also pop culture. The videos do not give basic knowledge to a broad audience, they show specific knowledge fitted to a specific audience. It is possible however, that a broader audience watches his work. From the way Kyle Hill talks in the videos, you can see that he imagines his audience as well informed about science and pop culture and as actively engaging in it. The underlying assumption of the videos is that people who are interested in Star Wars or sci-fi, are also interested in science.

Kyle Hill often calls the audience in his videos nerds, as he also regards himself a nerd (in the videos and interview). "I'm a huge Star Wars fan, but I'm also a huge science nerd. So because I know the movies so well, I can't help but apply reality to them in a fun way." (K. Hill, personal communication, May 4, 2016) In the videos he talks to the audience as if they were defensive about their fandom and if he said something negative about their fandom or when he might have another opinion than the movies do, the fans might get upset. Nevertheless, Kyle Hill tells in the videos that he does it anyway, because he likes to discombobulate Star Wars nerds and he likes to explain to them why they are wrong and science is right. "You nerds are wrong, George Lucas was wrong, let's move on." (Hill, 2015d) They are portrayed in the videos as if they could not take any criticism about Star Wars easily. Kyle Hill talks to them as if they would try to challenge Kyle Hill and his theories.
On the other hand, the audience is also portrayed by the way Kyle Hill talks in his videos as eager for knowledge and they want to better understand their beloved pop culture. The nerds are portrayed as having great knowledge about the genre they are interested in and like to discuss it and to learn more about it. In a previous section I have shown that there is no strict separation between different pop cultures and that Kyle Hill does videos on different pop cultures. This suggests that the audience is interested and knows many pop cultures.

When talking, Kyle Hill often includes his audience by using the 'we' form. This refers to a shared common knowledge, which he assumes that he and the audience have. But at the same time he also distances himself from the audience as the expert or a teacher figure in the videos, whereof follows he knows better than them. I have discussed this in the language section before.

From the interview with Kyle Hill it can be seen that he imagines the audience as young people who love fandom. In the language section I have shown that the videos are edited with fast and frequent cuts

and Kyle Hill also talks quickly. The words, grammar and content are chosen in a way which aims at young people. If you are not good at English, an older person or not familiar with the topics he talks about it can be difficult to understand what he refers to.
From the interviews it became clear that the educational purpose of every video is important for Kyle Hill. "My goal is to make videos that […] could be watched anywhere by anyone, especially classrooms." (K. Hill, personal communication, May 4, 2016) He regards himself as one guy using this pop cultural passion for science communication. "We all have the nerdy conversations anyway, I just use those conversations to make an educational science show." (K. Hill, personal communication, May 4, 2016) For Kyle Hill the teaching aspect is important as well.

Lievrouw (2010) suggests that communicating on Social Media has the possibility and advantage to be more open, responsive, participatory and discursive than in traditional communication channels (books, journals). SNS make it possible to be more accessible for a bigger audience; to debate, comment and argue about scientific developments together with the audience. Through analyzing my data, I have to say that I cannot fully agree to the points of Lievrouw. It was hard to get in contact with Kyle Hill. It took me different social media channels and four weeks before I got a response from him via the rather old technology E-Mail. The audience can comment the videos, but they are more talking to each other than to Kyle Hill. Kyle Hill only rarely answers to comments under his videos and if he does, he is short in his reply. This can partly be explained due to the fact that he is very busy, but I am not sure if this is the only reason.
In one video Kyle Hill discusses a topic which people asked him about on Twitter. (Hill, 2016b) In another one he let people on Twitter vote for a topic, he discussed in his next video. (Hill, 2016d) In the first case Kyle Hill took up a topic, which he wanted to discuss. In the second case, people could choose between different options he had given them. After analyzing all my material, I have to say that I think Kyle Hill does not engage a lot with the audience. He takes up what he likes from his audience and he only engages with them when it fits to into his plans. The videos suggest a close relationship with the audience, which I cannot confirm. Inclusion of posts from fans lead to the assumption that the audience is engaged in the topics, it seems like they are included in the discussion, but almost no exchange happens between Kyle Hill and the audience. When Kyle Hill answers to posts under the video or he includes Twitter posts in his videos (Hill, 2016b), it is only his own choice. Kyle Hill can decide when and how he wants to react to his audience. He does not exhaust all the possibilities that social networks generate, as described by Lievrouw.

In some videos less scientific knowledge is presupposed than in others. Still pop cultural knowledge is presupposed in them, but not as much scientific knowledge. From looking at those videos it can be assumed that these videos are aimed at a more general audience, which also loves pop culture and wants to know more about it, but knows less about science. In the two videos "Can Kylo Ren Lift Thor's

Hammer" (Hill, 2016b) and "Could a Lightsaber Cut Through Captain America's Shield" (Hill, 2016d), which I regard as handling less science than most of the other videos, different pop cultures are compared. It can be assumed that the audiences are imagined in these videos as not strictly separated between different pop cultures. If a viewer of the videos is a fan of one pop culture, Kyle Hill assumes that he or she is likely also a fan of another similar pop cultural field. The focus of these videos is on discussing pop culture and not science, which means the possible target group is larger and less specific. Here, science is rather a way to discuss pop cultural issues in these videos than the other way around. I will give an example, in the video "Can Kylo Ren Lift Thor's Hammer?" (Hill, 2016b) Kyle Hill has little scientific arguments on how Thor's hammer works, which he uses to discuss if Kylo Ren could lift it. "Thor's hammer has some kind of dwarfen north nanotechnology that has a hand or fingerprint sensing system that lets the user manipulate gravitons or the particles that transmit gravity." (Hill, 2016b) That is almost the whole scientific explanation Kyle Hill builds the whole video on and it is infused by pop culture. After that he talks about different pop cultural conclusions that follow from that explanation.

I have shown up how the audience or audiences are imagined by giving interview and video analysis data. What Kyle Hill says in the interview and how the audience is presented in the videos differs from each other. Kyle Hill imagines the audience in the interview I made with him as a general audience with little presupposed knowledge, but at the same time in the videos the audience is presented as nerds, which implies that they have knowledge and engagement in the topics he talks about. He talks in the interview about the audience as eager to learn. From my data I cannot say if the audience is one big group or many subgroups that watch different videos. I have proven that it is difficult to determine the imaginaries of the audience(s) of Kyle Hill, but I have tried to give some aspects of what I have found out. I have also tried to display how the boundaries reveal aspects of the imagined audiences. In the next point I will finalize the analysis section and review the arguments that I have made.

8.6 *Because Science* – Can pop culture be a good tool to communicate science?

I started the analysis with Kyle Hill's notion about science communication and his videos. In the previous sections I have presented by analyzing the videos that the ideas Kyle Hill has about his show differs from my interpretation of his videos. In the interview Kyle Hill explicitly claims that for him the videos are clearly science communication. "The science is absolutely the most important thing in my videos. The videos have to be fun, interesting, and have an actual link to the pop culture topic, but if I'm not teaching a general audience something there is no episode there, and I won't do it." (K. Hill, personal communication, May 4, 2016) For most of my work I take *Because Science* as science communication to be able to show how science communication is done in the videos. Only in this section I doubt that

this is the case, at least partly. In this part I will discuss if pop culture can be a good tool to communicate science. For this purpose I question, if *Because Science* is science communication at all.

From the interview it can be assumed that Kyle Hill believes that using Star Wars references makes science more interesting and valuable for an audience. Kyle Hill chooses questions of what he regards as scientific relevance and uses the saga of Star Wars to make science more appealing to an expanded audience. The underlying assumption of him about the videos can be summarized shortly that he thinks his videos are clearly science communication and that this science communication works better, if it is combined with pop culture and entertaining elements. In the interview it can also be seen that he thinks that if he uses Star Wars references, more people are going to be interested in science, and more people are going to find science valuable or 'cool'. Star Wars and pop culture in general is regarded as cool and through using Star Wars references, science should become even cooler. Star Wars pop culture has value for people and through using it, Kyle Hill thinks that he creates value for the science in his videos. "I think it's easier to learn scientific concepts and theories if you're building upon something that people already love and are passionate about: pop culture." (K. Hill, personal communication, May 4, 2016) Kyle Hill sees Star Wars as a good way to communicate science. These are Kyle Hill's most interesting ideas and thoughts about his show *Because Science*.

The line between science communication and entertainment is fluent and not fixed. It can change from one video to another and also in the videos themselves it can be difficult to tell the clear difference. Some parts are more entertaining, others are more about learning about science. This is not always clear, but I will try to make it as clear as possible in this section. I will also discuss here if science or pop culture is more important in the videos. I have touched on this subject in other parts before, but I will elaborate this point in more detail in this section.

After analyzing all the videos, I came to the conclusion that four videos can be regarded more as science communication and five less. All videos have elements in which science is used as a tool to discuss pop culture, but there are also elements which use pop culture to frame science. But in every video one of these aspects is stronger than the other one. No video does only fall into the one or the other category. Four videos are more on the science communication side and five videos are more on the communicating pop culture side. I created a scale starting with the videos, which I regard more as communicating science going to the videos, which I regard more as communicating pop culture. The exact order can be debated, but I summarized them in two blocks, which can be seen as more on one of the sides of the scale.

Communicating science	Hill, K. [Nerdist]. (2015e, December 10). How We Already Have Real TIE Fighters
	Hill, K. [Nerdist]. (2015d, December 3). Why Han Solo Is a Time Traveler!
	Hill, K. [Nerdist]. (2015c, March 19). How Much Would a DEATH STAR Cost
	Hill, K. [Nerdist]. (2015b, January 8). Can We Have Star Wars' Lightsabers in Real Life?
	Hill, K. [Nerdist]. (2016c, April 7). Why Does Darth Vader Breathe Like That?
	Hill, K. [Nerdist]. (2016a, January 21). How TR-8R's Lightsaber-Blocking Baton Works
	Hill, K. [Nerdist]. (2015f, December 17). Why Kylo Ren's Lightsaber Works
Communicating pop culture	Hill, K. [Nerdist]. (2016b, May 31). Can Kylo Ren Lift Thor's Hammer?
	Hill, K. [Nerdist]. (2016d, April 21). Could a Lightsaber Cut Through Captain America's Shield?

The videos that are more on the upper side of the scale work better to communicate science than the ones on the lower part. When looking at the dates of the videos it can be seen that the newer videos are more on the communicating pop culture side, as I have said in the section before. In the videos on the upper side of the scale Kyle Hill explains simple scientific aspects and theories and does not throw in too much pop culture. In these videos science and pop culture fit together well and the science part is not too far-fetched. Kyle Hill is better at explaining how technology, sci-fi or scientific concepts (more the upper videos) work than totally fantastic concepts (videos more on the bottom). Explaining totally imaginary concepts contradict any logic and are always far-fetched. They rarely work, because they are not built on any scientific explanation or concept.

The videos on the bottom of the scale have little scientific elements in them. These videos do not really try to communicate science, but they want to legitimize pop culture. Measured by time pop culture is definitely more in the focus of these videos. More time is spent on explaining and talking about pop culture than about science. Kyle Hill invests more time in building up questions than answering them in these videos. He says in the interview: "I make sure to basically introduce what the pop culture says, and then dive into my own explanations. I'd say most videos are more than 50% science-based or involve scientific thinking or concepts." (K. Hill, personal communication, May 27, 2016) From the data that I analyzed I have to say that I cannot agree with his statement. In the videos towards the bottom of the scale this is definitely not the case, but also in the videos on the upper part of the scale there is a strong focus on pop culture and I am not sure if 50 percent of the videos are about science. The question now is if it is about communicating science, shouldn't be the biggest part of the videos be about science?
The main questions and titles of the videos already show what the focus of the videos is; if the video aims more at answering a scientific or pop cultural question. The main questions of the videos that are more on the bottom of the scale focus more on the pop culture side and only little on the science part. They are rather asked in a way to answer a pop cultural question with science and not to tell a story about science with pop culture.

What happens in the Star Wars movies is seen as a pop cultural fact and science is seen as a way to explain or disapprove with the storyline and technology in the movies. In all videos science is one explanation for phenomena, next to other pop cultural explanations. Science is no more than one of many ways to explain the in-world logic of Star Wars. In the videos that are more on the bottom of the scale you learn little about science. In the videos more on the top of the scale you at least have the chance to learn about science, the question if the audience uses the chance is another topic.

In the end one question remains: Is pop culture a good tool to communicate science or not? People may say that pop culture and science do not fit together, that magic should be magic and science be science. It could be argued that science kills the wonders of a fantastic saga. But also the opposite could be said: Science makes pop culture more real and a story richer. I think it should be decided from case to case if pop culture should be used for science communication and if it is done in a good way, which benefits both sides. In the case of *Because Science* pop culture is used in a good way to explain science in four videos. In the other videos science is a way to legitimize pop cultural statements.
Yet, also in the videos on the top of the scale, which explain and discuss scientific topics extensively, it seems possible that science is rather used for legitimizing pop culture than for science communication. To discuss this point I found a quote which fits perfectly into this discussion.

"There are two kinds of truth: the truth that lights the way and the truth that warms the heart. The first of these is science, and the second is art. Neither is independent of the other or more important than the other. Without art science would be as useless as a pair of high forceps in the hands of a plumber. Without science art would become a crude mess of folklore and emotional quackery. The truth of art keeps science from becoming inhuman, and the truth of science keeps art from becoming ridiculous." (Chandler, 1976)
Science legitimizes pop culture; it explains how it works and in this way it makes pop culture more solid. Pop culture, on the other hand, legitimizes science; it can help us understand the relevance and implications of scientific knowledge. Pop cultural stories can aid us in grasping the importance of science for society, but they can also point out the risks and difficulties that come with it. Kyle Hill (personal communication, May 27, 2016) claims in the interview that his aim is to do both: "I want people who think they hate science but love pop culture to suddenly realize science can be awesome, and I want total science nerds to understand that pop culture is a great way to make science more relatable."

When watching the videos, I realized that a time-related aspect could be in them. The question is, if the *Because Science* videos change over time. It is difficult to say due to the small amount of videos that I analyzed, but I think that the quality related to communicating science has decreased after a time. I think

the focus of his videos have changed from science being in the center of the videos to pop culture being the most important aspect in them, as I will show in the next part in the scale. This can also be related to the videos that I have chosen (Star Wars themed videos), but I have no reason to believe that. In the latest videos science often gets lost in the nerdy discussions, which are definitely in their focus. I cannot say for sure, but I think there is a trend towards more edutainment than passing on of knowledge.

9. Conclusion

How to make sense of all these findings in the videos and the interview? How can all the findings and results be brought into one final argument? In this conclusion I will try to gather all the knowledge I accomplished through my analysis, and by summarizing and comparing I will try to make sense of all the different findings of my study.

In my work I have dealt with many different aspects of how Kyle Hill does science communication on the YouTube-show *Because Science*. Broadly speaking, Kyle Hill uses pop cultural elements to discuss scientific topics. I have been able to demonstrate that Kyle Hill uses Star Wars elements as a frame to discuss scientific content. By the way he uses titles and questions in the videos, he structures the videos into smaller parts. In these short sections, parts of the main question of the video are answered. In the videos Kyle Hill always draws a boundary between science and pop culture. The boundary can vary a lot, though, depending on the content. Some fantastic and futuristic aspects are seen as explainable by science and others are not. Due to his choice of words and explanations the boundaries between pop culture and science are drawn. Kyle Hill tries to explain fiction with science, but some fiction is just fiction. The only clear line between phenomena which are explainable and which are not by using science seems to be the imagination of the producer of the show. If he can come up with a scientific explanation, it is explainable with science. Kyle Hill is aware that his explanation is one of thousands of possible ones. He does express this explicitly in the interview, but not in the videos.

From the interview I know that Kyle Hill himself has a quite abstract view of science. "Science is nothing less than the best way of understanding our world. It's our only way out of the darkness, the only way to find ourselves, to find why we are here, and the only way to solve life's greatest challenges. Science is so important to our survival and advancement." (K. Hill, personal communication, May 4, 2016) From analyzing the videos, I came to the conclusion that the word 'science' in the videos refers basically to every kind of knowledge which is essential to explain how pop culture works. This is completely different from the interview, in which he explains science as a way to better understand the world. Science in the videos is a quantified science; it is fixed, measurable and calculable. In the form in which science is presented in the videos it seems like it is fixed and unchangeable. Kyle Hill creates this idea of science by inclusion of numbers, graphs, formulas and calculations in the videos. He talks about physics, chemistry, mathematics and natural sciences in general to explain natural phenomena. Social science is excluded from the videos. These results are related to the work of Bucchi (2004), who stresses that media always over-represents specific fields of science over others in the way it fits. After analyzing the videos, I absolutely agree with this notion. The videos show success stories of science; science that has been proven to work can be seen. Failed science is never shown in the videos. Kyle Hill almost

never shows the methods, the study design, the risks and the time frame in which scientific findings will bring benefits for society. These results coincide with the findings of Bubela et al. (2009).

In the process of transforming science into a newsworthy science story for media, science gets filtered, selected and prepared all the time. It constantly changes until it becomes the science story the viewer sees at the end. Science communicators are not objective people. They actively reconstruct the reality into a narrative, which contributes to the diffusion of scientific knowledge. (Claessens, 2013) This is also what Kyle Hill does; for his videos a science story is only worth telling, when science is combined with interesting, hot topics of the pop cultural sphere: For this science is often combined with events, release dates of movies or video games. In this way the videos are pop culture-science stories. As far as I know he only gets money from his channel Nerdist for his work and not from any other party. The pop culture and science part are always selected in a way that they match each other and hopefully support each other. Bucchi (2004) already says in his work that scientific priority is not the most important aspect to discuss a scientific topic in the media. In the case of *Because Science*, relevance in the pop cultural field is the most important aspect to choose a topic, not the scientific relevance. This way of choosing topics limits the possible amount of issues Kyle Hill can talk about. He assumes that science gets more value through using pop culture to explain it. This limits Kyle Hill to only being able to talk about science that fits into pop culture. The relation to Star Wars makes the science 'interesting' for this format.

What can be told with pop culture-science stories is limited. Through the analysis of the videos it can be seen that the videos are simple, clear and polished, and cannot handle complex scientific topics. These findings accord with the findings of Felt & Fochler (2013). At the same time Kyle Hill explains rather complicated technology and science instead of a more basic scientific concepts or technology. In doing science communication Kyle Hill asks very specific pop cultural questions in his videos, like "Why Kylo Ren's Lightsaber Works" instead of a broader question like "What is a laser?" He discusses very specific aspects of the movies. He also does not strictly separate different pop cultural fields, like in the video: "Could a Lightsaber Cut Through Captain America's Shield?" Kyle Hill does not only refer to the movies, but to the wider pop cultural sphere. Science is presented as great, fascinating and a clear solution for a clear problem. It is displayed as if it could tell you how things 'really' are. But *Because Science* only shows one way how science fiction technology might work scientifically, even though there are others as well. Science in the videos is always declared as positive, helpful and beneficial for society. These are also the findings Bucchi (2004) has given in his work.

Kyle Hill uses elements to communicate science which are stereotypically linked with science. He uses whiteboards, graphs and formulas to discuss his field of interest. So the formulas and graphs have become part of the setting. Many formulas are not explained in an understandable way and do not help

explain a topic in a logical or even merely complete way. Kyle Hill presents science almost always without sources. He does not show where his theories and facts come from, but this would be important to reproduce his train of thought. The formulas are black boxed and more used as pictures to show that he uses science. They are more a justification than an explanation.

In my analysis of the videos, I have put a strong focus on language. Kyle Hill draws a boundary between the audience and himself. By the way he talks in the videos he presents himself as the person that knows about science and the audience as information-seekers. The formulas, graphs and language portray himself as an expert and distance him from the audience. After the interviews I could see that Kyle Hill has a linear model approach, as Claessens (2013) describes it in his work. Kyle Hill thinks that communicating science will automatically increase science literacy in the public. On the other hand, Kyle Hill builds up an informal atmosphere with the audience due to the use of the 'we'-form and by giving the impression as if he were about to find out the results together with the audience.

How Kyle Hill imagines the audience influences how he designs and frames the show. He claims that his audience does not need any prior knowledge to watch his videos. When looking at the material, I have found out that the videos require a lot of presupposed knowledge to be able to understand them. Scientific as well as pop cultural knowledge is necessary to fully comprehend the content of the videos. Kyle Hill explains difficult aspects of science, but leaves out basic physics, which would be needed to completely apprehend the topics he refers to. The underlying assumption of the videos is that people who are interested in Star Wars or sci-fi are also interested in science. He imagines his audience as nerds, as having quite some scientific knowledge and being eager to learn more about the pop culture and science. Future research has to show if this is actually the case.

Lievrouw (2010) point out in his work that SNS make online SciCom more informal, immediate and provisional than traditional communication channels. SNS have the possibility and advantage to be more responsive, participatory and discursive. SNS have blurred the clear distinctions between producer and consumer of information, so his claims. This might be true, but in the videos I have found only little evidence that *Because Science* is actually more open, responsive, participatory and discursive than traditional communication channels. Kyle Hill takes up what he likes from his audience and he only engages with them when it fits into his plans. The videos suggest a close relationship with the audience which exists only to some limited extent. Inclusion of posts from fans lead to the assumption that the audience is engaged in the topics, it seems like they are included in the discussion, but an exchange between Kyle Hill and the audience only happens to a small extent. As far as I know does Kyle Hill himself keeps in touch with his audience and not an employee at Nerdist.

Trench (2008) has proven in his paper that science communicators on YouTube are in permanent competition with other science channels and have to fight for their viewers. I believe that because of this competition these channels have a big focus on entertainment to keep as many viewers watching for as long as possible. There are many other videos on YouTube the audience could consume. The necessity to be entertaining and to get as many clicks as possible might stand in the way of explaining scientific theories and findings in detail. Kyle Hill uses fast cuts and he talks extremely quickly with one reference and joke after the other. The content and the presentation of the content are changing a lot during the videos and many action-loaded scenes from the Star Wars movies are included. The seemingly 'boring' basics are probably left out hoping to be more entertaining and interesting. This fast and alternating video style is very popular among producers on YouTube. Most of the viewers on YouTube are rather young; between the ages of 18 and 34. (Statistik YouTube, n.d.) This can be a way to explain this video style, at least partly. This filming style aims at reaching a broad, young audience on YouTube. Sometimes it seems as if this style has become somewhat of a culture itself on YouTube. To be successful on this channel, it is almost necessary to make videos in this style. The platform limits the possibilities of Kyle Hill to do science communication in a short way, to not go into too much detail and to be entertaining. The videos have to be short and superficial.

I think, however, that *Because Science* can be a complementary way of communicating science to paper publications in scientific magazines and books, as Lievrouw (2010) suggests in his paper, but it can only be used for specific scientific topics which fit to a chosen pop culture. Science and pop culture have to improve and complement each other. YouTube videos about science are an additional tool for science communication and most likely will be so in the future as well, but it can never replace traditional science communication. It cannot handle complex and difficult topics to an extent that traditional science communication can. I think that this format is not useful for every scientific content. All in all, I think explaining science fiction with science can work, but only when a large effort is put into it and when the person that does it has a lot of knowledge about both science fiction and science. The videos also have to be well-researched, scientifically accurate, short in length and interesting at the same time. This is very challenging. Oversimplification of topics can lead to s by the audience. The content has to be prepared carefully and easy to understand for a broad audience. This is difficult to achieve, it is always a walk on a tightrope between entertainment and education. To use pop culture for science communication is very difficult, but when it is done deliberately, it can help to entertain and improve the knowledge of the viewer. In some videos Kyle Hill does this better than in others, as I have explained before. Pop culture-science videos are useful for some kind of knowledge, but not for all. To explain ion engines with tie fighters worked very well, because the real-life ion engine is very similar to the sci-fi technology tie fighter. To explain the theory of relativity with Han Solo worked also well, because it was a concrete and clear example. If a lightsaber can cut through Captain America's shield did in my view not work for science communication, because the example did not help to explain a scientific

concept or technology, it was just to talk about pop culture. The science and the pop culture part have to fit well in order to produce a good science story with pop cultural elements. Also the science part should not get lost in the pop culture.

My work could answer some questions of interest for my study, but it has opened more which would be interesting to explore. One of the things my research could not find out was who the audience of the show is, not only the imagined audience. It would be interesting to find out how the viewers perceive the videos and if they think they can learn science from them. It would also be fascinating to compare my findings to other science communication efforts on Social Network Sites and which role pop culture plays in them. SciCom on SNS is a big and fast changing field. More aspects of science communication on SNS can be elaborated. Future studies could analyze other YouTube videos, which are also science and entertainment oriented or look at other social networking sites, like Twitter or Facebook, to see how science communication takes place on these platforms and if there are similarities to my own findings. When looking at a broader spectrum of *Because Science* videos it could be looked at the quality of the videos regarding science communication and if the way it is done has changed over time. I have revealed in this work how pop culture and science are used in this one YouTube show, but my study is limited to 9 videos. I cannot tell how other YouTube channels use pop culture to communicate science. Other studies have to look at these points. *Because Science* is successful in its sphere. The study of this case can help understand better the mechanisms of science communication to a broad public. Furthermore, it can shed a light on the possibilities of SNS and establish knowledge and trigger interest in a broad public. Scientists and people who are interested in science communication can use this knowledge to spread their own work and ideas. It is my home that this study can be beneficial for science communicators to get the best strategies for publishing in a scientific field and may help experts learn how their own science communication can be improved.

The literature about science communication on SNS is limited. Especially the role of pop culture for the purpose of science communication has hardly been researched so far. Pop culture plays an important role our daily lives and it is quite possible that pop culture-science communication will gain importance over the next years. Science communication channels on YouTube are watched millions of times every week. Some of the most successful YouTube-channels worldwide are about science communication. This is no longer a marginal phenomenon; it is a phenomenon that has big influence on our society. There are already many science communicators that use pop culture for science communication purposes and their number will rise. On '*I Fucking Love Science'* there is a blog post about 'The Science Behind The Most Gruesome Deaths In Game of Thrones'. (Hazma, n.d.) In the blog '*The Big Blog Theory'* by Saltzberg (2011) the scientific facts that are addressed in the series The Big Bang Theory are scientifically discussed and explained. The book '*The Science of Superheroes'* (Gresh and Weinberg, 2003) explains scientific facts and refers to comic books and superheroes in their explanations.

Moreover, the growing number of mobile devices makes it possible to watch videos nearly everywhere and at any time. Where and how someone can watch these videos is not restricted by time or space. It can make science communication more appealing and informal and show topics in a new, entertaining and maybe fun light. It is also possible to build a closer relationship to an audience and to communicate directly with them, however, if the experts really do remains to be seen. It is possible that science videos can influence how viewers and in this way also the public think about socio-scientific issues. SNS can help spread scientific results and ideas to an audience that cannot be reached easily in another way, like with flyers or magazines.

In summary, pop culture – science stories have a huge potential for science communication and can be suitable to communicate specific aspects of science. In our society there is a big interest in pop culture and by using this for science communication, I think it can make science more appealing for a broader audience and can help increase people's scientific knowledge and interest. I believe that attempts of 'scientification' of fantasy or sci-fi stories can work and can give a new aspect to pop culture and can make it feel more real. It can help to better understand pop culture and to explain some of the mysteries of the pop cultural universe. Science can help explore and understand the wonders of a sci-fi world and it can be enriching to examine fantastic elements of fictional worlds. It can also help to reach a large audience. But science communication with the inclusion of pop culture has to be done with care. Scientific explanations of pop culture can be far-fetched, ridiculous and vague concepts. The format of using pop culture for science communication is limited. The videos are short and compact; plenty of information is shown in a short time. The educational purpose is limited and the information may only be superficial. One possible danger of these videos is that they only show a narrow aspect of science that primarily aims to entertain but fails to explain science in sufficient detail. It can happen that the videos show only a narrow science story, which only aims to entertain, as Felt and Fochler (2013) describes it. Using pop culture as a frame for science always includes the risk that the pop culture part overshadows the science part. In the end, it is quite possible that you rather remember that Chewbacca is 200 years old than how the theory of relativity works. (Hill, 2015d) Yet, I think in most videos Kyle Hill manages the balance between science and pop culture quite well. Some aspects are not very suitable for this format. Scientific content which can be easily linked to pop cultural works very well for science communication. In the video "Why Han Solo Is a Time Traveler!" (Hill, 2015d) the theory of relativity is nicely and tightly connected to the movies and the video shows how the movies would change, if relativity were considered in much detail. The videos also work better at explaining technology, sci-fi or scientific concepts than totally fantastic concepts. Illustrating totally imaginary concepts contradict any logic and are always far-fetched. They rarely work, because they are not built on any scientific explanation or concept. I think it should be decided from case to case if it is useful and beneficial to use pop culture for science communication purposes.

As Kyle Hill says himself: “It’s a balance between complexity and simplicity, being witty but not thorough and being a lecture but not boring.” (K. Hill, personal communication, May 27, 2016) It is difficult to keep the balance between science and pop culture. I will end this work with a statement by Kyle Hill that summarizes my findings and thoughts about *Because Science* very well.

> “If you’re just using pop culture as click bait, a nerdy audience will be able to smell that a mile away. If you’re going to smash together science and pop culture, you really have to know and love the fandom you are going to examine. I’ve been burned by this a few times, but when you really get it right – make the fans happy and the scientists – you can make something really special that does very well, and will stand the test of time.” (K. Hill, personal communication, May 4, 2016)

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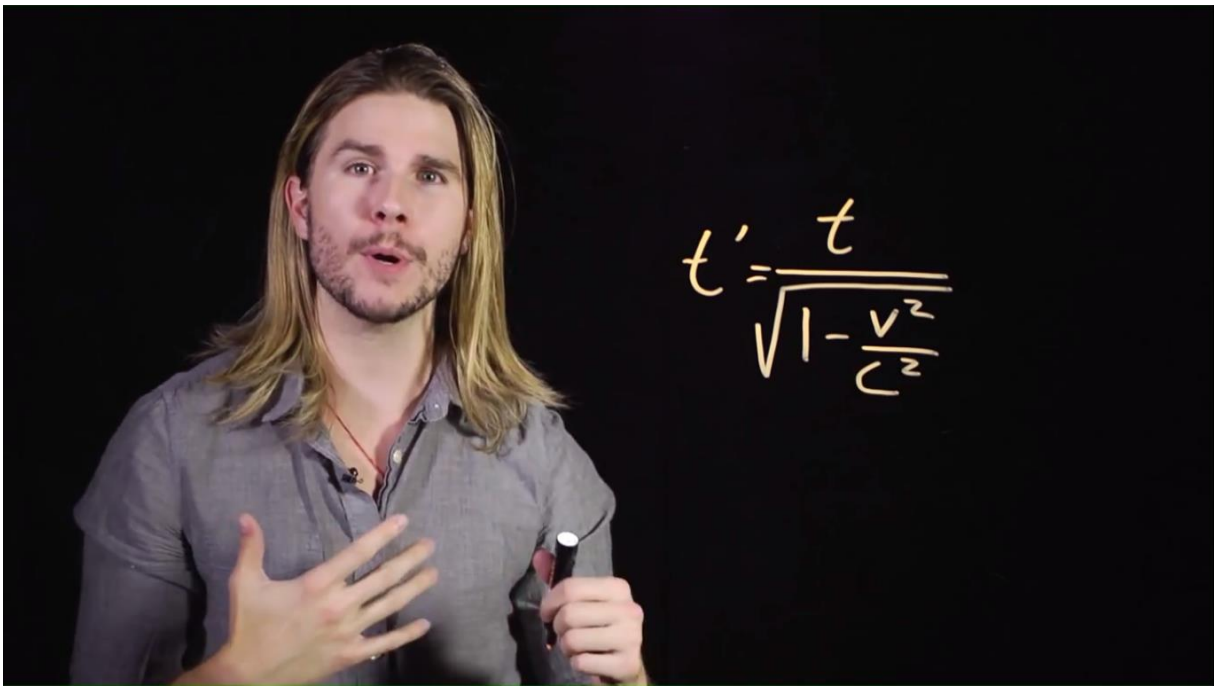
11. Appendix

Appendix 1



Appendix 2

Score: "Why Han Solo Is a Time Traveler!" 3:20-3:35						
Cut	**Time (sec.)**	**Visual Data**			**Audio Data**	
		Setting	*Camera*	*Body language*	*Speech*	*Music*
1	3:20 3:23 3:27	The setting is as before. In his left hand he has a pink marker. In the background white stripes shoot from the middle of the screen out in all directions, it looks like Han Solo is going into Hyperspace with the Millennium falcon.	Front shot, upper part of Kyle Hill	He makes quotation marks in the air with both hands.	"I will do something you probably won't agree with. And throughout the concept of hyperspace Entirely." "Sorry, Nerds." He says slowly.	There is fast, rhythmic, electronic, but silent (?? Silent means there is no sound!!) background music.

	3:35	The hyperspace background stops and gets black again.		Gestures to underline the word.	"It just seems like from everything we know of the universe. The speed of light is the universal speed limit." Last word is emphasized.	

11.1 Abstract in English

Science communication (SciCom) on Social Network Sites (SNS) is and has been increasing in recent years. This phenomenon is especially strong on YouTube, one of the biggest SNS worldwide. It has more than one billion users; this is a third of all the internet users. (Statistik YouTube, n.d.) The Star Wars Popular Culture is one of the largest, longest going pop cultural phenomena of the last century and Star Wars movies are the most successful movie series ever. (Star Wars: The Force Awakens, n.d.) Star Wars Pop Culture is a phenomenon which has an influence on millions of people all over the world. Star Wars has real-life and fictional technological and scientific aspects in it, which makes it a good start to use for science communication. Even though these aspects are not in the center of the movies, they are an important and much discussed part. The success and popularity of the movie series, as well as their use of technology and science give Star Wars a unique position, which makes it ideal to use for science communication. With the help of pop cultural elements, Kyle Hill (the producer of the show *Because Science*) tries to explain scientific phenomena. In his videos Kyle Hill for example talks about: "Can We Have Star Wars' Lightsabers in Real Life?" (Hill, 2015b). The videos do not only use elements of the movies; in referring to them they relate to a wider pop cultural phenomenon around Star Wars. I have analyzed nine videos of the show and conducted a structured interview with Kyle Hill. I have transcribed parts of the videos into scores, as indicated by my method video hermeneutics and used grounded theory to analyze the data.

In the YouTube show *Because Science* Star Wars pop culture and SciCom come together in an entertaining and educating way, also called "edutainment". This particular form of science communication has the potential to reach a large audience. Edutainment programs "are guided by the aim to educate and entertain the audiences with reference to scientific ideas and processes." (Lehmkuhl et al., 2012, p. 10) It is difficult to find a good balance between science communication and pop culture.

In this study I have tried to find out how Star Wars is used in the videos to create science communication. I also want to understand how edutainment is used in the videos to talk about science. This can help get a better understanding of how pop culture can be utilized for science communication by including pop culture.

In this paper I show how Kyle Hill understands his videos as science communication, how he presents science and what role pop culture plays in them. My main research question is: How does Kyle Hill use the pop culture-focused YouTube-show *Because Science* as a vehicle for science communication? To find this out, I have used three major theories, which help me analyze the data: These are science story, frames and boundary work.

Science communication in the media always happens in the format of science stories. The science part gets shaped and transformed by the science communicator into specific science stories, which are presented to the public. The type of presentation or the format of a science story depends on the platform where it is presented, nonetheless all science stories ground on the same basis: "[S]tories need to be brief and speak to a particular audience in an entertaining manner, while simultaneously and convincingly conveying relevance." (Felt & Fochler, 2013, p. 80) In the case of *Because Science* this format is a pop cultural-science story. Every science story is told in a specific way; the selection of topics, language and the presentation shape the outcome. This specific way of telling a science story is called frame, and Star Wars is the overarching frame in the videos. Kyle Hill chooses one or two aspects from a Star Wars movie as a topic to discuss it scientifically in his show. Through the use of the title and questions in the videos, Kyle Hill structures the video into smaller sections. In these smaller sections, parts of the main question of the video are answered. One essential question in my research is, what exactly 'science' is in the *Because Science* videos and the interview and the differences between them. I look at the boundary-work between science, non-science and pop culture. The boundary can vary a lot, depending on the content. Some fantastic and futuristic aspects are seen as explainable by science and others are not. The only clear line between explainable by science and not explainable seems to be the imagination of the producer of the show. If he can come up with a scientific explanation, then the aspect of the movie has a connection to real life. Kyle Hill is aware that his explanation is one of thousands of possible ones.

In general, our society is strongly interested in pop culture and I think that this interest can be used to communicate science, when it is done right. Pop cultural edutaining science stories have the potential to communicate specific scientific issues to a broad audience. The disadvantage of this format is the limitation to only discuss scientific topics that fit to pop culture. In addition, the scientific topics can only be discussed superficially in a very short time. Pop culture and science have to be combined in a way that they fit to and enrich each other. Scientific explanations of pop culture can be far-fetched, ridiculous and vague concepts, this should be avoided. The right balance between science and pop culture is difficult to achieve, but when it is done in a right way, it can become a great science communication strategy.

Keywords:
science communication, boundary work, frames, science stories, STS, pop culture, Star Wars, Kyle Hill, Because Science, Social Network Sites, YouTube

11.2 Abstract in German

Wissenschaftskommunikation auf sozialen Netzwerken ist in den letzten Jahren stark angestiegen. Dieses Phänomen ist besonders verbreitet auf YouTube, eines der größten sozialen Netzwerke der Welt. Es hat mehr als eine Milliarde Nutzer, was einem Drittel aller Internetnutzer entspricht. (Statistik YouTube, n.d.) Die Star Wars Filme sind die erfolgreichste Filmserie aller Zeiten. (Star Wars: The Force Awakens, n.d.) Star Wars Popkultur ist eine der am längsten anhaltenden und größten popkulturellen Phänomene des letzten Jahrhunderts. Star Wars Popkultur ist ein Phänomen, das Millionen Menschen weltweit beeinflusst und begeistert. In den Star Wars Filmen kommen fiktionale sowie reale Technologie und Wissenschaft vor, die zur Wissenschaftskommunikation verwendet werden können. Diese Aspekte sind zwar nicht im Zentrum der Filme, aber dennoch ein wichtiger Teil davon. Der Erfolg und die Popularität der Filmserie, sowie deren Verwendung von Technologie und Wissenschaft gibt Star Wars eine einzigartige Position, die die Filme ideal für Wissenschaftskommunikation macht. Kyle Hill, der Produzent von *Because Science*, verwendet popkultureller Elemente, um wissenschaftliche Phänomene zu erklären. Er spricht zum Beispiel in seinen Videos über: „Can We Have Star Wars' Lightsabers in Real Life?" (Hill, 2015b). Die Videos verwenden nicht nur Elemente aus den Filmen, sondern beziehen sich auch auf popkulturelle Phänomene, die um die Filme herum passieren. Für meine Studie habe ich neun Videos der Show analysiert und ein Interview mit Kyle Hill geführt. Ich habe Teile der Videos nach der Methode Video Hermenutics transkribiert und mit Grounded Theory analysiert.

In der YouTube-Sendung *Because Science* kommen Star Wars Popkultur und Wissenschaftskommunikation auf eine unterhaltsame und lehrreiche Weise zusammen, auch Edutainment genannt. Edutainment Programme haben zum Ziel gleichzeitig zu lehren und zu unterhalten mit Bezug auf wissenschaftliche Prozesse und Ideen. (Lehmkuhl et al., 2012) Diese Form von Wissenschaftskommunikation hat durch ihre Mischung aus Lernen und Vergnügen das Potenzial, ein großes Publikum zu erreichen. Es ist jedoch schwer, eine gute Balance zwischen Wissenschaftskommunikation und Popkultur zu finden.

In dieser Studie habe ich versucht herauszufinden, wie Star Wars verwendet wurde, um Wissenschaftsvermittlung zu betreiben. Außerdem wollte ich besser verstehen, wie Edutainment in den Videos verwendet wurde, um über Wissenschaft zu sprechen. Dadurch wollte ich ein besseres Verständnis für Wissenschaftsvermittlung mit Hilfe von Popkultur bekommen. Ich werde in dieser Arbeit zeigen inwiefern Kyle Hill seine Videos als Wissenschaftskommunikation versteht, wie er

Wissenschaft darstellt und welche Rolle Popkultur dabei spielt. Das versuchte ich durch meine Forschungsfrage herauszufinden, die da lautet: Wie verwendet Kyle Hill die popkultur-fokussierte YouTube-Sendung *Because Science* als ein Vehikel für Wissenschaftskommunikation? Drei große Theorien haben mir geholfen, meine Daten zu analysieren, diese sind: Science Story, Frames und Boundary Work.

Wissenschaftskommunikation in den Medien passiert immer in der Form von science stories. Wissenschaft wird zum Zwecke der Wissenschaftskommunikation in bestimmte science stories transformiert, die die Öffentlichkeit dann zu sehen bekommt. Die Form der science stories hängt von der Plattform ab, auf der sie präsentiert werden, nichtsdestotrotz basieren alle science stories auf derselben Basis: Sie müssen kurz sein und eine bestimmte Zielgruppe auf eine unterhaltsame Weise ansprechen, während sie gleichzeitig auf überzeugende Weise die Relevanz der angesprochenen Themen darlegen. (Felt & Fochler, 2013) Im Fall von *Because Science* passiert dies in Form einer popkulturellen science story. Unter anderem durch die Auswahl an Themen, der Sprache und der Präsentation wird das Endergebnis beeinflusst. Diese Art eine science story zu formen wird Frame genannt. Star Wars ist der überspannende Frame der Videos. Kyle Hill sucht sich einen oder zwei Aspekte aus den Star Wars-Filmen aus und diskutiert diese wissenschaftlich in seiner Show. Durch die Verwendung von Titeln und Fragen in den Videos strukturiert Kyle Hill seine Videos in kleinere Abschnitte. In diesen Abschnitten werden Teile der Hauptfrage des Videos beantwortet. Ein wichtiger Aspekt meiner Arbeit ist, was genau Wissenschaft in den *Because Science* Videos und im Interview ist und wie sich diese voneinander unterscheiden. Außerdem erforsche ich, wie sich Wissenschaft von Nicht-Wissenschaft und Popkultur abgrenzt. Die Grenze kann variieren und ist abhängig vom Inhalt. Manche fantastische und futuristische Aspekte werden als wissenschaftlich erklärbar angesehen und andere nicht. Die einzige klare Grenze, die ich in meiner Forschung zwischen wissenschaftlich erklärbar und nicht wissenschaftlich erklärbar, erkennen konnte, scheint zu sein, ob dem Wissenschaftsvermittler eine mögliche wissenschaftliche Erklärung für popkulturelle Phänomene einfällt. Kyle Hill ist sich bewusst, dass seine Erklärung in den Videos eine von tausenden möglichen ist.

Im Allgemeinen gibt es in unserer Gesellschaft ein großes Interesse an Popkultur und ich glaube, dass dieses Interesse zur Kommunikation von Wissenschaft verwendet werden kann, wenn es richtig gemacht wird. Popkulturelle Edutaining Science Stories haben das Potenzial bestimmte wissenschaftliche Themen an ein großes Publikum zu kommunizieren und deren Interesse daran zu wecken. Der Nachteil dieses Formats ist die Limitierung der wissenschaftlichen Themen auf jene, die popkulturell diskutiert werden können. Außerdem können die Themen nur oberflächlich und kurz behandelt werden. Mit Sorgfalt muss Popkultur und Wissenschaft zusammengestellt werden, damit es gut zusammen passt und sich gegenseitig bereichert. Wissenschaftliche Erklärungen können weit hergeholt und vage sein, das gilt es zu vermeiden. Die richtige Balance zwischen Wissenschaft und Popkultur zu erreichen, ist

schwer, doch wenn es gut gemacht ist, kann die Verwendung von Popkultur eine großartige Strategie zur Wissenschaftsvermittlung werden.

Schlüsselwörter:
Wissenschaftskommunikation, boundary work, frames, science stories, Popkultur, Star Wars, Kyle Hill, Because Science, Soziale Netzwerke, YouTube