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The Making of a Celebrity Scientist: Stephen Hawking's Life in Physics and Public

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The Making of a Celebrity Scientist:

Stephen Hawking's Life in Physics and in Public

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Master Thesis

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Preface

This master thesis represents many hours of hard work for me: many frustrations and happy moments too. I would like to thank my supervisor, Kristian Hvidtfelt Nielsen, for guidance and encouragement. I would actually like to thank the whole Centre of Science Studies for feedback and questions at the Pitch Event on 13th of February 2019. This sparked new ideas for me. I would also like to thank a fellow student, Camilla, for help on topics where she knows much more than I do.

In addition, I want to thank my boyfriend, Rune, for loving support when it was tough - but also when it was fun.

I hope you enjoy.

Jeanette

Abstract

This master thesis will argue how and why Stephen Hawking became a face of science. His celebrity status is evident in the many obituaries written about his at the time of his death, on March 14th, 2018. This thesis will present some of Hawking's scientific endeavors to illustrate the significance he had to science, theoretical physics and cosmology. Some of Hawking's contributions to the public scene are also presented, analyzed and discussed with popular science in mind. Movie productions, TV appearances and rumors are also included here. This serves to demonstrate the point that fame doesn't merely come from great achievements; the world must hear of those achievements. Thus, work in the public sphere will evidently grant a bigger chance for celebrity. Next, Hawking will embody Goodell's visible scientist and Fahy's celebrity scientist. Stephen Hawking possessed certain traits and underwent specific processes and indeed became a celebrity scientist. Lastly, the life after reaching celebrity status is examined and discussed. Tensions between the scientific community and the visible/celebrity scientists are evident and exemplified in the case of Stephen Hawking.

Resumé

Dette speciale vil kortlægge hvordan og hvorfor Stephen Hawking blev ét af naturvidenskabens ansigter udadtil. Hans berømmelse er tydelig i de nekrologer, der fulgte efter hans død den 14. marts 2018. Dette speciale vil redegøre for udvalgte dele af Hawkings faglige bidrag til naturvidenskaben, teoretisk fysik og nærmere bestemt: kosmologi. Hawking bidrog også til den offentlige sfære på den måde, at han skrev populærvidenskabelige bøger, han optrådte i TV dokumentarer og i TV shows. Disse offentlige bidrag er præsenteret, analyseret og diskuteret ud fra populærvidenskabelige værktøjer. Film om Hawking og rygter om hans privatliv er også inkluderet her. De offentlige optrædener illustrerer, at man skal gøre mere og andet end at bedrive videnskab for at blive en berømt videnskabsmand. Verden skal høre om vedkommendes bedrifter i naturvidenskab. Derefter vil dette speciale analysere Stephen Hawking som legemliggørelsen af Goodells 'synlige videnskabsmand' og Fahys 'berømte videnskabsmand'. Stephen Hawking vil vise sig at passe på beskrivelsen for den synlige videnskabsmand og efterfølgende have gennemgået processen, som gjorde ham til en berømthed. Endeligt er livet efter berømmelse undersøgt og diskuteret. Det viser sig, at der er spændinger mellem det videnskabelige samfund og de berømte videnskabsmænd/kvinder. Eksempler på dette er belyst ved hjælp af Stephen Hawking.

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1. Introduction

Stephen Hawking died on March the 14th 2018. His death spurred an impressive number of obituaries. The obituaries were featured in a variety of tabloid and broadsheet magazines and newspapers (Ritz 2018, web, Penrose 2018, web). They were seen in news sections on the television, in peer reviewed journals – both British, International and Danish (Castelvecchi 2018, web, Alstrup 2018, web, Hyldal 2018, web). Thus, Hawking had permeated a wide range of public spaces and scientific grounds.

This thesis will start from a wonderment at how Stephen Hawking was described in these obituaries. For instance, Stephen Hawking was considered "one of science's most recognizable faces" (Barr 2018, web).

The obituaries depict Stephen Hawking as the scientist – cosmologist - he truly was. Most obituaries tour around his scientific career, presenting Hawking radiation and a few other significant endeavors (Kaiser 2018, web, Page 2018, web). Yet, the obituaries also term Hawking a somewhat special scientist – namely a celebrity scientist (Kaiser 2018, web, Barr 2018, web, Penrose 2018, web). In *The Guardian*, a Hawking colleague, Roger Penrose, writes that Hawking was commonly perceived as "the No 1 celebrity scientist", which meant that huge amounts of people would attend his lectures and not just for academic purposes (2018, web). In *Physics World* and *Physics Today*, Hawking was named "an icon of modern physics" and "the most famous scientist of the late 20th and the early 21st centuries" (Lloyd 2018, web, Page 2018, web). Castelvecchi agrees in *Nature*: Hawking was "one of the most influential physicists of the twentieth century and perhaps the most celebrated icon of contemporary science" (2018, web). Hence, Hawking was more than a scientist – he was a celebrity scientist. This indicates that he did more than carry out intricate mathematical calculations.

The obituaries also mention his literary contributions to the popular science scene. *A Brief History of Time* is portrayed to have initiated his extensive fame, after which "Hawking went mainstream" (Lloyd 2018, web, Vanderhoof 2018, web). Hawking wrote other books than *A Brief History of Time*, yet, this work would prove to be significant for his public life, as he "achieved a level of fame uncommon among scientists" (Conover 2018, web). The other works include, for instance, *Black Holes and Baby Universes, The Universe in a Nutshell,* and *Brief Answers to the Big Questions*.

Some obituaries also display his personal life, presenting his first wife Jane and his three children: Robert, Lucy and Timothy (Kaiser 2018, web). However, almost all obituaries mention his illness ALS, with which he was diagnosed at age 21. This was around the same time he wrote his Ph.D. dissertation. ALS is a motor neuron disease, which, in the long run, leaves the brain unable to control any muscle (Castelvecchi 2018, web). ALS eventually put Hawking in a wheelchair and, on the bright side, gave him plenty of time to think while being aided in everyday tasks. This appearance helped form the image on which Hawking would built much of his success. The image consisted of an "imprisoned mind roaming the cosmos. [This image] grabbed the public's imagination [and he] achieved [a] resonance with a worldwide public" (Durrani 2018, 7). All obituaries that mention ALS also point to the fact that Hawking would not let the illness "interfere with his passion for physics" (Page 2018, web). Hawking in many ways represented a "role model for those overcoming physical adversity" (Rocek 2018, web).

Thus, Hawking was more than a scientist, he was a celebrity scientist by all other things he did than carry out science. In addition, he was a famous writer, a disabled man, a husband and a father. All of this and the narrative constructed upon it, made Hawking a celebrity. Durrani even argued that Hawking was "perhaps the only true celebrity scientist" (2018, web). This thesis will thus analyze and discuss how and why Stephen Hawking was portrayed like this in his obituaries.

The very expression: 'celebrity scientist' may seem an odd mix of genre. The celebrity scientist is constructed primarily by the media and can influence both the public and the scientific community in positive ways. Fame is not just a consequence of great achievements; the world must hear of those achievements. Since the early 20th century the media as expanded drastically to become "the center of public life with enormous power" (Fahy 2015, 2). This is where most adults get their information about science and about all other topics. The celebrity scientist secures science a prominent place in popular culture, where celebrity is a defining feature. They give science a face, and they understand that celebrity can help spread important ideas and issues "in our personality-focused cultural mainstream" (Fahy 2015, 204). In other words: celebrity scientists can positively influence public lives, they can appeal directly to policy makers for funds, they stand up for science when science is publically attacked and celebrity scientists can enhance scientific literacy in general (Fahy 2015, 204).

The first and very noticeable case of a celebrity scientist was Albert Einstein, who personified science like no other in the early 20th century. Another example of a celebrity scientist is Carl Sagan. However, Einstein is interesting because he became famous at a time where relativity matched an uncertain mood after World War I and a time when the mass media exploded. "Telescopes and towers were named in his honor, as were children and cigars" (Fahy 2015, 2). Yet, this is not a thesis about Albert Einstein. It is about Stephen Hawking, who indeed was compared to Einstein on several occasions (Vanderhoof 2018, web, Lloyd 2018, web).

More precisely, this master thesis presents how and why Stephen Hawking became a celebrity scientist. Thus, this thesis will present an analysis and discussion of the factors contributing to Stephen Hawking's celebrity status. Questions of interest are:

- Did Stephen Hawking do anything special in science? What was special?
- How did Hawking become visible to the public? Did he do something exceptional in areas outside science?
- Did Hawking possess certain traits? Which ones?
- Which processes did Hawking go through?
- Is context and the contemporary of any importance when moving towards celebrity?
- What is the difference between a visible scientist and a celebrity scientist?
- Does the scientist control every aspect of the process towards celebrity?
- How does the scientific community react to visible scientists and celebrity scientists? How did it react to Hawking's fame?

The methodology used in this thesis includes presentations, analyses and discussions. The first chapter is a presentation and a mapping of scientific contributions, the second is a presentation, an analysis and a slight discussion of public appearances of various forms, while the third and last chapter is an analysis and a discussion of Hawking, as he is the example of a visible and celebrity scientist. Some references are written by Hawking himself or someone close to him, which means a bias is present. The bias is recognized. Secondary works are included to avoid a bias analysis and discussion.

As evident, to be a celebrity scientist, one must be a scientist first. Therefore, the first chapter presents Hawking's scientific endeavors from his Ph.D. dissertation to why he should or shouldn't have been given a Nobel Prize. This chapter will present ideas that solidified his work as a cosmologist: the second law of black hole dynamics, Hawking radiation, the information paradox, the 'no-boundary' proposal, the Hartle-Hawking state, wormholes, and time travel. These quests are presented in a chronological structure with a minimal use of equations. It will be evident from the first chapter how much and what Hawking contributed to theoretical physics over the course of his career.

The second chapter will analyze Hawking's contributions and appearances in the public sphere, since these are just as – or more – significant than professional contributions when moving towards celebrity status. Some are Hawking's own contributions and others are contributions made about him. However, all contributions have an impact on his image, his public reputation and his status. Hawking wrote popular science books, appeared in TV documentaries and TV shows and voiced many opinions in areas where he was no expert. This chapter will start by looking at a popular science 'boom'. Next, popular science and cinematic science as a genre is examined: what they are and what they can do. Next some of Hawking's popular science books are analyzed using tools of popular science that can indicate a level of technicality which in turn determines how popular and/or scientific the work is. *A Brief History of Time* is devoted special attention, as this marked a pivot point for Hawking in many ways. Then a few movies displaying Hawking's life are examined using cinematic science and Hawking's appearances in TV documentaries and TV comedy shows follow. Then all popular science works and appearances are ranked from scientific to popular based on the analyses. Lastly, a section displays what follows from being a celebrity in general: namely rumors and gossip about one's personal life. This is part of the visibility as Goodell will argue later. Rumors also exemplify that the scientist will lose control with his own celebrification as it proceeds.

Thus, leading to the third and last chapter, which uses the two former chapters to illustrate what, how and in what order a scientist becomes – first visible – then a celebrity scientist. Goodell theorized on the visible scientist and Fahy on the celebrity scientist. Certain traits belong to the visible scientist and one speaks of a process of celebrification which applies to the public intellectual. The traits include a credible reputation in a scientific field, a colorful image, articulateness, controversy and relevance. Hawking demonstrated all traits and underwent every process towards celebrity and thus became a celebrity scientist – as obituaries argue (Kaiser 2018, web, Barr 2018, web, Penrose 2018, web, Durrani 2018, web). This chapter will end with an examination of Stephen Hawking's life after becoming a celebrity. This section will depict tensions between the scientific community and visible/celebrity scientists. Where those tensions come from and how they are manifested are discussed – also in relation to the case of Stephen Hawking.

As already mentioned, to potentially be a celebrity scientist, one needs to be a scientist. Therefore, this thesis will start off with a presentation of some of Stephen Hawking's contributions to science, theoretical physics and more precisely: to cosmology.

2. Stephen Hawking's Physics Career

As evident from obituaries, Hawking was much more than an ordinary physicist. But first and foremost, he *was* a physicist. More precisely, Stephen Hawking was a cosmologist.

As this thesis will later show, the first trait which needs to be established for a scientist to become a potential visible scientist, and later a celebrity scientist, is a credible scientific reputation. Hawking was a celebrity scientist and thus had secured a credible status in physics before moving towards visibility and fame. This chapter will examine his scientific endeavors from his Ph.D. dissertation to the reasons why he wasn't given a Nobel Prize. Another chapter will look at his other quests in other fields.

Stephen Hawking's life in physics is well documented in the form of biographies, articles, debates - and now obituaries. Flattering words are used to describe his contributions to theoretical physics. But the scientific community hasn't always been following Stephen Hawking blindly. And Stephen Hawking admitted himself to have made some blunders. Yet, the obituaries speak for themselves when they say that Hawking was "one of the most influential physicists of the twentieth century and perhaps the most celebrated icon of contemporary science" (Castelvecchi 2018, web). Rees agrees with Castelvecchi and calls Hawking "one of the world's most celebrated scientists" (2018, web).

In the pursuit of simplicity, this chapter limits and skips some of Stephen Hawking's physical quests. This chapter will present ideas like: the second law of black hole dynamics, Hawking radiation, the information paradox, the 'no-boundary' proposal, the Hartle-Hawking state, wormholes, baby universes, and time travel. The ideas and proposals stated in the following are not presented using complex mathematics or physics. They are highlighted to a minimal technical degree, since the scope of this thesis is not to account for or derive any of the theories. This has proved to involve some difficulties, and popular explanations are included to match the style and technical level of the rest of the thesis. The ideas and proposals are presented here to give an indication of the diversity and amount of contributions Hawking made to theoretical physics in his career. Other scholars might have made other choices when portraying Stephen Hawking.

The following start out in 1959, when Hawking joined Oxford University College.

2.1 Cosmology as a Field

From 1959 to 1962, Hawking attended Oxford University College (Hawking 2013, 30-40). He graduated with first-class honors, and wanted to go to the University of Cambridge. At this time, two rivaling theories existed in physics. The two theories were: the theory of relativity – representing the very large - and quantum mechanics - representing the very small (Ferguson 2011, 32). Attempts to unite them had been made since the early 20th century (Kragh 2011, 72-83). Hawking would be the man behind one of the earliest successful descriptions of phenomena using both these theories (Hawking 1975, 199).

In 1962, Stephen Hawking arrived at the University of Cambridge as a graduate student (Hawking 2013, 41). He decided to do his research in the field of astronomy, more precisely: in cosmology. At that time, cosmology wasn't really a branch of science in itself (Kragh 2011, 124). It "was in an unsettled state, with no paradigm ruling the field" (Kragh 1996, 219). Thus, discussions of a more general philosophical kind took place: "man's place in the universe" for instance (Kragh 1996, 220). Thus, cosmology was placed in the fields of religion and philosophy, but moved, towards the 1970s, to being a mathematical science and then a physical science (Kragh 1996, ix). Hawking was present when cosmology underwent this route of changing belonging.

Even though cosmology was in a fragile position, the best candidate for a structure of the universe was the relativistic expanding universe. "But it was thought to be impossibly difficult. People were so pleased to find any solution of the Einstein field equations […] that they didn't ask what physical significance, if any, the solution had" (Hawking 2013, 43). Thus, Hawking wanted to add physical understanding to the mathematical equations.

Stephen Hawking was assigned a supervisor at Cambridge: Dennis Sciama, who favored the steady-state theory to explain the history of the universe (Kragh 1996, 221). The steady-state theory was one of two theories claiming to explain the evolution of the universe in the 1950s and 60s. The other theory was the big bang theory (Kragh 1996, xi-xii). The steady-state theory didn't imply a beginning in time. Instead, as the name implies, it required the universe to expand at a constant rate with new matter forming to fill the gaps between stars and galaxies. This theory was a serious competitor to the big bang theory (Kragh 1996, 379). Yet, in 1965, the cosmic microwave background radiation (CMB) was discovered by Arno Penzias and Robert Wilson and interpreted "as the fossils of the big bang" (Nobel Prize 2019, web, Kragh 1996, 59). Hawking and Ellis proved mathematically that the CMB could verify a big bang in 1968 (Hawking and Ellis 1968, 25). By this, the steady-state theory was put to rest. Thus, the big bang theory was, and still is, the best theory we have of the evolution of the universe. It all started in a point-like state with infinite (or near-infinite) density and pressure before it expanded to what we live in today (Hawking 2001, 23).

Thus, these are the circumstances under which Stephen Hawking started his academic career. The field of cosmology was changing and he would later contribute to this change. Hawking started his dissertation in the early 1960s and used it to prove that a relativistic universe must have originated in a singularity, thus the universe must have started in a big bang.

2.2 Ph.D. Dissertation

In 1965, Stephen Hawking presented his thesis. It provided theoretical grounds for a beginning of the universe similar to a big bang starting from a singularity. The dissertation was presented two years after Hawking was diagnosed with ALS. ALS is a motor neurone disease, which is a deterioration of the ability to control muscles in the body. Nerve cells eventually die as well as the nerve fibers that connect them to the muscles, "leaving [the] muscles unable to move or function" (Larsen 2005, 19). In America, the illness goes under the name: Lou Gehrig's disease (Hawking 2013, 97). Hawking was given approximately two years to live - but obviously, things turned out otherwise.

Hawking's thesis was titled: *Properties of Expanding Universes* (Hawking 1965, 123). To put the dissertation in context, this chapter starts elsewhere.

In the beginning of the 20th century, Albert Einstein changed physicists' understanding of gravity with the general theory of relativity. The theory is presented via Einstein's field equations, which have the famous simple form using Einstein notation:

$$G_{\mu\nu} = 8\pi G T_{\mu\nu},$$

where $G_{\mu\nu}$ is the Einstein tensor, $T_{\mu\nu}$ is the energy-momentum tensor and G is the gravitational constant. The indices μ and ν represent space-time coordinates (Dodelson 2002, 32, 25). Einstein showed that we can think of gravity as the curvature of space-time formed by the presence of matter (Peruzzi and Realdi 2011, 664). The Einstein equations relates a gravity metric to the matter and energy in the universe. Assuming a homogeneous and isotropic universe, the Friedmann-Robertson-Walker metric (which is an invariant coordinate description of the universe (Dodelson 2002, 24)),

$$ds^2_{(4)} = -dt^2 + a^2(t)ds^2_{(3)},$$

is a solution to Einstein's field equations (Goldwirth and Piran 1992, 227, Dodelson 2002, 32). The metric in four dimensions is related to a time dimension and the three-dimensional space, which is taken to be Euclidian space. The scale factor, a(t), is a measure of the relative expansion of the universe (Hannestad 2018, 8).

In the 1960s, it was explored what happens to space-time for various physical situations. When all volume is crushed to zero size, there is a strong curvature in space-time (Joshi and Dwivedi 1993, 5357). This means that nothing, not even light, can escape. A colleague of Hawking, Roger Penrose, had shown in the 1960s that sufficiently massive stars collapsing form black holes that contain a singularity (Penrose 1964, 57-9). Singularities are situations where matter is concentrated to a single point. In other words, points where a given mathematical object is not defined because an infinity appears (OED *s.v:* singularity). Part of Hawking's thesis explored the idea of a singularity, but reversed the time and applied it to the whole universe (Hawking 1965, 101, Larsen 2005, 25). Hawking used the Robertson-Walker metric to investigate the singularities. Thus, the idea of the singularity was applied to the homogeneous and isotropic universe (Hawking 1965, 106). Chapter 4 in Hawking's dissertation states that "if the Einstein equations without a cosmological constant are satisfied, a Robertson-Walker model" *must* contain a singularity (Hawking 1965, 101). Hawking claimed that if "reasonable physical conditions should hold" any model must have a singularity in the past and "must be of the big-bang type" (Hawking 1965, 101-102). This allows the spatial part to change with time, thus indicating an expansion of the universe, as should be cf. Hubble's discovery in 1929 that showed that other galaxies are moving away from us (Kragh 1996, xi, Dodelson 2002, 7). Using the RW metric, Hawking thereby provided the theoretical evidence for a universe, governed by general relativity, to necessarily have started from a space-time singularity (Kragh 1999, 363). Thus, a big bang was necessary to form the universe. This was not seen before, and it was the beginning of what was to become a comprehensive singularity theorem of gravitational collapse and cosmology worked out by Penrose, Geroch and Hawking (Kragh 1999, 363 Hawking and Penrose 1970, 529).

Thus, Hawking's dissertation provided mathematical proof that a homogeneous and isotropic universe must have started in a singularity if general relativity should hold. This was part of a larger development in the quest to find out how the universe was formed. Other scholars made similar contributions.

This endeavor was Hawking's first contribution to cosmology. Next, he examined black holes in more detail.

2.3 Second Law of Black Hole Dynamics

To follow in Stephen Hawking's footsteps somewhat chronologically, we go back to the black holes that Penrose initially discussed. Black holes are one of the mathematical consequences from Einstein's equations of general relativity. The equations show that if an object has sufficiently high density, space will be warped into a 'hole' and gravity will be so strong that nothing - not even light - can escape. Thus, a 'black' 'hole' is created (NASA, web). In 1970, Stephen Hawking used general relativity to propose the second law of black hole dynamics: "A black hole of given mass, angular momentum, and charge can have a large number of different unobservable internal configurations which reflect the different initial configurations of the matter which collapsed to produce the hole. The logarithm of this number can be regarded as the entropy of the black hole and is a measure of the amount of information about the initial state which was lost in the formation of the black hole […] the entropy is finite and is [considered similar to] the surface area of the event horizon" (Hawking 1976, 191). The event horizon of a black hole can only grow larger, because entropy can only increase (Ferguson 2011, 113, Schroeder 2014, 74). An event horizon is the boundary around a black hole from which nothing can escape. And this feature is what made the black hole black. The surface of the Schwarzschild radius act as the event horizon for a non-rotating black hole, and is defined as

$$r_s = \frac{2MG}{c^2},$$

where M is the mass of the black hole, G is the gravitational constant and c is the speed of light (Christensen-Dalsgaard 2008, 219). Thus, the event horizon is determined by the mass of the black hole.

In popular terms, entropy is a measure for disorder. More precisely, entropy is the logarithm of the number of microstates in a system, assuming each microstate is equally probable, timed by the Boltzmann constant:

$$S = k_B \ln(\Omega),$$

where k_B is Boltzmann's constant and Ω is the multiplicity, which is the number of microstates leading to a certain macro state (Schroeder 2014, 50). Thus, in statistical mechanics, entropy is a property of a thermodynamic system (Schroeder 2014, 75-6).

The second law of black hole dynamics is a pendant to the second law of thermodynamics (Hawking 1975, 203). There was some dispute about whether the perception, that the event horizon was similar to entropy, was an analogy (as Hawking thought by this time) or if the event horizon was *equal* to a measure of entropy. Bekenstein insisted it was more than an analogy (1973, 2333). If the event horizon really equals entropy, then the black hole has a temperature, and if it has a temperature, then it must radiate away energy. This is simple thermal radiation (Hawking 1976, 193). Now one can't say that nothing comes out of a black hole. This led to a paradox.

Up until this time, it was assumed that a black hole could only be characterized by external quantities like mass, electric charge, and its angular momentum. This was called the 'no hair' theorem (Hawking 1976, 192). It was generally accepted that nothing from inside could pass the event horizon. The three observables could yield one unique configuration, one microstate, and this would yield zero entropy. Thus, all information there was to collect from a black hole was found in the three external properties. All other information was stuck when matter entered the black hole, as it evidently will, because it never returned (Hawking 1977, 36). Information here is essentially understood as conserved quantum numbers (Gibbons et al. 2003, 6). The name of the theorem may come from the use of 'hairy'. When something is hairy, it is complicated, troublesome and bothersome (Merriam-Webster *sv: hairy*, web). A physicist, Wheeler, had proposed that "black holes have no hair" – hence the name (Thorne 2003, 81). Thus, a 'no-hair' theorem is uncomplicated. Yet, Bekenstein's idea that the event horizon equaled the entropy suggested a 'hairy' theorem (Hawking 1976, 192). Hawking was very troubled by this paradox and he started to view black holes from a new perspective, which led him to certain discovery.

Later, Hawking accepted Bekenstein's notion and constructed, what is now called the Hawking equation or Hawking formula,

$$S = \frac{Ac^3}{4\hbar G} \text{ (Hawking 2013, 73),}$$

where S is entropy and A is the area of the event horizon. c is again the speed of light and $\hbar$ is the reduced Planck's constant, while G is the gravitational constant. This equation equates entropy with the area of the event horizon (times a constant).

Thus, Hawking formulated the second law of black hole dynamics, which was inspired by thermodynamics. However, at this time, Bekenstein's idea would lead Hawking to the discovery of Hawking radiation.

2.4 Hawking Radiation

In order to progress, in 1973, Hawking started to view black holes through the eyes of quantum field theory (Gibbons et al. 2003, 5). Relativity and quantum mechanics had been reluctant companions from the beginning. Quantum field theory was the groundwork for the two theories to be synthesized, but the *general* theory of relativity and quantum mechanics remained irreconcilable. "It seemed safe to assume that nothing was light enough for quantum mechanics to be important and also heavy enough for gravity to be important" (Susskind 2008, 7). This means that the two theories applied to entirely different physical situations. Yet, Stephen Hawking discovered that "quantum mechanical effects cause black holes to create and emit particles as if they were hot bodies" (Hawking 1975, 199).

Previously it was assumed that quantum gravitational effects were so small, it was obvious to ignore them. However, it was also known that quantum mechanics play an important role in matter fields (Hawking 1975, 199). The problem therefore was to find a classical space-time metric that also coupled to matter fields, which must be treated quantum mechanically. Hawking chose a metric that was a good approximation as long as the curvature of space-time was small (Hawking 1975, 199). This would provide an almost Euclidian space – the space we are most familiar with. The quantum mechanical uncertainty principle means it is impossible to know both the position and the momentum of a particle at the same time with complete accuracy. This is equivalent to saying that we can never know both the value of a field and the rate of change of that field (Ferguson 2011, 119-120). Thus, a field can never be zero, because that would violate the uncertainty principle. Hereby, we can see that empty space does not exist: it is filled with fluctuating electric and magnetic fields. Thus, intergalactic space with a small curvature is not empty. In other words: in space, pairs of particles – electron/positron, for instance – appear and annihilate all the time (Hawking 1975, 202). This is what led Hawking to the finding of Hawking radiation, and this suggests that a black hole can get smaller and eventually evaporate. More precisely: a pair of particles appear near the event horizon of a black hole – one with positive energy and one with negative energy. The negative particle can potentially tunnel through the event horizon into the black hole, while the positive particle can escape to infinity and constitute a part of the thermal emission (Hawking 1975, 202). To an observer, it will seem that the positive particle appears out of the black hole. The particle with negative energy is captured by the black hole, but since its energy is negative the black hole will lose mass. This will lead to a decrease in the size of the event horizon, according to the Schwarzschild radius equation. The image of the virtual particles is heuristic and "should not be taken too literally", as Hawking put it (1975, 202). A more likely explanation is that the black hole decays quantum mechanically and lets energy tunnel out of the hole because of quantum fluctuations. Yet, the implications are the same: this will lead to a decrease in entropy according to Bekenstein. However, the flow "across the event horizon would always cause some increase in the area of the event horizon" (Hawking 1975, 203). Thus, a total increase in the event horizon and in entropy would be evident. This agreed with what Bekenstein claimed: the area of the event horizon equals the entropy of a black hole. And along with entropy, the black hole had to have a temperature, which would lead to thermal emission, as mentioned. Thus, black holes radiate energy, and eventually the black hole might evaporate entirely – if it is small enough.

Thus, Hawking radiation is "thermal emission [which] leads to a slow decrease in the mass of the black hole and to its eventual disappearance" (Hawking 1975, 199). Hartle and Hawking derived Hawking radiation in a number of ways to convince all critics (Hartle and Hawking 1976, 2188). Using path-integrals, they showed that a black hole will emit scalar particles with a thermal spectrum characterized by a temperature related to the black hole mass by:

$$T_H = \frac{\hbar c^3}{8\pi G M k_B}$$ (Hartle and Hawking 1976, 2188),

where $\hbar$ is Planck's reduced constant, c is the speed of light, G is the gravitational constant, M is the mass of the black hole and k_B is Boltzmann's constant. This temperature is called Hawking temperature and depends merely on the mass of the black hole, since all other factors are natural constants (Hawking 1975, 199). On a side note, Hawking's tombstone displays this one equation, which incorporates thermodynamics (k_B), quantum theory ($\hbar$) and relativity (c and G) (Hawking 2003, 113).

Hawking radiation was very controversial and the scientific community thought Hawking was mistaken at first. The accepted notion was very firm: a black hole was entirely black and inaccessible. Yet, after some time, Hawking radiation was generally accepted in the community. However, there is no direct evidence to prove the theory (Fahy 2015, 30).

In May 1974, Hawking was invited to become a Fellow of The Royal Society – as one of the youngest ever (royalsociety.org, web). The Royal Society is a fellowship made of the very most eminent scientists, engineers and technologists from the UK. Members are elected through peer review on the basis of excellence in science (royalsociety.org, web). "The discovery of black hole radiation sealed Hawking's international reputation" as an expert in the field (Larsen 2005, 43). This would turn out to be merely one of the first in a long row of medals, prizes and honorary degrees.

Despite the portrayed debates, Stephen Hawking had indeed achieved something great. He had successfully described a physical phenomenon using both general relativity and quantum field theory (White and Gribbin 1992, 151, Ferguson 2011, 117). This was something new. He had furthermore opened physicists' eyes to profound connections between general relativity, thermodynamics and quantum mechanics (Hawking 2018, xvi). Thus, he had established himself so firmly that he was invited to become a fellow of the Royal Society at an early age. This is one of the reasons for his initial success as a physicist. Later chapters will argue that a credible reputation in science is needed in order to become a visible scientist. Thus, this was the first step on the path of becoming a celebrity scientist (White and Gribbin 1992, 153, Fahy 2015, 20).

Moving along the lines of Hawking radiation, Hawking encountered a new paradox.

2.5 The Information Paradox

For ordinary black holes made of dead stars, Hawking radiation will not mean the death of them. They are so massive that they continuously will swallow more energy than Hawking radiation will ever emit (Hawking 2005, 3). Yet, Hawking had already proposed so-called primordial black holes. Tiny black holes that could be anywhere. These kinds of black holes would be dominated by Hawking radiation, and thus, eventually evaporate (Bousso and Hawking 1995, 5664, Hawking 1975, 199).

This posed a serious problem with conservation of energy. Conservation of energy is one of the most basic laws of nature (Young and Freeman 2012, 176). What happens to everything that fell into a black hole when it is gone? One might suggest that Hawking radiation carries some information from the black hole assuring no violation of energy conservation. But Hawking insisted that Hawking radiation is completely random and featureless, thereby not carrying away any information about the black hole (Polchinshi 2003, 304). As mentioned, the radiation appears just outside the black hole having nothing to do with its interior. This is called *The Black Hole Information Paradox* (Polchinski 2003, 303).

Hawking believed information was lost with the evaporation of tiny black holes. Another scientist, Leonard Susskind, wouldn't accept that it was a possibility that information could ever be lost. He believed if information is lost, then we can forget about predictability and the dependability of cause and effect – the principles on which we base our very existence and all our experiences. Therefore, Susskind initiated a war on black holes. Hawking believed Susskind was actually the only one, who understood the implications of the information paradox (Ferguson 2011, 169, Susskind 2008, 210). The debate led to the holographic principle proposed by 't Hooft, modified by Susskind.

The holographic principle is a reconstruction of physical laws and is based on string theory (Susskind 2008, 301). The principle claims that "the combination of quantum mechanics and gravity requires the three-dimensional world to be an image of data that can be stored on a two-dimensional projection much like a holographic image" (Susskind 1995, 6377). Thus, the event horizon of a black hole – the boundary surface – is a two-dimensional hologram of the interior of the black hole. This way, no information is lost (Ferguson 2011, 305). Yet, as Polchinski points out, Susskind's principle shows how radically physics would have to be altered to avoid information loss (2003, 304). Fortunately, new tools developed to resolve the paradox. But that was later.

The information paradox would be a problem Hawking, and others, continued to try and solve. This is evident as it is the subject of many of Hawking's articles throughout the 1990s and 2000s. The last article Hawking wrote on information loss in black holes is from 2015 (Hawking.org, web). This chapter will return to the information paradox.

In 1979, Stephen Hawking was given the venerable title of Lucasian Professor of Mathematics by the University of Cambridge (Hawking 2013, 84, Kragh 2011, 296). This position was once held by Sir Isaac Newton and later Paul Dirac (Hawking 1988a, 68). Hawking's inaugural speech was titled: "Is the End in Sight for Theoretical Physics?" (Hawking 1981, 15). Hawking predicted that a Theory of Everything would be found within the following 20 years. Some argued that this was the ultimate achievement for physicists, and others argued that it wouldn't change much (Hawking 1981, 17, Fahy 2015, 30). That statement was modified several times.

Thus, the information paradox was the object of many of Hawking's articles from the 1970s to 2015. He thought he solved it, then he knew he hadn't, and then he tried to solve it again. If he succeeded, a following chapter will address. As the information paradox was a continuous frustration for Hawking, other questions smoldered most of his career too.

2.6 The 'No-boundary' Proposal and the Hartle-Hawking State

Stephen Hawking was regularly asked fundamental, ontological and metaphysical questions, so-called 'big questions', about life and the universe (Hawking 2018, vii). One of the more common ones were: 'Why does the universe exist?' and 'What was it like before the Big Bang?' By 1983, Hawking claimed the latter was a question without meaning (Ferguson 2011, 216). Hawking thought the universe to be finite but without a boundary both in time and space. The boundary conditions of the universe had long been hard to conceptualize for physicists, and several ideas had been examined (Kragh 1996, 7). Hawking's popular notion was that space without a boundary is like the surface of a balloon or the surface of Earth. But time with no boundary is harder to imagine. Yet, it is the same picture: time with no beginning or end is like the surface of a ball. If both time and space curve around at the beginning, it is intuitive to view the question as something similar to: 'What is south of the South Pole?' Thus, the question of what was before the Big Bang is without meaning. You can't go south of the South Pole, you will end up north of it. This is Stephen Hawking's 'no-boundary' proposal, proposed in 1983. The universe is finite and "the boundary conditions of the universe are that it has no boundary" (Hawking 1984, 259). This proposal also indicates that the universe will be spontaneously created out of nothing and will have some initial phases of expansion (Hawking 1984, 272).

Also in 1983, Hawking published this proposal with Hartle in the Hartle-Hawking state, which presented a wave function of the universe. They showed that the excited states of the wave function of a universe "expand from zero volume, reach a maximum size, and […] have the probability of tunneling through a potential barrier" and reach a state of continual expansion (Hartle and Hawking 1983, 2960). Thus, this was in the same lines as the 'no-boundary' proposal. They both proposed a universe starting from nothing and expanding forever. In the wave function of the universe, there were no singularities at which the theory broke down. It may seem as if Hawking had just proven his younger self wrong as his doctoral thesis presented mathematical proof for a universe starting from a singularity. But the wave function was manipulated in imaginary time, which has nothing to do with real time (Hawking 2003, 114). Using imaginary time is a mathematical trick in order to not have the equations break down. Thus, the singularity still existed in real time.

Much of Stephen Hawking's 1980s were filled will illness, hospitalizations and the writings of a very famous book. I will return to this. Many things changed during those years. Stephen caught pneumonia and received a tracheotomy. The operation left him with no ability to speak (J. Hawking 2007, 369). But a small Californian computer company sent Hawking a program that allowed him to select words on a string and the opportunity to send the words to a speech synthesizer (White and Gribbin 1992, 235-6, Ferguson 2011, 227, Hawking 2013, 85, Larsen 2005, 71-5). Hawking found more people could actually understand him now than before. The Hawking family also experienced other changes to everyday life. The publication of *A Brief History of Time* ignited the smoldering sparks of media attention and lit it on fire. The book's last remarks have been iconic for the work.

Hawking argued that if physicists found a Theory of Everything, “then we would know the mind of God” (Hawking 1988a, 175). These are points of a later chapter too.

In the wake of this book success, Hawking received the Companion of Honor, which is bestowed by the Queen (royal.uk, web). This happened in 1989 (Ferguson 2011, 384). Thus, with the book came fame, and life would never be the same for any of the Hawkings (Larsen 2005, 85-6).

The no-boundary proposal and the Hartle-Hawking state are well recognized ideas, however other ideas exist too. There is no way of settling the debate, since it is impossible to test the boundaries of the universe. Thus, these are somewhat philosophical questions and Hawking examined other questions of similar nature. Science fiction has taken some of these theories a little too literally.

2.7 Time Travel, Wormholes and Baby Universes

In the late 1980s and early 1990s, Stephen Hawking started working on time travel, wormholes and baby universes.

Popularly: if one imagines the universe as being the surface of a balloon. When the universe expands, the balloon is simply inflated. Hawking started thinking about bulges in the surface of the universe. This is equivalent to a weak spot on a balloon. The weak spot will develop a little bulge at some point when the balloon is inflated. Hawking labels this – for the cosmic balloon – the birth of a ‘baby universe’ (Ferguson 2011, 251). These births take place in imaginary time, which does not transfer into real time (Hawking 2003, 114). The image of bulges in a balloon indicates that there may be billions and billions of universes born from one another. Our universe may even have been born as a bulge in the surface of another universe in space-time. Thus, many universes may exist. The next question is: ‘Why do we exist in this universe?’ Hawking uses the anthropic principle to answer this. The principle states that if any observable in the universe was any other value than what we observe, then we wouldn’t be here to ask the question (Karpenko 2018, 141, Ferguson 2011, 177). This argument is used by some, yet, “is declared meaningless by the significant part of the scientific community” (Karpenko 2018, 141).

In our universe, assuming a Euclidian approach, “quantum gravity will allow closed universes to branch off from our nearly flat region of space-time” (Hawking 1988b, 904). From the possible quantum states of these universes, a wormhole will form connecting two Euclidian regions or different parts of the same region at different times (Hawking 1988b, 904, Hawking 2001, 110). A wormhole is like two tiny black holes that appear and then vanish again after too short a time to imagine (Thorne 2003, 100). This has rightly fed the ideas of science fiction writers. Yet, Kip Thorne found that the only way to make a wormhole accessible to macroscopic objects was to use "exotic material with a negative energy density to hold the" 'door' open (Thorne 2003, 27). This is not allowed by physical laws; thus, time travels are impossible.

These ideas of time travel and a multitude of universes have been elaborated by other scientists and theorized in the multiverse theory (Karpenko 2018, 148). There are both proponents and critics of the idea. Again, there is no way to settle the controversy.

Speaking of science fiction material. The black hole information paradox was not settled yet, but string theory and Susskind's holographic principle gave Hawking new ideas.

2.8 The Information Paradox Once Again

String theory had been useful in trying to resolve the information paradox. In string theory, particles are little strings that can vibrate in different modes equal to different particles (Hawking 2001, 51). Just at – or on – the event horizon of a black hole, virtual string pairs are created. Wiggles in the strings can form larger wiggles, which can turn into loops on the strings. These loops can break off and be emitted – as Hawking radiation. Since this popular image came from conventional methods of quantum mechanics, it did not allow for loss of information.

In 2004, Hawking held a lecture at a Dublin conference, where he claimed to have solved the information paradox. Hawking's superstar celebrity at this time made the rumors swirl and 600 physicists and dozens of reporters attended Hawking's lecture (Larsen 2005, 124). He admitted he had been wrong about the loss of information, but he claimed that Susskind hadn't solved the paradox completely either. He wanted to attempt that himself (Ferguson 2011, 360). String theory had provided Susskind with the holographic principle, which preserved information. But it still wasn't clear how information gets out of a black hole. Hawking used Maldacena's results of an examination of black holes in AdS, which is a specific space-time that solves Einstein's field equations for empty space and a positive cosmological constant. Hawking also employed brane theory, a sort of string theory, and his usual mathematical tricks (Hawking 2005, 3). The result suggested that a black hole could have several spatial structures at the same time. One cannot tell which structure contributed to an observation in the same way that one cannot tell which slit the electron traveled through in the two-slit experiment (Hawking 2005, 3). This meant that a true event horizon could not form, since the 'shape' of the black hole wasn't unique – thus information could not be trapped. "This explains how a black hole can form and then give out the information about what is inside it" (Hawking 2005, 4). Thus, Hawking's idea was to use Susskind and Maldacena's insights together with brane theory to try and solve the paradox.

Thus, the information from a deceased black hole remains in our universe and is not carried off to a baby universe – as was one of Hawking's earlier ideas. Yet, the information is not retrieved in any usable form. Thus, "information can be recovered in principle, but it is lost for all practical purposes" (Hawking 2015, 1). Hawking illustrated the information recovery using an encyclopedia, which was also the subject of a bet made with Kip Thorne and John Preskill about information loss in black holes. If one burns an encyclopedia, the ashes and the smoke still contain all information. But it is very hard to read now. Hawking gave Preskill a baseball encyclopedia, but wondered if he should just have given him the ashes (Hawking 2005, 4).

Thus, Hawking claimed that information is not irretrievably lost in black holes as he initially thought. And once again, the fundamental laws of physics were safe. However, as Thorne points out: this was not a *proof* that information is restored in black holes' evaporation, this is merely a well-documented theory that it is (Hawking 2018, xxii). Hence, physicists agreed that Hawking hadn't solved the information paradox (Fahy 2015, 34).

The information paradox was exposed in the 1970s, but continued to be a subject of interest since no one was sure how to solve it. Something else with the same lifespan was Hawking's academic title as Lucasian Professor. But that was about to end – in contrast to the resolution of the information paradox.

2.9 Nobel Prize or Not

In 2009, Stephen Hawking stepped down from his position as Lucasian Professor of Mathematics at Cambridge. He didn't do this to retire as his new title was: Director of Research for the Cambridge Centre of Theoretical Cosmology (Ferguson 2011, 393). Thus, his status remained much the same.

Yet, overall, much had changed since he was given the title in 1979. The field of cosmology had firmly established itself – partly due to Hawking's contributions. As Hartle writes in a book celebrating Hawking's contributions to theoretical physics and cosmology: "Stephen's remarkable combination of boldness, vision, insight and courage have enabled him to produce ideas that have transformed our understanding of space and time, black holes and the origin of the universe" (Gibbons et al. 2003, 1). One of the particularly important endeavors had been to try and unify quantum theory and general relativity.

Another change was that the end of theoretical physics did not seem as near as it appeared in 1979. Hawking's inaugural speech argued that a Theory of Everything was near. But Hartle points to the fact that a Theory of Everything cannot be a theory of everything in a quantum sense, we merely get 50-50 probabilities in most cases. A Theory of Everything will be too simple in all cases to make sure we predict the event we want – and not something similar, but at another time or at another position (Hartle 2003, 47). Thus, a Theory of Everything had transformed into a complex phenomenon, and was no longer what it sounded like. Hawking agreed: "At one point I thought I would see the end of physics as we know it, but now I think the wonder of discovery will continue long after I am gone" (Redford 2018, web).

As mentioned, Hawking received many awards and prizes. Yet, there is one particular prize he did not win. It is suggested that Hawking never received the Nobel Prize for Hawking radiation because of the difficult experimental verification – despite indirect proofs (Castelvecchi 2018, web). Yet, in 2015, something was detected that might help experiments along.

Albert Einstein had predicted the existence of gravitational waves from his field equations of general relativity. The waves would be transverse, of spatial strain, and travelling at the speed of light. On September 14th, 2015 at 09:50:45 UTC, two detectors simultaneously observed a gravitational-wave signal (Abbott 2016, 061102-1). The frequency matched the ones predicted by general relativity for a "merger of a pair of black holes and the ringdown of the resulting single black hole" (Abbott 2016, 061102-1). "These observations demonstrate[d] the existence of binary stellar-mass black hole systems. This [was] the first direct detection of gravitational waves and the first observation of a binary black hole merger" (Abbott 2016, 061102-1). This observation would enable studies of additional relativistic systems and provide new tests of general relativity (Abbott 2016, 061102-1). Thorne joins in and states that the findings of gravitational waves might be the beginning of a revolution in our understanding of the universe, since gravitational waves are so radically different from electromagnetic waves, from which most of our current understanding come (Hawking 2018, xix).

Gravitational waves may be the ideal tool for examining Hawking's insights about black holes and Hawking radiation (Thorne in Hawking 2018, xix). We will just have to wait and see.

The last academic article by Stephen Hawking was published in July 2017. Just in the nature of Stephen Hawking's career, the last publication departed from the no-boundary idea, which he himself proposed in the 1980s (Hawking and Hertog 2017, 14).

2.10 Summary

This chapter has presented Stephen Hawking as a scientist, a theoretical physicist and more precisely: a cosmologist. An overview of Hawking's scientific career has been provided and phenomena like the second law of black hole dynamics, Hawking radiation, the information paradox, the 'no-boundary' proposal, wormholes and time travel have been presented using a limited amount of mathematics, since the scope of this thesis is not to prove any of his relations. The intent is to present a chapter with highlights of Hawking's career and the implications from those. Comments on his personal life is incorporated into this chapter as well, since this also can explain why things turned out the way they did. Some of his academic titles have also been presented. It is hopefully evident from here the enormous imprint Hawking made on theoretical physics in the 20th and 21st century (Gibbons et al. 2003, 1).

As stated before, Stephen Hawking was a celebrity scientist. He was an established physicist, who then took on the job of writing popular science books too. This snowballed and Hawking became a product of culture. And in the end, Hawking's personality had become synonymous with a set of ideas, a way to view the world. This chapter has elaborated on the first step in this development: being a credible scientist. With the contributions mentioned above, Hawking had established a credible reputation in his own field: cosmology. This happened as early as in the 1970s and 80s. Yet, Hawking didn't refrain from making more contributions as his public fame increased.

The next chapter will examine Hawking's popular science books, the movies made of him and his appearances in TV documentaries and TV comedy shows. This is done to investigate Hawking's public life, which ranges from books and movies to rumors about his love life. Yet, in order to understand the time and the fame, especially the books gave him, the chapter starts off with an investigation of popular science in the late 1970s; what the genre can do, and what cinematic science can do.

3. Stephen Hawking in the Public Eye

Obituaries on Stephen Hawking portray him as an "international superstar" and the "No 1 celebrity scientist" (Carr 2018, web, Penrose 2018, web). Thus, it is evident that Hawking was much more than a scientist. In order to become a celebrity scientist, several characteristics need to be present in the scientist and he has to go through some specific processes to reach celebrity status. Those traits and processes are manifested in the way the scientist operates in the public eye to a higher degree than how he manages the scientific sphere. Thus, this chapter will examine Hawking's various contributions to different public fields. Some are Hawking's own contributions, while other contributions by other people include Hawking in their final product. This way Hawking hasn't had control with all the cultural products that use his name and brand. Yet, all the contributions have had an impact on his image, his public reputation and his status. Hawking appeared in TV comedy shows and TV documentaries in addition to writing popular science books, which he is mostly known for. Thus, this chapter will depict the Stephen Hawking a public audience knows and remembers.

Why and what it meant to Hawking's increasing celebrity status to appear in the public in these ways is the scope of another chapter. As is which traits and processes Hawking possessed and went through to become a celebrity scientist.

This chapter will take a look at what popular science and cinematic sciences are and what they can do. But first, the 1970s popular science 'boom' is put in context in relation to Hawking's career. Then popular science as a genre is looked at. Next, a selection of Hawking's popular science books is examined with tools of popular science that can indicate a level of technicality which determines how popular and/or scientific the work is. Next, the movies based on Hawking's early adulthood are examined with the eyes of cinematic science. These movie productions are both the result of an increasing public status, but have also contributed to this increase. Then, TV documentaries are studied as a mix between cinematic science and written popular science. This subsection on TV appearances include Hawking starring on popular TV shows too. Lastly, rumors about Hawking's persona are included, since these are estimated to also have had an impact on the public perception of Hawking.

3.1 Popular Science

In order to present and assess Hawking in a light that reflects the circumstances he was in, we need to take a look at some tendencies of the latter part of the 20th century. There was evidently a popular science boom in the 1970s. As a result from this, journalists and scientists experienced some tension.

Following a look at the contemporary tendencies in the 1970s and 80s, the genre of popular science and cinematic science are examined. The genres can broaden the scientific interest, reach out to more and new people and they can enhance scientific literacy. But are popular science books scientific or popular?

3.1.1 A Boom in Popular Science

Lewenstein presents evidence of a popular science 'boom', which happened in the late 1970s (1987, 30). The popular science boom includes a total of three new shows, 15 magazines, 18 newspaper sections, and 17 TV shows, which devoted themselves to popular science for the first time. To explain this boom, we need to consider the circumstances. In the 1970s, the baby boom after World War II was maturing. They had grown up with Sputnik, the Space Program, the atomic bomb, and the energy crisis. But the 1970s served as an information vacuum of science information (Lewenstein 1987, 30). Broks argues that there is no evidence of a demand for science – although a hunger might have emerged, as Lewenstein points to (Broks 2006, 90, Lewenstein 1987, 30). What developed was a moral certainty about the importance of science among a network of organizations and journalists, which meant a broad interest in the supply of science (Broks 2006, 90). Thus, it was generally recognized that an increase in scientific literacy would benefit science and citizens. This, and other, factors are responsible for the emergence of new newspaper sections, science magazines and TV shows in the late 1970s and beginning of the 1980s.

Popular science literature was part of this boom. Popular "science books [became] more central to American culture" in the 1970s (Turney 2008, 8). Along with this development, the scientific community went to take on an active role in the presentation of scientific information. This would serve as a self-preservation for the scientific endeavor. It would help protect or gain credibility, funding, and it helped secure prestige for scientists in society (Dudo 2015, 763). Broks exemplifies the popular science boom with the publication of *A Brief History of Time,* which he calls a "phenomenal success" (2006, 89). The shift in prominence of science books was part of the basis of the success of Hawking's *A Brief History of Time.*

The rise in popular science also meant a rise in science journalists (Broks 2006, 88). With the journalistic approach, the intent was to try and make scientific information as accessible as possible. The journalists started to view themselves as advocates of science. But they needed the scientists' expertise to make accurate and convincing science articles. And the scientists needed the journalists in order to communicate their research beyond the laboratory to the general public (Dudo 2015, 762). Thus, both professions have depended on each other. Yet, that doesn't mean the relationship has been without strain. This is in large part due to the different norms and values underlying the two professions (Dudo 2015, 762). The scientist has been critical of the simplification of the research by the journalist. The scientists believed articles told the research inaccurately, that the journalist was overly sensational, focused on the individual, and gave more time and paragraph space to the maverick scientists. This fits with the guidelines of the news industry. And opposing: the journalist perceived the scientist as uncooperative, arrogant, defensive, and wanting to control the content of the article (Dudo 2015, 762). Broks even argues for popular science as a 'low science' encouraged by science journalists. Low science in the sense of "encouraging amateur activity and emphasizing the universal accessibility of science" (2006, 19). Thus, the journalists could broaden the scope of scientific activity.

Yet, in the light that scientists were criticizing science journalists, it is no wonder that they sought more control over the process and product of popular science in the 1980s (Dudo 2015, 763). Thus, Hawking is an example of just such a scientist. A scientist, who started to write popular science books.

3.1.2 Popular Science and Cinematic Science

As popular science boomed in the 1970s, it is interesting to examine what this genre is and what it can offer.

3.1.2.1 Popular Science Literature

Popular science books have generally been trapped between two fields: literature and science (Turney 2008, 10). They try to convey a scientific content through the established techniques of literature. Difficult questions are raised about the level of the work. Level in the sense of how technical it is. The more technical, the more accurate the science and vice versa. The dilemma arises when the writer assumes no prior knowledge by the reader, yet still wants to portray and discuss the scientific theory in its whole (Turney 2008, 6). One cannot do both at the same time.

A journalist will have a tendency to write for the literature, with a low level of technicality, focusing on humanized accounts designed to connect with lay readers (Bubela 2009, 516). This will mount to a low degree of accurate scientific content, but will widen the possible reader audience. A journalist will also use other techniques from literature. This does not mean that the work is without scientific content, yet the work will provide more of a glimpse into a scientific world than an account of it.

A professional scientist will often work in the other end of the spectrum. Thus, presenting a piece that is scientifically accurate but with a more narrow scope of audience. These kinds of accounts "make it less likely to be published in competition with the news of the day" (Bubela 2009, 516). This seems to be the prize of scientific accuracy.

Thus, scientific popular science books are very technical. They display complex explanations of physical phenomena. A common tool is mathematics: equations and representations in the form of graphs. Mathematics is the language of natural science in many ways. Yet, for a popular science book to be successful, something is missing. Olsen argues that what scientists lack to communicate science efficiently is narrative intuition (2015, 20). If scientists had an intuition for narrative, they could "speak in a manner that is less boring, and not as frequently confusing" (Olsen 2015, 20). A way to construct narrative is to rely on guidelines from the news industry. Actuality, significance, identification, sensation and conflict are points to use when writing for a public audience, where a massive amount of information is in contest with what the popular science book tries to tell (AiU 2018, web). The use of these criteria will reduce complexity as readers are engaged to a higher degree. An example is anecdotes, which is a way of maintaining the reader through identification. This also works as a break from technical content.

Furthermore, Olsen advocates for simplicity in storytelling, and argues for the important point that simplicity doesn't mean anything is dumbed down (2015, 31). But simplicity contrasts with science, where complexity is the norm (Olsen 2015, 28). Complexity is fun, exciting and stimulating. Yet, the problem with complexity is that it can be so overstimulating that the net result is zero. Thus, Olsen presents templates for scientists to use to get the feel of constructing narrative. One of the more efficient ones he calls 'ABT' (2015, 16). The A stands for *and*, the B for *but*, and the T for *therefore*. Before, in between, and after these words, the narrative can unfold. The template can be used over and over again in the same story – this yields clarity (Olsen 2015, 16). Thus, narrative is a tool from literature which Olsen believes science communication will benefit from using. Thus, indicating that there is not much use of it as it is. Yet, when analyzing popular science books, the degree of narrative will help determine whether the work is more scientific or popular.

The genre of popular science can offer many things. It can widen interest in science, and increase general scientific literacy. But, what are popular science books; are the works scientific or popular? It is a spectrum. It depends on the level of the work. "It makes a difference if you offer an account of modern physics with all the equations left in […] or write a 'biography' of an equation containing no mathematics" (Turney 2008, 6). It also depends on the use of narrative, personifications, progression – and on the use of sensationalism, individualism and conflict (AiU 2018, web). The lack of use of these literature techniques will tip the scale towards a scientific popular science book. Now we have discussed popular science books and their mix of science and literature. But what about cinematic science, which is a popular science too?

3.1.2.2 Science in the Cinema

Popular science and cinematic science are two fields that invoke similar problems, since cinematic science is a subsection of popular science. Movies are at once an influencer of science literacy but it is also a "source of insignificant depictions that audiences recognize as a fantasy world" (Kirby 2008, 52). Movies are known to portray fiction. Thus, movies are at best unreliable when it comes to an attempt to increase scientific literacy. The historical public understanding of science – called the 'deficit model' – attributes negative attitudes towards science to a lack of scientific knowledge (Kirby 2008, 41). An entertaining way to remedy this model is to use popular films to influence people's opinions of science. Yet, this is not without problems. Science in fiction does not consist solely of factual information. If it did, perhaps not many would find it entertaining. Movies portray a "system of science" as Kirby puts it (2008, 42). This system involves the methods of scientists, the social interaction among scientists, science education, science policy, science communication, and cultural meanings. These are all features an audience witness in a movie. Kirby argues that "presentations of science in the entertainment media reveal a tension [between] the needs of the entertainment industry and those of the scientific community" (2008, 42). Scientists "working on popular films need film-makers to maintain the authenticity of scientific depictions. Film-makers, on the other hand, need only to claim authenticity for their films, and ask scientists to help them maintain an acceptable level of verisimilitude" (Kirby 2008, 42). Thus, the scientific authenticity – for the film-maker – is restricted by the budget, the narrative and time. "Scientific accuracy will always take a backseat to storytelling" (Kirby

2008, 51). Therefore, scientific authenticity is not equal to a film-makers' idea of authenticity. In the worst-case scenario, the film-maker's claim for authenticity can leave "audiences either believing inaccurate information or not accepting accurate science" (Kirby 2008, 43).

Thus, movies are unreliable when it comes to promoting scientific literacy. Thus, they can increase scientific literacy – but the opposite can also be the result. Nonetheless, cinematic science presents samples of science to the public in an entertaining way. Thus, generally, movies are way more popular than scientific, but that seems to be the prize for a widened audience.

3.1.3 Summary

This section has presented the circumstances in which Hawking would publish his first popular science books. There were indications of a popular science boom, which in turn created some tensions between journalists and scientists. Some scientists took the job of science communication, which journalists could also carry out.

Popular science as a genre is trapped between two disciplines: science and popular writings. This will create a spectrum where works may be placed, ranging from the more scientific to the popular ones. There are several tools one may use to analyze where a work is placed on the spectrum. The use of narrative, or lack of such, will be helpful. Cinematic science is also a popular science, yet is quite unreliable when it comes to portraying accurate science.

Next, some of Hawking's popular science books, among other things, are analyzed.

3.2 Stephen Hawking in Books, Movies and on TV

In the case of Stephen Hawking, his popular science books must be viewed in the light of popular science. The movie productions must be considered with cinematic science in mind. Yet, what about the documentaries Hawking has narrated? It is assumed that this is a situation right in the middle of the two former. The scientific documentaries can be viewed as visual and spoken popular science books, but the film-maker may have some of the same constraints as to budget, narrative and time as with a fictional science movie.

Circumstance and timing are inevitably factors that enabled Hawking to become a celebrity scientist. More precisely: timing in the sense of general movements and trends of the time. In the 1970s, there was a renaissance of public awareness of science and black holes caught the public imagination. It was perceived to be one of the strangest features of cosmology. "It was at about this time that the name Stephen Hawking first impinged on popular awareness" (White and Gribbin 1992, 133). Newspaper articles and TV documentaries about black holes appeared and Stephen Hawking was the guy to talk to. In 1974, Hawking had become an international celebrity in his field (Ferguson 2011, 146). This is largely attributed to the discovery and acceptance of Hawking radiation and the invitation to become a Fellow of The Royal Society (royalsociety.org, web). Thus, Hawking had made himself a reputation of being a tough, good-humored man, and he had already become "legendary" (Ferguson 2011, 135). Yet, there is a difference between being a celebrity in a scientific field and a celebrity scientist in the public sphere. To become the latter, one must appear in and influence the public in various ways. To write popular books and star in shows are two fine examples of such. A following chapter will elaborate on the factors which turns someone into a celebrity scientist.

This chapter will start out by analyzing some of Stephen Hawking's popular science books with the proposed toolset in mind. Next, the movies are studied. Then, the TV documentaries and appearances on other TV shows are included. And lastly, other events covered by the press about Hawking's big achievements and rumors about his private life are also examined.

3.2.1 Popular Science Books

Stephen Hawking wrote several popular science books, but the publication of a certain work made Hawking's reputation reach public awareness to a whole new degree. *A Brief History of Time* wasn't his first book, but his first popular science book. And this work secured Hawking a spot in literature history. After *A Brief History of Time* nearly a dozen works followed, which Hawking either wrote or co-wrote. Hawking and his daughter, Lucy, also attempted the genre of children's literature.

A Brief History of Time was written at a time, where the world press had started to show some interest in Hawking already (White and Gribbin 1992, 133). Since the book solidified Hawking's name in lay people's minds, it is interesting to elaborate on the personal story connected to the emergence of this work. It was written at a time where Hawking was given something else of a key signature – his computerized voice.

Following *A Brief History of Time*, other popular science books will be examined.

3.2.1.1 A Brief History of Time

In 1982, Stephen Hawking decided to write a popular science book (Hawking 1988a, vi). Both to earn money for his daughter's education, but also to cover the costs of nursing

(White and Gribbin 1992, 221, Ferguson 2011, 224). Yet, the main reason was that he wanted to explain how far science had come in understanding our universe. As a scientist, Hawking "felt obligated to communicate with the world what we were learning" (Hawking 2018, 18). Hawking wanted to write a book to sell in airport shops. Yet, there was a long way from academic articles to popular writings. Hawking struggled to keep things simple. His first publisher at Cambridge University Press, Mitton, claimed that "every equation [would] halve the sales" (White and Gribbin 1992, 222). Hawking took notice of this statement – as will be evident in all his later popular books, which have less than a total of ten equations in ten-some publications.

In order to live from the book as soon as possible, Hawking talked the publisher into a £10,000 advance. This was very generous as it was the biggest advance the Cambridge University Press had ever offered anyone (White and Gribbin 1992, 223). Yet, by this time, a couple of American agents contacted Hawking because they had heard that he was working on a book. They helped Hawking secure a contract with Bantam Books and a $250,000 advance (White and Gribbin 1992, 226).

By 1985, Hawking traveled to CERN for a month in the summer to do some research. Yet, he also planned to allow himself to devote time to write this popular science book. However, the trip was to become a significant time in Stephen Hawking's life – in a way he didn't anticipate. Hawking caught pneumonia (White and Gribbin 1992, 232-3, Ferguson 2011, 226). As an ALS patient, this could prove to be fatal. Hawking was left in intensive care and his staff contacted Jane, who rushed to see him as he was put in an induced coma. There was really nothing left to do but wait, everyone thought. However, there was the opportunity left to perform a tracheotomy. But this would leave Hawking with no ability to speak. Jane took the decision to make the operation (J. Hawking 2007, 363). Hawking recovered well, but could now only communicate by raising an eyebrow when someone pointed to the right letter on a spelling board. Money for nursing went through the roof, and Jane convinced a foundation; the American MacArthur Foundation to pay £50,000 a year to the costs of nursing (White and Gribbin 1992, 235-6). This enabled Jane to have more freedom. With regards to Hawking's ability to speak, a small Californian company came to his rescue. They had invented a program which allowed the user to select words from a screen and send them to a speech synthesizer (White and Gribbin 1992, 236, Ferguson 2011, 229, Hawking 2013, 85, Larsen 2005, 73-5). Even though the words were slowly formed – he spoke up to 15 words per minute – this was of immense importance for Hawking's quality of life (Ferguson 2011, 229). He found more people could understand him now than before, when his speech was very slurred and people who didn't know him didn't understand him (J. Hawking 2007, 395). The computerized voice came to be one of Hawking's key signatures. With this new voice and a higher degree of financial security, Hawking quickly resumed to work on the manuscript of his book (White and Gribbin 1992, 237). One of the last changes was to the title. The wording was changed from 'short' to 'brief' and the rest is history (Hawking 2013, 97).

Bantam Books used aggressive marketing strategies and attractive cover arts, which resulted in the growth of Bantam in the 1980s thanks to a strategy centered on accessible non-fiction (Fahy 2015, 24). Again, Hawking's medical condition came up in the promotion of the book, as Hawking, bound to the wheelchair and unable to write himself, had done most of his outstanding work on black holes solely in his head (Fahy 2015, 22). This way, the publishers promoted the book around the idea that Hawking was a scientist trapped in a broken body – which would prove to be a large part of his image.

A Brief History of Time was published on 1st of April in the US and in June in the UK, 1988 (Hawking 2013, 97). *TIME Magazine* ran a large article about Hawking in April too, much to Bantam's delight (White and Gribbin 1992, 242). The introduction to the book was written by the famed American popularizer of science Carl Sagan (Larsen 2005, 83). Carl Sagan was a well-known communicator of science and thus well suited to introduce the book to the world. The book communicates cosmology and ideas of time and space to a public audience without equations – except for one: Einstein's famous equation

$E = mc^2$ (Larsen 2005, 81).

Different chapters display ideas about space and time, the expanding universe, the uncertainty principle, black holes, the origin and fate of the universe, and a unification of physics (Hawking 1988a). Illustrations and figures appear as helpful assistants throughout the book. The latter part of the book is index-like with sections on Albert Einstein, Galileo Galilei, and Isaac Newton (Hawking 1988a, 177).

The book was very well received, and has now sold over 10 million copies and is translated into more than 40 languages. It was on the bestseller list of *Sunday Times* for 237 weeks and on the *New York Times'* bestseller list for 147 weeks (Fahy 2015, 25). By November 1988, the book had already become a cult book, and Hawking a cult figure (Maddox 1988, 267). Most reviews followed the same formula of telling people he suffered from ALS, "was in a wheelchair, could not speak, could only move his fingers, yet has written a popular book on one of the fundamental mysteries of the universe: its formation" (Fahy 2015, 25). Hawking himself noted later that the human interest story might have helped the sales, but that was not the intention (2013, 98). Maddox claims "the plain truth is that professor Hawking's way of life and his reputation have gripped the public imagination in a way that is almost as phenomenal as the sales of his book" (1988, 267). This is a point of another chapter too. Rodgers also analyses the popularity of the work and attributes it to the living language in the book, the authenticity of the author as a scientist, and the sympathy from Hawking being in a paralyzed body (1992, 232). Yet, it is not all fun and games. Maddox is disappointed that the book does not live up to its "promise to explain the whole of recent cosmology" (1988, 267). As the book advances, the complexity of the topics overtakes the "freshness" of the text, and it becomes hard to follow the ideas presented (Maddox 1988, 267). The success of the book puzzled commentators. Many questions went unanswered and the content wasn't fully explained. However, that didn't seem to matter.

There is another curious fact surrounding this book; it seems many of the bought copies are unread. Maddox mentions this as early as 1988 (267). The book is notorious to be the most purchased and least read book of all time (McKie 1994, 694, Larsen 2005, 81). The book may be hard to read or the ideas it presents hard to understand. Jenkins points to the latter and to the fact that clarity does not equate ease (1992, 529). She investigates a chapter of *A Brief History of Time* with the eyes of a linguist looking at text structure, linearity and cohesion, nominal group structure, lexical density, and the use of passives and negatives (Jenkins 1992, 529-30). Jenkins believes the chapter is very clear to read as prose, yet finds the content challenging. With this in mind, Hawking has written a book in a clear, simple language. It must be the content that stops people from reading and/or finishing it. Thus, the technical level of the work – in regards to language – is low. In addition, there is only one equation, yet the phenomena are still complex. This indicates both a low and high level of scientific content in *A Brief History of Time*.

Furthermore, there is the use of narrative. Narrative in the form of anecdotes distributed evenly over the chapters, but without an overall narrative of the book. A few examples of anecdotes are Hawking's eureka moment while getting into bed, where he realized the second law of black hole dynamics, and the tale of the world standing on turtles, as a woman called astronomy a nonsense science (Hawking 1988a, 99, 1). The anecdotes serve as accounts of events and to personify Hawking as more than a physicist. The eureka moment anecdote usually includes the birth of his second child, Lucy, as she was born the same year as Hawking worked out the second law of black hole dynamics. Context is also given as Hawking continuously includes fellow physicists' contributions in the search for answers (Hawking 1988a, 59, 85, 112, 133). Both those who agree and disagree with himself.

Thus, Hawking uses identification, sensationalism, conflict, and narrative to depict cosmology in *A Brief History of Time*. In addition, despite a clear language, the content is very complex. Thus, there are more popular features in this book than scientific ones.

The impact *A Brief History of Time* had on Hawking's life was enormous. For the first time, people described him as a public celebrity (Ferguson 2011, 240). He was awarded the Order of Companion of Honor in 1989 (Ferguson 2011, 384). The order is awarded "those who have made a major contribution to the arts, science, medicine, or government" and is bestowed by the Queen (royal.uk, web). And he was named one of the 'Twenty-Five Most Intriguing People' of 1988 by People Magazine (Larsen 2005, 86). Thus, fame was instant. Although it had both amusing and inspiring aspects, Hawking's home was overrun by journalists as well (Larsen 2005, 85-6).

As mentioned, *A Brief History of Time* was not the first science book Hawking wrote. In 1973, Hawking and Ellis collaborated on the book called *The Large Scale Structure of Space-Time*. Hawking called this work "highly technical, and quite unreadable" to the reader in *A Brief History of Time* (1988a, vii). Thus, this was not an attempt to write a popular science book, which *A Brief History of Time* was. Judging on the sales of *A Brief History of Time*, Hawking had understood and communicated the features of the genre very well.

Thus, *A Brief History of Time* features a clear and simple language. Anecdotes are frequently used throughout the book and contributions from other physicists are included to tell the story. The work was well received and quickly became a cult book. However, it was criticized to be too complex, yet not thorough enough. Hence, this work is more popular than scientific.

In the years following 1988, Hawking wrote several other popular science books. A mere selection of those appear below.

3.2.1.2 Black Holes and Baby Universes and Other Essays

By 1993, another popular science book by Hawking was published. This was a collection of essays, talks, and interviews titled *Black Holes and Baby Universes and Other Essays*. The book featured subjects ranging from deeply personal to wholly scientific (Hawking.org, web). This was considered an easier book to read than its predecessor. This may have to do with a showcase of Hawking's wry humor and a mix of scientific ideas with philosophical insight (Larsen 2005, 94). Examples of humor are: "Do we really believe that the Grand Unified Theory has predicted that Sinead O'Connor will top the charts this week, or that Madonna will be on the cover of Cosmopolitan?" (Hawking 1993, 87, translated from Danish). This work also received critique of being fragmented, too technical, and too short to describe the ideas in full (Mellor 1993, 418, Sapp 1993). Yet, in the preface of the book, Hawking states that every chapter has been adapted to be read alone and in whatever order one might like (Hawking 1993, 7). This way, Hawking explains the fragmentation and the repetitions. But Mellor continues to criticize the lack of originality in this work. "There is little that is new" when comparing this work to *A Brief History of Time* (Mellor 1993, 418). And much of the book is "devoted to autobiographical sketches", which Mellor argues takes up a third of the book (1993, 418). These anecdotes Hawking indeed used more frequently now than previously.

Thus, even though this work was less technical than *A Brief History of Time*, some found it too technical still. Mellor attributes this feature to the lack of clarity in the language. It may be useful to point back to Jenkins and her linguistic analysis of *A Brief History of Time*, which concludes that the content rather than the language was technical. It may very well be the same case in *Black Holes and Baby Universes and Other Essays*.

Hawking also makes use of narrative techniques as each chapter starts with a personal motivation for writing about the topic in question. The anecdotes take up a prominent fraction of the work, as Mellor notices. In addition, the historical development in physics in the 20th century is a very prominent theme throughout the book.

Thus, this book makes frequent use of identification and storytelling as literary techniques. The technical level is lower than in *A Brief History of Time* and more history and humor is included here. Yet, it is still said to be fragmented, repetitive, unoriginal and too technical (in content, not language). The, overall, low level of technicality, broadens the audience. In this way, this book is a popular science book in the popular sense.

3.2.1.3 The Universe in a Nutshell

The Universe in a Nutshell is a popular science book explaining current cosmological thinking in 2001. Kitty Ferguson assisted in the editing of Hawking's notes for the book (Fahy 2015, 31). She did not believe the initial notes would clarify anything in a nutshell. The notes were displaying elaborate mathematical explanations of the big bang, black holes, then string theory, M-theory, imaginary time, the information paradox and extra dimensions among other things. Ferguson thought the notes could never be a coherent book. Yet, with some time and patience, she and Hawking finished the book in 2001 (Ferguson 2011, 330). Like in previous works, Hawking takes the time to explain historical developments in cosmology up until the millennium. Several scholars believed Hawking conveyed the concepts in a lucid manner, displaying his own humor and curiosity (Beall 2002, 146, Kamionkowski 2002, 267). Kamionkowski argues that Hawking does not dumb down the physics, he merely omits the mathematical language that physicists usually use (2002, 267). In Fahy's book, Gribbin aired the idea that Ferguson did more than just edit the notes. "Parts of the present book certainly read like the work of Kitty Ferguson" (Fahy 2015, 31). In addition, he didn't believe Hawking's jokes are funny. He thus questions Hawking's own influence on this work.

Colorful illustrations helped visualize the aspects of the universe that Hawking was explaining. Some illustrations showed motorcycles riding with the speed of light, a worm with a graduation hat, and trains moving in some spacetime topology (Hawking 2001, 135, 165, 33). These illustrations are special for this book, as other popular science books by Hawking do not display this feature to the same degree. Even though the reader might not attain Hawking's depth of understanding, the book is fascinating nonetheless (Kamionkowski 2002, 267). Hawking writes in the introduction that this work was structured using the idea that most chapters could be read on its own after reading chapters one and two, which represent the trunk of a tree from which branches could be read separately (Hawking 2001, vii). Thus, justifying lack of cohesion. The technical level of the work is roughly the same as the previous cases, yet, the lix number (i.e. the readability) is lower because of fewer words on each page, which is done to make room for illustrations and pictures.

What also separates this work from other works by Hawking is the lack of personal involvement and mention of personal life in this book. Hawking does not spend much time on his own story in this book. Yet, the anecdote of realizing the second law of black hole dynamics while getting into bed still made its way in there along with a few other (Hawking 2001, 146). Thus, this book is more an introduction to cosmology than to Hawking himself.

Even though Hawking limits his own story in this work, this does not mean that the narrative suffers from that decision. To return to Olsen's idea of simplicity in storytelling, Hawking makes use of the ABT template: "The analogy […] and […] However […] Thus […]" (Hawking 2001, 35). Kamionkowski notices these "novel and intriguing approaches" (2002, 267). Thus, even though the topics are complex, the language is simple as prose – as Jenkins advocates in *A Brief History of Time* too (1992, 530). Hence, this book is driven much by narrative strategies.

The Universe in a Nutshell is a popular science book leaning towards being popular. This is evident despite the technical content and the lack of personification. Yet, the narrative and the illustrations, which make up such a large part of the book, makes sure there is no way around the book being a popular book of science. This might widen the scope of the audience to include older children too, whilst explaining the popular inclination of this popular science book.

3.2.1.4 My Brief History

In 2013, Stephen Hawking publishes an autobiography named *My Brief History*. The title is a clear-cut reference to his own work *A Brief History of Time*. In fact, "there have been many 'brief histories' of this and that" – and even a *Brief History of Thyme* (Hawking 2013, 97). *My Brief History* offers readers a glimpse of his private life – but not more than a glimpse. Science is of course present in the book, but "this is not a book to learn Hawking's science from" (Sample 2013, web). This is a fairly easy read and an introduction to the world of Hawking and to the cosmos (Sample 2013, web). The level of technicality is low. And probably the lowest of all his popular books. Even the lix number is very low. Thus, this work presumably has the widest scope of audience. The book is a fine display of narrative as the work depicts Hawking's life until this point. Some of the same anecdotes as in *A Brief History of Time* appear here. The eureka moment of Hawking realizing the second law of black hole dynamics as going to bed is also mentioned here (Hawking 2013, 69). In addition to this anecdote, he mentions that he was born exactly 300 years after the death of Galileo, as if this fact was a foresight of what he was to become (Hawking 2013, 6). This anecdote is used in other works as well. The glimpse into Hawking's private life strengthens his persona as being more than a physicist.

Speaking of inviting readers into his private life; Hawking does limit how much he shares. Readers learn of Hawking's upbringing and his schooling in a few chapters. Something which both Sample and Leddy mention in their reviews is that Hawking admits he didn't study much in his Oxford years (both 2013, web). Hawking blames the spirit of the time and estimates to have spend on average an hour a day on school work for three years (Sample 2013, Leddy 2013, web). This is perhaps not what the public would expect from such an iconic scientist. It seems; however, Hawking was not proud of this fact. Hawking's personal life is brushed by very smoothly, even the time where he was diagnosed with ALS is a swift page or so (Sample 2013, web). In the 1990s, the media brought several crises on the martial life of Hawking. This is left without comment, or mentioned in the passing: "as for his private and marital life, he offers very little" (Leddy

2013, web). Yet, readers do learn about Jane and Elaine (first and second wife) and the children.

Stephen Hawking's humor does not go by unnoticed, as Leddy mentions it too. When talking about Newton and himself both having occupied the Lucasian chair at Cambridge at another occasion, Hawking jokes that Newton's chair "wasn't electrically operated" like his own (Leddy 2013, web).

My Brief History offers a glimpse into what Hawking was other than a cosmologist. Hawking is portrayed as an understated physicist, a hard-working man and a likable father and husband (Leddy 2013, web). The work is actually more an autobiography than a popular science book. Yet, science is a prominent factor in the book, as it was in Hawking's life. The work is low in technicality, low in lix number and driven by an overall narrative – as biographies are. Thus, this is perhaps the most popular book Hawking ever wrote.

3.2.1.5 Children's literature

Stephen and Lucy Hawking have written five children's books from 2007 to 2016 (Hawking.org, web, Amazon 2019a, web). For some it may seem far off for an iconic scientist to endeavor into this whole other field. But Hawking explained that he was like a child himself: "Children ask how things do what they do, and why. Too often they are told that these are stupid questions to ask […] I'm a child myself, in the sense that I'm still looking" (George 2009, web). The books deal with black holes, the beginning of the universe and other astrophysical wonders – at eye level with children. Together the books are a series where George is the protagonist. George and his good friend Annie travel into space to explore the universe. They land on mystery planets, rescue someone from a black hole, chase aliens and much more (L. Hawking 2018, web). The series is a fantasy adventure series – but opposed to most children's fantasy literature – "all the science in the book is correct so you learn as you go along" (L. Hawking 2018, web). Thus, the level of technicality may be somewhat high, if all the physics is correct. But it must give way for a clever and appealing narrative, since the target audience is children. So, the level much match the scientific literacy of this group. Therefore, the George-books are practically entirely popular books, with correct science and not science books.

The first book in the series was published in 2007 and called: *George's Secret Key to the Universe*. The book was called charming, and was "bound to tickle curious young readers into falling in love with science" (Popova 2009, web). The book portrays a mix of fact boxes, pictures of astronomical phenomena and enjoyable drawings. But "like any educational tool, it will succeed for some and not for others" (Ellis 2007, 949). They "may not be as well-written as Tolkien's Lord of the Rings Trilogy but then few books are! Still, it is a valiant attempt to make science interesting to young readers" (Guardian 2013, web). Thus, the series has received much praise and recognition.

The George-books are written for children, thus stand outside the genre of popular science books. The books are popular children's books with some scientific content.

3.2.1.6 Brief Answers to the Big Questions

The last publication in the name of Stephen Hawking hit the market in October 2018.
Hawking was working on this book at the time of his death in March 2018. Yet, with the help of "his academic colleagues, his family and the Stephen Hawking Estate" the book was completed (Hawking 2018, ii). There was enough material from lectures, speeches and interviews with Hawking, to make sure the wording of the book is almost entirely Hawking's own. A percentage of the royalties are earmarked Motor Neurone Disease and the Stephen Hawking Foundation (Durrani 2018, web).

As previously mentioned, Hawking was frequently asked 'big questions'. In this book he answers ten such big questions like: 'Is there a God?' 'What is inside a black hole?' 'Will we survive on Earth?' Thus, this last work is a popular science book on science, yes, but also a book about religion, humanity, present and future. The chapters can be read in no particular order or independently from the book itself (Durrani 2018, web). This makes the book seem fragmented when read from cover to cover. The line of argument is not coherent and there are far too many references to *Star Trek*, according to Butterworth (2018, web). Anecdotes are also present in manifold as we hear of Hawking being born 300 years after Galileo's death, the realization of the second law of black hole dynamics around the time of Lucy's birth and many more (Hawking 2018, 5, 13). The work is a missed opportunity to tell something new – despite the fact that the publishers call the book Hawking's final thoughts. As best, this is a collection for fans or a brief introduction to Hawking's ideas in cosmology and their impact on our perception of the universe (Butterworth 2018, web). There are two forewords and an afterword, which are written by Eddie Redmayne, Kip Thorne and Lucy Hawking, respectively. Thus, this book does not want to tell something new, it is constructed to dwell in the remembrance of the icon Stephen Hawking. Radford joins and assesses the book as "a market test of what is known within the publishing world as the Hawking effect" (2018, web). The market test seems a success, as the book reached the top of the New York Bestseller list and was called "one of the best books of the year" (Amazon 2019b, web).

The level of technicality in this last work is similar to *A Brief History of Time*, *Black Holes and Baby Universes* and *The Universe in a Nutshell*. Yet, the level of sensation of publishing a book with Hawking's "final thoughts" results in a book even more popular than the three mentioned (Hawking 2018, cover).

3.2.1.7 Summary

Thus, the six popular science books examined here have all been placed somewhere on the spectrum of scientific and popular. When considering *A Brief History of Time* and *Black Holes and Baby Universes* and *The Universe in a Nutshell* and *Brief Answers to the Big Questions* these are more popular than scientific, despite the high complexity of the content. *A Brief History of Time* is, however, considered the most scientific one of these. When examining *My Brief History* and Hawking's children's literature, the scale clearly tips to the popular side. This partly explains Hawking's fame and the wide scope of audience he had. If the books had been more technical, the audience would have been narrower. However, it leaves the conclusion that the works are neither overwhelmingly popular nor scientific. Yet, they are still categorized as popular science books.

Next, movie productions about Hawking's life are examined.

<u>3.2.2 Movie Productions</u>

There have been produced a few movies about Hawking's life. These productions have great entertainment value, which means that they have been seen by many people. Thus, the movies have helped shape Hawking's image and public reputation. Hence, an account of the movies is helpful in the analysis of how the public has viewed Hawking. Cinematic science is a tricky field where the fear is that "audiences either believ[e] inaccurate information or [does not accept] accurate science" (Kirby 2008, 43). Science in cinemas is unreliable, but can promote interest in science, if not scientific literacy.

The movies presenting Hawking's early adult life, may or may not have intended to promote scientific literacy. The more likely purpose is to convey the life of an extraordinary scientist and to simply entertain people at the movie theater (Kirby 2008, 51). Thus, on the popular science spectrum, we are near the popular end - once again.

3.2.2.1 Hawking

Benedict Cumberbatch played Stephen Hawking in a BBC television drama in 2004 (Hawking.org, web). The movie portrays Stephen Hawking from his 21st birthday party in 1963 and until 1965. We follow Hawking in the despair from the diagnosis of ALS and into the feverish work on his Ph.D. thesis, which proved that the universe started from a singularity (Hawking 1965, 101). The movie displays a parallel story between Arno Penzias and Robert Wilson being interviewed about their discovery of the CMB and the Nobel Prize, and on another timescale: Hawking's career from 1963 and onwards a few years (Nobel Prize 2019, web). The link between the two stories are evident as Hawking theorizes a proof of a beginning of the universe – in contrast to the steady-state theory – and Hoyle asks why no one has found the fossils of that beginning. Thus, the two stories take place in different decades: in the 1960s and in 1978 (Nobel Prize 2019, web).

The movie was described as heartbreaking, as we see Hawking/Cumberbatch trying to fight the increasing difficulty to speak and move in a coordinated way (IMDb, web). We also witness the growing love between him and Jane. However, the love story is secondary, while Hawking's career and work on his Ph.D. is primary. Hawking's parents also appear quite a few times to enhance the emotional consequences from his physical deterioration. The level of technicality is somewhat high, as much of the science is correct and therefore increases scientific literacy. Equations are displayed too, even though Hawking and Penrose make good use of images to explain concepts. In addition, this movie is a prime example of portraying a quite accurate 'system of science', where the audience experiences both the methods of scientists, the social interaction among scientists, science communication, and cultural meanings of science. However, the movie is constructed for entertainment purposes, which leaves little way for correct science – however it is correct.

Cumberbatch played Stephen Hawking with brilliance and was nominated for a BAFTA award in 2005 in the category 'Best Actor'. The movie was also nominated for 'Best Single Drama' (BAFTA 2005, web). Cumberbatch was the first man to portray Hawking other than himself on television.

Despite award nominations, this movie hasn't resonated as much as the Hawking movie from 2014. One might argue that the large amount of physics is responsible for this. One goes to the cinema to be entertained, and perhaps the level of technicality proved slightly higher than expected. Thus, even though the level of technicality is surprisingly high in this movie, a movie production, generally, is unreliable when it comes to promoting science and scientific literacy.

3.2.2.2 The Theory of Everything

The Theory of Everything is a motion picture, directed by James Marsh, aired in 2014. The movie has the same title as a book by Hawking published in 2002. Yet, the focus of the two are completely different. Whereas the book communicates scientific ideas, the movie is a biographical portrayal of a young adult Hawking. "The Theory of Everything reveals Stephen Hawking's personal side" (Grant 2014, 28). The movie is based on the memoir by Jane Hawking: *Travelling to Infinity: My Life with Stephen* from 2007. The movie features Stephen and Jane from the time they met in college until Stephen became a Companion of Honor in 1989. These years Stephen rise to fame, while the marriage with Jane becomes increasingly complicated. The main storyline of the film is the complex relationship between Stephen and Jane and Jonathan. However, the film "impressively avoids to sensationalize the deterioration" of this intricate relationship (Grant 2014, 28). There is sympathy for every person in the three-person-marriage.

Even though the film portrays only fractions of the science Stephen Hawking has developed, the story – Stephen's story – is driven much by his scientific career. Yet, if the science was primary in *Hawking* from 2004, the story between Jane and Stephen is primary here. However, the audience does experience a few everyday illustrations of black holes and of quantum mechanics versus relativity. A pea and a potato served the last purpose. The correctness of the image gives way for the everyday appeal for a lay audience (Grant 2014, 28). Thus, the level of technicality – to use the same tools as for popular science books – is low, and gives way for the effect of entertainment and the broad audience that comes with this. This is one of the constraints of a movie production. As Kirby puts it: "Scientific accuracy will always take a backseat to storytelling" (2008, 51). Accurate science also isn't the main purpose of the movie anyway – that is left for TV documentaries.

A recurring theme of the movie is science versus religion. Jane representing one side and Stephen the other. This theme is very symptomatic of a rhetoric that has surrounded Stephen throughout time (Deltete 1993, 485). *A Brief History of Time*'s legendary last sentence "- for then we would know the mind of God" set the stage for a debate that would haunt Stephen for the rest of his life, as mentioned (Hawking 1988a, 175). Despite his openly atheist affiliations (Garrett 2018, web).

Eddie Redmayne was cast in the role of Stephen and the audience experiences the young man be diagnosed with ALS and the, sometimes rapid, deterioration of his body (Garrett 2018, web). "The motion picture biography of Stephen Hawking is a portrait of a brilliant mind defying a weakened body" (Garrett 2018, web). One might argue that Hawking embodied the stereotype of a scientist. Another chapter will return to this point.

Yet, historical events are moved and happens in the wrong order to enhance cinematic effects. By doing this, the movie does Jane a disservice (Dean 2014, web). She is not so much portrayed as in individual, but as Stephen's helper and Jonathan's lover (Dean 2014, web).

Even though some events were switched, the film also wants to set facts straight about Stephen Hawking, since misconceptions were roaming. "Very little [was] understood about [Hawking] in America or Canada" (Grant 2014, 28). Many people thought he was an American scientist, and others didn't know he had been married and had three children. As Lucy Hawking states in the afterword of Stephen's last book *Brief Answers to the Big Questions*, it wasn't commonly known that he was a family man too (Hawking 2018, 215). Thus, the movie specifies the overall facts surrounding his life, and isn't attempting to portray accurate science.

The movie earned multiple nominations. *The Theory of Everything* was nominated in six categories at the 87th Academy Award; The Oscars. The only winner was Eddie Redmayne for Best Actor in a Leading Role (Oscars 2015, web). The movie was also nominated for 10 British Academy Film Awards of which three were won; Leading Actor, Adapted Screenplay, and Outstanding British Film (BAFTA 2015, web). Additionally the movie won two awards (of four nominations) at the Golden Globes in 2015. Redmayne won 'Best Performance by an Actor in a Motion Picture - Drama' and Jóhannsson for 'Best Original Score' (goldenglobes 2015, web). Thus, the movie did a great job being a popular biographical movie.

3.2.2.3 Summary

These two movies have been seen by many people. And perhaps more people have seen one of the movies than people have read one of his books. Thus, they have largely shaped a public perception about Stephen Hawking. But the two movie productions featuring Hawking's life don't have the same intentions. *Hawking* displays Hawking's life while writing his Ph.D. and *The Theory of Everything* spans a whole 25 years, approximately. Also, science is the focal point of *Hawking* while the love story is primary in *The Theory of Everything*. Yet, any movie production, which is included in cinematic science, is defined to be fictional and entertaining (Kirby 2008, 51). Thus, movies are unreliable when it comes to promoting science. A film maker's idea of authenticity constrains the opportunity to portray accurate science. Therefore, these works are highly popular and merely based on the life of

Stephen Hawking. It is an important note, that Hawking wasn't much involved with the production of these movies. Thus, the movies are constructed from the outside to provide an image of Hawking, which is easily digestible.

Now to something similar: Hawking appearing on TV comedy shows, but first: Hawking in TV documentaries.

3.2.3 TV Documentaries and TV Comedy Shows

As a mix between popular science literature and cinematic science production, TV documentaries can be viewed as spoken popular science books with visuals. Yet, the film-maker has some of the same constraints as to budget, narrative and time as with a movie production. Therefore, the level of technicality is also helpful here in order to determine where on the spectrum of popular science the documentaries are placed.

Following TV documentaries, an account on Hawking's appearances on popular TV comedy shows are presented as well. These are all very short, but often multiple, appearances on the same shows. What all the TV shows have in common is that the narrative is the driving force of the show – but not the narrative of Stephen Hawking. Yet, without a doubt, this has increased the familiarity of Hawking to a younger and more contemporary audience. He may have appeared to sell more of his own works or to aid in selling the show to more viewers – or both.

3.2.3.1 Stephen Hawking's Universe and Into the Universe with Stephen Hawking

By 1997, Stephen Hawking was busy with a television project called: *Stephen Hawking's Universe*. The series is an astronomical documentary featuring Hawking (BBC 2018, web). The series discusses the history of astronomy, black holes, and dark matter. The program included computer models of the theories, interviews with scientists, and a commentary from Hawking himself (pbs.org, web). The television series was accompanied by a book that was available online (pbs.org, web). The book served as an index explaining difficult terminology, different models of the universe and provided biographies of several historical figures in science.

Into the Universe with Stephen Hawking is a documentary series similar to *Stephen Hawking's Universe.* Hawking gives us the ultimate guide to the universe "from the nature of the universe itself, to the chances of alien life, and the real possibility of time travel" (Hawking.org, web). The series aired on the Discovery Channel in 2010 and has three parts.

Despite the intention to portray accurate science in a documentary, the level of technicality is not high, and the lack of mathematical representation makes way for a dramatic picture that is painted of the wonders of the universe. If there was more mathematics included, the documentaries would not have the same wide audience. Furthermore, equations don't work well on TV, I presume. The technical level is also constrained by a narrative constructed to keep viewers on the channel. Therefore, the documentaries are similar to written popular science books by Hawking, which are more popular than scientific.

Many similar series have aired with approximately the same scope: *Stephen Hawking's Grand Design*, *Brave New World with Stephen Hawking*, *Master of the Universe: Stephen Hawking*, and *Hawking: A Brief History of Mine* (Hawking.org, web).

3.2.3.2 Star Trek

Stephen Hawking first appeared in a science-fiction TV series in 1993 when he appeared on *Star Trek*. As he was shooting a promotional film for *Black Holes and Baby Universes* at Paramount, an opportunity welcomed itself for Hawking to appear on an episode of *Star Trek: The Next Generation*. Hawking was an avid fan of *Star Trek* himself and asked if there was any chance the production would have him on the show. The executive producer Michael Piller suggested Hawking be in the introduction to a weekly episode. He was to play poker with Einstein, Newton and Data: an android in the series (Star Trek 2018, web). Hawking, much to his delight, had to crack a joke and win the whole game of poker (Ferguson 2011, 292-3). Hawking was thus in prominent company. It seemed this appearance would turn out to be a nice career move for Hawking.

His part on *Star Trek* brought him back into the limelight to a degree that almost exceeded the fame he had gathered from *A Brief History of Time*. He had widened his audience to now include a younger party too (Ferguson 2011, 293-4). This benefitted *Black Holes and Baby Universes* as this was published the same year. Hawking only appeared on the show once, but fans of *Star Trek* would on later episodes also hear references to a shuttlecraft called 'The Hawking'. On the series finale, in an alternate future, "Data holds the Lucasian Chair of Mathematics at Cambridge University" – also a reference to Hawking (Star Trek 2018, web).

The appearance in *Star Trek* is entirely without scientific purpose. This platform establishes Hawking as a popularizer and an entertainer, which, together with his reputation of an accomplished scientist, made him "the personification of modern science"

(Gazan 2013, 4). Thus, the appearances on popular TV shows widens his audience once more.

The appearance on *Star Trek* was the beginning of several appearances in popular culture.

3.2.3.3 The Simpsons

Stephen Hawking appeared on *The Simpsons* four times from 1999 to 2010 (simpsons.wikia 2018, web). Lucy Hawking, Stephen's daughter, knew one of the scriptwriters, who wanted to have Hawking on the show, and she convinced her father to guest star (simpsonswiki 2018, web). Hawking appears as himself in an animated version. The script was sent to him in advance and the lines were encoded into his computer. This way they were ready to send to the speech synthesizer when recording. The first episode in which he appeared, he stated a well-remembered line telling Homer that Homer's theory of a doughnut-shaped universe is interesting and that he "might have to steal it" (Ferguson 2011, 317). Hawking is also subject of a few jokes, which the character itself presents: "'I don't need anyone to talk for me, expect this voice box'. [He also] pushes the wrong button of his computer, and instead of flying away with a helicoptered wheelchair, has his teeth brushed" (Brodesco 2018, 466). The Simpsons' authors have presented several scientists on their show. And they did it "with minimal political correctness", however "it becomes perfectly respectful" (Brodesco 2018, 465-6). For instance, Hawking was introduced as "the world's smartest man" (Brodesco 2018, 466)

The Simpsons has been a cultural phenomenon since 1990 and is known to be an innovative global entertainment franchise (Fox 2018, web).

The appearance on *The Simpsons* was of the same nature as *Star Trek*, the audience widens and the fame increases. *The Simpsons* may have helped include a younger audience too.

3.2.3.4 The Big Bang Theory

Stephen Hawking appeared seven times on CBS's *The Big Bang Theory* from 2012-2017. Albeit not all times in person. Several episodes featured only his computerized voice and in another episode, Hawking appeared on Skype to sing a birthday song for Sheldon; one of the main characters (Big Bang Theory 2018, web). Yet, the show had many references to Hawking, partly since Sheldon thinks Hawking "is his only intellectual equal" (Big Bang Theory 2018, web). In short, Hawking is considered a hero of the four male main characters of the series. Bearing in mind the name of the series, it is not farfetched for Hawking to appear and continuously be mentioned by the cast of this show. The show uses accurate science, but it is not what drives the show. "It's the part that you don't need to understand" (Hooker 2012, web).

The last appearance in person was in September 2017 – 6 months before he passed (Big Bang Theory, The Proposal Proposal 2017, web).

As mentioned, TV shows like this, solidifies Hawking's celebrity status to a huge audience as *The Big Bang Theory* has had about 19 million viewers – just in the US – the last six of the recorded seasons (Statista 2018, web).

3.2.3.5 Summary

The TV documentaries differ from the TV show appearances. The documentaries have a certain level of technicality, thus they increase Hawking's public scientific reputation. The TV shows don't have much to do with science. Yet, they have the potential for increasing Hawking's popularity too. More specifically, increasing Hawking's general reputation as an entertainer. In these settings, Hawking is perceived as a cultural commodity, which can be used to sell other cultural products. More on this later. Thus, both TV documentaries and TV comedy shows attributed to Hawking's status in the public eye – but in different ways.

<u>3.2.4 Summary</u>

Popular science can do many things. It can broaden the interest in science to include people who wasn't initially interested and it can increase scientific literacy on a societal level. What is interesting in such an interdisciplinary field is to determine what is scientific and what is popular. Cinematic science is part of popular science, and has great entertainment value but is unreliable when promoting science.

Nonetheless, one can determine the technical level of the different popular science works by use of narrative techniques or the absence of these. The appearances and works may be ranked from popular to scientific in this manner: *Star Trek, The Simpsons* and *The Big Bang Theory* as the most popular entertainment fora where science plays practically no role. Next comes the movies *Hawking* and *The Theory of Everything*, which – despite the nature of a movie production – has some factual information that serve to clear up matter surrounding Hawking's persona. Yet, the movies are unreliable when it comes to portraying accurate science. The genre of the children's literature that Hawking co-wrote with his daughter is slightly different from popular science, and maybe stands outside the spectrum presented here. TV documentaries are slightly more scientifically inclined and next comes Hawking's popular science books, which are more scientific than the other events and productions mentioned here. Yet, Hawking's autobiography *My Brief History* is the most popular of his books. The other books include: *Brief Answers to the Big Questions, The Universe in A Nutshell, Black Holes and Baby Universes* and *A Brief History of Time* (from scientific to popular, approximately). In fact, all the popular science books investigated here are more popular than scientific in the overall spectrum of popular science works. However, none of them have an overall narrative to drive the book – except the autobiography. Thus, the works aren't fully science books that are popular. As Jenkins puts it: it is not the language, but the content, which is challenging (1992, 529). In short: the content of the works overshadows most of the literary techniques. This leave the works as neither particularly *popular* science books nor popular *science* books. However, the works may still be placed on a spectrum between popular writing and scientific textbook. In addition, there are other popular books by Hawking, which are not examined here, yet, these are assumed to portray similar levels of technicality. Despite of Hawking's popular science books being a mix of popular and scientific writings, the works have contributed to the public perception of Hawking, since the sales have been overwhelmingly successful (for some books).

To view Hawking's career in the public sphere, there are other fora from which the perception of Hawking has also been influenced. Therefore, cases of gossip and rumors in tabloid papers are touched upon below. Tabloid papers are easy access and read without difficulties. Thus, such stories of Hawking had a wide audience – including people who don't know Hawking from other arenas. Therefore, a few rumors of scandals are included here before we move to a chapter that discusses the factors and circumstances leading to Hawking's celebrity status and the consequences he experienced from this.

3.3 Rumors and the Paralympics

To take a step outside popular science, there have also been other press events that have shaped the view of Stephen Hawking. Since Hawking had proved to be much more than a cosmologist and an actual celebrity scientist, the media was interested in much more than his career and professional work (Fahy 2015, 26). Hawking biographies were written in the 1990s, where his private life was also an object of the press – much in accordance with the norms and values of the journalist (Dudo 2015, 762). A celebrity scientist is "required to share not only their achievements but their families, their idiosyncrasies, their past sins, their favorite foods" – even if they don't want to (Goodell 1977, 7). Some tabloid magazines engaged in the hunt for details of Hawking's private life.

Therefore, to present the Stephen Hawking that the public has known, there is more to view here than scientific contributions, popular science books and movies. The following will concentrate on Hawking's private life or speculations about his private life – seen from the press. Also, a particularly big event is included here.

3.3.1 Separation and New Marriage

The marriage between Jane and Stephen was widely admired and they were considered the perfect couple (Larsen 2005, 87). Hawking had on several occasions spoken of Jane in the most heartwarming manner. He described their relationship as the "mainstay of his life and his success" (Ferguson 2011, 273). Only later, in one of Jane Hawking's books, it became known that the two had led separate lives (J. Hawking 2007, 355). The hard practical house work Jane had taken on while Stephen's body deteriorated wasn't mentioned until years later. She felt that he was "stretching [her] to the limit of [her] endurance" (J. Hawking 2007, 260). For many years, Stephen wouldn't hear of getting external help around the house. This took its toll on Jane. Before Jonathan came into the picture, Jane had the sense that she was sharing Stephen with another woman: "the goddess of Physics, who deprived children of their fathers and wives of their husbands. After all, [she] remembered that Mrs. Einstein had cited Physics as the third party in her divorce proceedings" (J. Hawking 2007, 196).

Later, ironically, Jane fell in love with Jonathan and Stephen with Elaine, who were both assistants and friends of the house (J. Hawking 1999, 361). In 1990, Jane and Stephen split up after 25 years of marriage. The divorce was not final until 1995. The media attention bordered on paparazzi by this time and Jane felt like they were being hunted (Larsen 2005, 87). Yet, they kept their secrets very well. Only Stephen sent a brief mention to the press that he was leaving Jane. Otherwise, none of them spoke to the press (Ferguson 2011, 274).

The break-up had practically no impact on Hawking's status as iconic, as might have been expected (Larsen 2005, 88).

3.3.2 Questions of Physical Abuse

By the turn of the millennium, the media displayed rumors that Hawking was suffering from physical abuse from his second wife, Elaine, who allegedly was mistreating him (Gysin, web). Journalists reported that Hawking's children were very concerned about their father's wellbeing living with Elaine (Fahy 2015, 32-3). Even though the rumors came from tabloid newspapers, the Cambridge police wanted to start an investigation. But Hawking refused to take any part in it, and let it be known to the police and everyone interested that he wanted no interference in his or his wife's life. The police went on with investigations and interviewed colleagues, staff and family for five years before dropping the case in 2004 (Ferguson 2011, 327). Thus, throughout his life, Hawking was a very private person and only allowed the media to come this close.

3.3.3 Paralympic Games

In 2012, Hawking opened the Paralympic Games in London (Hawking 2018, 19). The estimates indicate that more than 11 million viewers watched the opening of the Paralympic Games (Plunkett 2012, web). The Paralympic Movement wanted to "find the most famous disabled person alive in the world at this present moment, which [was] Professor Stephen Hawking" (paralympic.org, web). Hawking told the crowd to "look at the stars, not at your feet" and to be curious about the world in the cosmologically themed opening (paralympic.org, web, Fahy 2015, 38). The 11 million viewers worldwide have without a doubt only widened the perception of Hawking to an even broader and multicultural audience. Many disabled people had already seen Hawking as a role model prior to 2012, but this manifested Hawking as a role model for the disabled beyond the disabled (Ferguson 2011, 247).

3.3.4 Summary

Gossip about Hawking's private life is one of the results from being a celebrity scientist. The gossip was mostly about his marital status and the circumstances in his love life. The gossip and rumors may form the perception of the person in subject and the rumors can be very strong (Tiger 2015, 340). Thus, the speculative rumors of Hawking's private life both increases his celebrity status, as well as they are a result from it. This may be much of the down side of being a celebrity, since these are factors wholly out of the hands of the celebrity himself. Yet, magazines want to sell units. And from the above, what sells is actuality, significance, identification, sensation and conflict. Thus, the news is formed in order to meet these demands (Tiger 2015, 344).

3.4 Summary

In the process towards celebrity, certain traits of the scientist must be met and he has to go through some specific processes. These processes and characteristics are more dependent on how the scientist acts in a public setting than in the scientific community. Therefore, it has been useful to look at what contributions Hawking has made to the public mass-market. Thus, this chapter has examined the Stephen Hawking a general audience knows and remembers. This perception is largely formed by popular books, movies, TV documentaries and appearances on TV shows. But first, Hawking's public career was put in context with the popular science boom, which happened around the time he wrote and published the popular science book: *A Brief History of Time.* The genre of popular science can widen interest in science, and increase general scientific literacy, yet, it is an interdisciplinary field, which can result in confusion about what is popular and what is scientific.

Thus, using tools from the literature, it was possible to analyze the technical level of the works. Therefore, Hawking's appearances and works were ranked from popular to scientific on a spectrum. The most popular appearances were on *Star Trek, The Simpsons* and *The Big Bang Theory.* Next came the movies, then children's literature and TV documentaries. At the other end, the most scientific popular science works were placed. These were *Brief Answers to the Big Questions, Black Holes and Baby Universes, The Universe in A Nutshell,* and *A Brief History of Time.* These works were placed somewhat on the same position on the spectrum. In fact, all the popular science books analyzed here were more popular than scientific. Yet, none of them have an overall narrative to drive the book. In other words: the popular books examined here were neither particularly *popular* science books nor popular *science* books. This may seem problematic, but it merely illustrates the intersection between two disciplines that are wholly different: science and popular writing. Yet, the lack of clear categorization hasn't stopped people from buying and reading such works, evidently.

The last subsection displayed some of the very last results from a full process of celebrification. It seems the celebrity will experience less and less control with the process of celebrification as the process proceeds. Gossip and rumors about Hawking's private life started to roam in the 1990s. These rumors may also contribute to his image, yet, none of them have been damaging in any significant way. Speaking of such a process of celebrification, this is exactly what scholars argue that a person goes through as he becomes a celebrity. Yet, there needs to be some traits present in the scientist in order to be a potential celebrity. A visible scientist is well on the way to become a celebrity and the traits of the visible scientist are manifold, as the following will show and apply to the case of Stephen Hawking. However, none of the literature considers the very initial trait, which must be present when someone becomes visible: the wish to do so. Since the visible scientist is the predecessor to the celebrity scientist, the visible scientist has a higher degree of control with the process at this early stage. The degree of control decreases as the process moves on. The media gains control on the contrary.

The following chapter will assume Hawking did wish to become visible, which is much the onset of the development towards becoming a celebrity scientist. What follows will elaborate on this.

4. Stephen Hawking as a Celebrity Scientist

As the previous chapter showed: Stephen Hawking published a great number of popular science books. He was featured in two movie productions and appeared in several TV comedy shows. Hawking's celebrity status allowed him to do these things, and they contributed to the increasing celebrity status in return. Yet, the mechanisms that drive a celebrity status are complex. It seems one first becomes a credible scientist, then a visible scientist and since a celebrity scientist. The following will outline the processes in more detail. Thus, this chapter examines the backgrounds for Hawking to be termed "the most famous scientist of the modern era" (Fahy 2015, 20). And: a "world-famous physicist and cultural icon […] ambassador for science […] role model […] a myth" (Larsen 2005, 129). In obituaries, Hawking is also termed "perhaps the only true celebrity scientist" and "the best known physicist of his time" (Durrani 2018, 7, Barr 2018, web).

Evidently, Stephen Hawking was a true celebrity scientist. To understand why, it is advantageous to investigate what characterizes a celebrity scientist and which processes drive the celebrity status. Goodell identified traits of, what she called, the visible scientist in 1977. She wrote her dissertation on the "scientists who are visible to the general public today" (1977, 4). The scientists had become visible primarily because of activities that influenced people and policy makers. Her book was criticized, but has had a lasting impact (Fahy 2017, 1021). Thus, the theory is still relevant. Fahy examines aspects of the visible scientist too. He concentrates on *how* the scientist becomes visible, while Goodell investigates *why*. Fahy terms his visible scientist a public intellectual. But the two terms are similar. Goodell's five traits make a scientist more likely to be picked by the media and molded into a celebrity. Thus, Goodell recognizes the power of the media – as does Fahy: "the media had become a center of public life with enormous power" (2015, 2).

For most adults and adolescences, the media is where they get most of their ideas and information about science and science related issues. The media shape public opinions, convey ideas about how the world works, how the world should be experienced and what issues matter for citizens. In addition, the media focuses overwhelmingly on individuals, wherefore fame is the most powerful tool in our complex world (Fahy 2015, 2-3). The concept, fame, can be viewed in different ways. Some more negative and some positive. Despite all, the celebrities have power, because they represent ideas, issues, ideologies and because they personify these concepts. Celebrities can initiate social movements and help people make sense of the world (Fahy 2015, 7). Celebrity scientists can motivate others to engage in the scientific world and some argue that they have a responsibility to promote scientific literacy and fight scientific nonsense (Krauss 2015, 27).

This chapter starts off with Goodell's traits of the visible scientist. The visible scientist is the precursor of the celebrity scientist. But not all visible scientists will evolve into a celebrity. Fahy presents aspects of the visible scientist – or the public intellectual – too. Next, Stephen Hawking and his career will be analyzed with just these traits in mind. True to chronology, then the chapter moves to celebrity scientists and the processes that drive the so-called celebrification. The tools from this will also be applied to the case of Stephen Hawking. And because the scientific community reacted to Hawking's celebrification, his life after becoming a celebrity is examined too. Lastly, these reactions are discussed as symptoms of the difference and tensions between ordinary scientists and celebrity scientists.

4.1 The Visible Scientist and Public intellectual

Goodell's traits of the visible scientists were published in 1977. Yet, as we shall see, they are still much relevant today and can be applied nicely to Hawking, as he evolved into a visible scientist and next a celebrity scientist. A related development into a public intellectual is also analyzed. The scientific public intellectual and the visible scientist are considered similar.

4.1.1 Goodell's Visible Scientist

Rae Goodell made her observations in the 1970s. But what did the scientific community and science communication look like at this time?

Initiated by postmodernism and the subjective truth, science was troubled in the late 20th century. Outbreaks of salmonella, mad cow disease and meltdowns of nuclear power plants in the West made the public confused and skeptical of science (Fahy 2015, 9-10). No understanding for science meant no public support for scientists and science policy. Thus, the scientific community understood that it needed to be more proactive in the public arena. What was needed was to increase scientific literacy, whereby citizens could make informed decisions based on solid evidence. Scientists "correctly viewed the media as the key to potentially enhancing the public's scientific literacy" (Fahy 2015, 11). Yet, scientific literacy is complex. It is more than knowing facts, it also entails knowing the methods of science, how it works and how it really works. In addition, and this is the deepest level of scientific literacy, it is the knowledge that science is conducted by scientists, who are driven by the same pressures and desires as other humans are. Hence, in order to increase scientific literacy, scientists needed to communicate real science to the public (Fahy 2015, 9-12). This is in part what explains the popular science boom of the 1970s, as discussed in an earlier chapter.

However, it wasn't easy for just any scientist to address the public. It needed to be done in a personified, engaging, interesting, and right way, since this is what the users of the media want. This, the visible scientists possessed the exact qualities to do. Also, some scientists took this more serious than others. Only some addressed the public, others did not.

In the 1970s, Goodell observed some scientists becoming visible and she identified these with an 'after' scientist. The 'before' scientist is the stereotype: a pale man in a laboratory coat uncomfortable standing in the spotlight. The stereotype announces his scientific results in muddy, technical terms standing in front of newspaper journalists. He would rather be alone is his laboratory or in his mind, where he can continue to pursue his life's work. Yet, the stereotype is not the scientist we see in the media today, or even in 1977. Nevertheless, the stereotype is not at all dead. I will return to this point. Goodell portrays the 'after' scientists – the ones who are visible in the general public and continuously influence policy makers on science related subjects (Goodell 1977, 4). Changes in the communication arena and changes in science and technology brought about changes in science communication and thus in the kind of scientist who gets communicated (Goodell 1977, 6). In short, the visible scientists are the ones who have adjusted to the changes, which haven't been undramatic. The democratization of science communication has left traditional scientists uneasy. In order to follow the change, the new visible scientists had to break old rules of protocol and rules of ethics and conduct (Goodell 1977, 9). As a result from this, the visible scientists may have success in the public sphere – but close to the opposite in their scientific field. This may deal with the quantity and not quality of their scientific research (Goodell 1977, 101). There is a "feeling that pervades the scientific community that the press is no place for a self-respecting scientist" (Goodell 1977, 120). This tension is interesting, and I will return to it.

To explore the nature of these visible scientists, we start with the first trait: 'a credible reputation', which is Goodell's fifth trait. Yet, this trait is the first thing that needs to be established before the scientist can move on to potentially become a visible scientist. Otherwise, the visibility is not based on any professional abilities. Such a person would be famous for being famous. Thus, the first trait is that the visible scientist has a 'credible reputation'. To become visible, the press needs to expose the scientist. In a world where the press receives uncountable suggestions for stories, "reporters and editors must weigh in a number of factors, including the credibility of the scientist in the story" (Goodell 1977, 35-6). If the scientist is unknown in the field, the story is much too likely to be fake or tampered with. Therefore, the journalists are unlike to publish the story by this scientist. "For this reason, it is not surprising that most visible scientists were visible within their own fields before they became known to the public" (Goodell 1977, 36). Hence, it is mostly older scientists that are visible, because they had time to establish a credible reputation in their own fields before they became publically visible. As Fahy points to: once their scientific reputation is set, they can – if they want to – become visible scientists. If they do, then their overall reputation is formed both within and outside science. This furthermore challenges the established norms of science cf. Merton (Fahy 2015, 6). Thus, this adds to the tension between the visible scientists and the scientific community. Krauss even argues that public recognition is unaffected by scientific accomplishments and depends more on personality traits and the ability to communicate (2015, 27). Goodell does not disagree, but includes a credible reputation as one of the traits of the visible scientist. Krauss' point may explain what factors affect the reputation of an already established visible scientist. Yet, to become visible, the reputation in the person's own field needs to the credible.

The second trait in a visible scientist is that he has a 'colorful image'. The visible scientist "possesses certain striking characteristics which the press gradually molds into an image" (Goodell 1977, 32). The characteristics could be appearance, past, vigor and/or personality. Visible scientists are often strong, assertive personalities with large egos. They are so trained in telling the same story that they have "a number of skits, little routines [they] tell[] every time, even with the same inflection" (Goodell 1977, 33). In other words: some anecdotes are used repeatedly, and these come to be synonymous with the visible scientist in question.

Goodell's third trait is 'relevance'. The visible scientist should be associated with a 'hot topic' (Goodell 1977, 19). A hot topic is determined by media fads that are particularly popular in the mind of the public at a certain time. Thus, scientists from a field of interest are more likely to become visible scientists. Yet, this visibility may not last long. Science topics move in and out of vogue and the visible scientist that stays in the spotlight moves with the fads from issue to issue. Physics had long been the glamor field until the 1970s, but it moved to exobiology and the study of extraterrestrial life by the mid 70s (Goodell 1977, 20). This put astronomers in just the right place between old and new prestige fields.

The relevance trait also entails 'humanness' (Goodell 1977, 20). A scientists' humanness may be seen in various ways. A love story aided Jane Goodall in her popularity. Goodall lived more than twelve years in Africa observing chimpanzees day in and day out. Then National Geographic sent a photographer to film her work, and they fell in love. The romance in her story certainly made her more relevant for the ordinary reader. Yet, her sex – more than anything – may explain her popularity. This was the ultimate female liberation: living alone in the wild, coping with a child, malaria and cobras while building a successful scientific career. "A man in her position would probably be ignored" (Goodell 1977, 20-22). Thus, this was an example of humanness, as a hot topic, helping a scientist become visible. The use of anecdotes is another way to express humanness. Other hot topics could be: sex, religion, population, environment, and energy (Goodell 1977, 19, 22).

The fourth trait is 'articulateness'. Most scientists speak esoteric – in a manner that is only understood in their field. But "visible scientists have mastered the art of the exoteric" (Goodell 1977, 30). Thus, visible scientists speak in a way that everybody can understand. They are concise, speak clearly and vividly. They spice up their talks with well-placed analogies and metaphors, which leaves a lasting image. Visible scientists can put their science in perspective (Goodell 1977, 30).

The fifth trait of the visible scientists is 'controversy'. Media and journalists emphasize drama and conflict. Thus, in science news controversy sells. It is intuitive to present opposing opinions and it is easy to remember. "Controversy is always in" even if science, as a topic, is out (Goodell 1977, 23). The visible scientists are the ones who are willing to take dramatic stands on issues, they are maverick, they provoke and advocate change in science by proposing new concepts. In general, "controversies abound among visible scientists" (Goodell 1997, 25).

All in all, the characteristics of the visible scientists are the same characteristics for visibility in any endeavor. The traits also include: intelligence, organizational ability, ambition, energy, creativity, and aggressiveness. But Goodell's five characteristics are based on the needs of the press. Thereby, the media in many ways control who the visible scientists are – and "whose message gets to the public, across the complex channels of modern communication" (Goodell 1977, 38). And again, the needs of the press are determined from sales. There are five key words that describe these needs, as mentioned. Those are actuality, conflict, significance, identification, and sensation (AiU 2018, web). Actuality and significance correspond to relevance, while conflict is the same as controversy. Sensation and identification are a mix of articulateness and a colorful image. Thus, the needs of the press approximately match the characteristics of the visible scientist. The only trait that stands out is that the visible scientist has a credible reputation. Yet, this is the professional validation, that may lead to someone becoming an expert, in addition to someone who thrives in the media. This increases sales. Hence the wider audience, the more sales or 'clicks', and the more power the press receives. Goodell's traits were formulated in 1977, but the factors which turn a scientist into a visible scientist are largely the same still.

4.1.2 The Public Intellectual

Fahy examines another aspect of the visible scientist. He investigates the process by which a scientist becomes, what he calls, a public intellectual. The equating of a public intellectual and the visible scientist is particularly evident when Fahy describes the public intellectual as "someone who visibly represents a standpoint of some kind" – in other words: someone who is visible (2015, 13). The scientist who appear in the public sphere becomes a public intellectual if four steps are followed:

> one: he has become an expert in his own field. This is the basis of the following, as with Goodell's traits.
> Two: the scientist speaks in media about cases outside their field of expertise.
> Three: he makes statements about topics that concern a broad audience.
> Four: he gets a reputation for voicing these views in an interesting fashion through broad-access media. He becomes a spokesperson for a cause, a movement or a position (Fahy 2015, 12-3).

This four-step dynamic does not exclude Goodell's five traits. These steps are limited to deal with how a scientist operates in, first a scientific field, then the media – and in what order. Goodell examined the *why* in contrast to the *how*. Thus, it seems the public intellectual is much like the visible scientist. Someone who works within a broad public culture (Fahy 2015, 12). Since public intellectuals can form out of every possible field, this thesis limits itself to deal with the scientific public intellectuals.

The following will analyze Hawking's career using Goodell's five traits and the process of becoming a public intellectual.

4.2 Stephen Hawking as a Visible Scientist and a Scientific Public Intellectual

Hawking defended his Ph. D. dissertation in 1965 and was already on the path towards a credible scientific reputation. Yet, the thing is: fame is not just the result of great achievements. "The world must hear about the achievements" (Fahy 2015, 2). Thus, as established, Hawking was more than a great scientist. The fame he received is the result from telling the world, fitting the mold of a stereotypical scientist and passing thought the celebrity eye of the press. This chapter elaborates on the factors besides the scientific ones. First, Goodell's five traits are applied to Hawking's life and career. Later, processes of becoming a public intellectual are examined.

4.2.1 First Trait: A Credible Reputation

A credible reputation needs to be established before there is even a chance of becoming a visible scientist. The credible reputation as a scientist is necessary for the press to consider running the stories connected to the particular scientist. Already in the 1970s, Hawking was the guy to talk to about black holes (Ferguson 2011, 146). He was an international celebrity in his own field (Ferguson 2011, 146). Put in popular terms: his scientific celebrity status was largely attributed to how he used general relativity and quantum theory to deduce was has become known as Hawking radiation (Hawking 1975, 199). At first, the scientific community was reluctant to accept this new phenomenon. But it didn't take long to be recognized as a key feature in cosmology. This discovery admitted him to the Royal Society at just age 32. The Royal Society was the most prestigious scientific society in Britain. Thus, his "professional status was already sealed" in the mid 1970s (Fahy 2015, 21). Hawking had done more than discover a new type of radiation, he had opened the eyes of the established scientists to connections between relativity, thermodynamics and quantum mechanics. This was a new way to view the world.

Hawking's scientific endeavors consisted of more than discovering Hawking radiation, as is evident from a former chapter. Other contributions to cosmology included the second law of black hole dynamics, the information paradox, the 'no-boundary' proposal, wormholes, time travel, and baby universes. However, it was Hawking radiation, in particular, which established his credible scientific reputation.

Later in the same decade, Hawking was appointed the Lucasian Chair of Mathematics at Cambridge in 1979 (Hawking 2013, 84, Kragh 2011, 296). This position is considered one of the most prestigious academic posts in the world (Alleyne 2009, web). Thus, Hawking's credible reputation was firmly established on more than one occasion in his early career. As Hawking started to appear in the public eye, he continued to do scientific work. Many of the other contributions were proposed in the 1980s and later.

4.2.2 Second Trait: A Colorful Image

The second trait of the visible scientist is a 'colorful image'. The image, or the public perception, of Hawking was largely formed via the contributions he made on the public scene. As mentioned in the former chapter, these contributions were manifold. There were popular science books, TV appearances, movies among other things. The image both resulted from the increasing celebrity status and contributed to it.

The public appearances started early on; Hawking appeared in a small BBC documentary called *The Key to the Universe* in 1977, because he was considered an expert in the field. Shortly after, the media "saw Hawking as more than just an expert source" (Fahy 2015, 22). Many magazines profiled Hawking between 1978 and 1984. Several famous magazines like *Time* and *Vanity Fair* ran features of Hawking displaying him as the perfect symbol of the strange, new physics, which was cosmology. He was portrayed as being separate from his body – a brain with a no earthly body. These profiles found Hawking to be a good visualization of cosmology's mystical dimensions. "These portrayals were crucial for the establishment of Hawking's image" (Fahy 2015, 22). Thereby, already in the 1970s and 80s, the media founded the basis for Hawking's image. Many of the descriptions molded him to fit the stereotype of a scientist. In some ways, he was the ultimate personification of a man wholly devoted to his science, without any earthly desires or needs. In addition: Hawking was of the 'right' gender to fit the stereotype too. The fact that Hawking was "a brilliant mind trapped in a paralyzed body" seemed to convey a sense of him being overly "cerebral" (Gazan 2013, 4, Fahy 2015, 22). Thus, a stereotype scientist, who was on the border of the 'before' and 'after' scientist in Goodell's terms. Hawking was portrayed as a man, who would rather than anything else be inside his mind to continue his life's work. Yet, he was not a scientist uncomfortable in the spotlight. He was witty, reflective, engaging and just what most people want to see or read about, when they turn on the TV. This way, Hawking perfectly personified the merge of the 'before' and 'after' scientist. This was part of his 'colorful image', as Goodell identifies as a trait of the visible scientist.

Other parts of his image included his appearance, which was distinctive from most people – scientist or not. ALS put Hawking in a wheelchair, which had turned electrical in 1974 (Ferguson 2011, 144). The wheelchair made Hawking easily recognizable, since it would still give him away even if he was wearing a wig and dark glasses (Hawking 2018, 19). Thus, Hawking's wheelchair has been an embedded feature in the construction of his image. Larsen even argues that Hawking was a role model for the disabled, since the illness, in no ways, stopped him from pursuing his love for science (2005, 129).

Goodell also mentions that visible scientists are so trained in telling their story that they have a handful of skits, which they tell over and over again. Hawking's story is filled with anecdotes that he used several times. As pointed out in a previous chapter, his popular science books are good places to search. Hawking often mentioned the eureka moment of realizing the second law of black hole dynamics. The story includes the birth of his daughter and the fact that he was getting into bed, as he grasped this. His disability made getting into bed a slow process, which allowed him to think of other things simultaneously. The story has been mentioned in *A Brief History of Time, My Brief History, Brief Answers to the Big Questions* (Hawking 1988a, 99, Hawking 2013, 69, Hawking 2018, 13, respectively). Biographies of Hawking also grab this moment and use it for their narrative. Ferguson uses the anecdote (2011, 113). As does White and Gribbin, and Larsen (1992, 141, 2005, 34). This anecdote is thus very special. What is interesting about this anecdote is the merger of a private life, a professional life and his disability. The birth of Lucy represents the first, black hole dynamics the second and the slow process of getting into bed the last. This may explain why this anecdote has survived 45 years. This anecdote is merely one in a series of skits, Hawking continuously used. In the nature of his speech synthesizer, the story always had the same inflection, which Goodell also argues is characteristic (1977, 33). In fact, the computerized voice became much his trademark (Hawking 2013, 87).

Other anecdotes and skits are, for instance; Hawking was born in the same day Galileo died, but 300 years after, which was also frequently used (White and Gribbin 1992, 5, Hawking 2018, 5, Larsen 2005, 1, Ferguson 2011, 42, Hawking 2013, 6). Hawking also mentions his time at Oxford as a time and place where "the attitude was very 'anti-work'" (Hawking 2013, 33). It was supposed to be easy to study. Hawking was not very proud of this attitude (Hawking 2013, 33, Hawking 2018, 7, Ferguson 2011, 55). He also frequently points to his arrival at Cambridge, where he had hoped to work with Hoyle, who was in favor of the steady-state theory. Yet, Hawking thinks it was probably for the best. He wouldn't have had much of Hoyle's attention, and Sciama "stimulated him to develop his own picture" (Hawking 2013, 41, Hawking 2018, 9, White and Gribbin 1992, 58). The diagnosis of ALS and the tracheotomy, almost with the same wording, also deserves some room in many of Hawking's texts and in his biographies (Hawking 2013, 47, 85, Hawking 2018, 10-11, 17, White and Gribbin 1992, 60, 233, Ferguson 2011, 67, 227). Thus, there are many anecdotes about Hawking, and this is merely a selection. Hawking made use of these anecdotes to help maintain his image. Yet, his own version of his image isn't fully compatible with the media's version of him as a mind without a body. His own anecdotes serve to illustrate that he was more than a scientist. He was a father, a disabled man and a scientist who, at first, didn't understand that is takes hard work to be one of the best. Yet, these skits don't survive the turmoil of the press, and the lasting image is the brilliant scientist in the paralyzed body, which is what many people know Hawking to have been.

That image is evident despite the fact that the media did try addressing Hawking's life as a father, a husband and a disabled man. Articles examined his domestic life. The press observed the bond between Hawking and his children and found it strong. Other articles described how Hawking needed help to eat, dress, write and go to the bathroom (Fahy 2015, 23). Yet, Hawking wouldn't engage much in journalists' questions about his private life. He wanted to decide himself what, how much, and when something was revealed. But with time, Hawking lost control gradually with what and how he was portrayed – and thus how his image formed.

The scientific community had a fear when all this was happening. A fear of Hawking becoming "Hawking sans physics" (Fahy 2015, 23). A scientist without anything scientific to say. Some argued that Hawking could easily have been swept up by the media and left science behind. Yet, as Hawking soaked up media attention, his scientific career progressed. In 1979, Hawking took the Lucasian Chair of Mathematics at Cambridge. As he points out himself, this position was once held by Sir Isaac Newton and later Paul Dirac (Hawking 1988a, 68).

Hence, Hawking's image was largely formed by his appearance, his voice, his anecdotes and the tale of the paralyzed man with a brilliant mind.

4.2.3 Third Trait: Relevance

Goodell's traits of the visible scientist also include 'relevance'. The scientist needs to be connected to a 'hot topic'. Cosmology was in style in the early 1980s. It had moved from not being a field in its own, to a prominent area within physics and astronomy (Kragh 1996, 219). Observations that proved or disproved ruling theories, made cosmology a mathematical science in the 1970s. Thus, it was a very young field. As mentioned, physics had long been in vogue, yet the fad had moved to extraterrestrial sciences in the 1980s, which may have put astronomy and cosmology in a favorable position connecting the new and the old fashion (Goodell 1977, 20). Cosmology and black holes were the mysterious new phenomena.

The trait of relevance also entails a degree of humanness. Hawking's multiple anecdotes testify to an attempt of a personification which exceeds the role of the scientist. Being a disabled person, a father and a husband is as human as it gets.

Another 'hot topic', which Hawking returned to time and time again was questions of religious content. As mentioned, the popular science book: *A Brief History of Time* ended with the words: "If we find the answer to that [why the universe exists], it would be the ultimate triumph of human reason – for then we would know the mind of God" (Hawking 1988a, 175). The press diligently used this sentence for promotion and all Hawking's comments about God or religion was always magnified in the media. Hawking himself was an atheist, but knew that God was on the minds of most people (Hawking 2018, 25). He considered cutting this last sentence, but believes if he had done so, "the sales might have been halved" (Hawking 2013, 98). Later works display similar comments: "the universe [is] not created by God" (Fahy 2015, 35). Both the *Guardian, Telegraph* and *New York Times* greeted Hawking's announcement "as though it were 'the final judgement of science on the Biblical creation: Hawking Has Spoken'" (quote in Fahy 2015, 35). These statements were created to attract publicity, critics argued. They thought Hawking used them intentionally as "attention-grabbing headlines" like the sales-man he was (Fahy 2015, 35). Yet, many reviewers found it dull, as the statement was the same every time – merely put in different words. Philosophers and theologians were troubled that readers would attach too much weight to such views. However, the Godmongering worked: most of Hawking's popular science books reached the bestseller lists – some for several years (Fahy 2015, 36). Thus, this hot topic was really hot. This is also an example of scholars willing to criticize Hawking in the open, not many wanted to do just that. Similar examples are given further below.

Goodell's definition of a visible scientist entails being a scientist involved with scientific policies and politics in general (1977, 4). There are examples of Hawking expressing his opinion on purely political issues, which can be categorized as 'hot topics'. Hawking continuously made his opinion known in the Israeli-Palestinian conflict. He accepted the Wolf Prize in 1988, which is given in Israel, but only if he could meet and spend time with Palestinians too (Ferguson 2011, 371). In 2013, Hawking voiced an opinion in the conflict again. He refused to participate in a Presidential Conference in Israel because Palestinians asked him to respect an academic boycott of Israel (Sherwood et al. 2013, web). Abunimah argued that Hawking's decision may be seen as a turning point in the future, "when boycotting Israel as a stance for justice went mainstream" (2013, web).

Hawking presented opinions on other political issues like climate change and artificial intelligence (Alstrup 2018, web). Thus, Hawking moved with the fads as he voiced an opinion on different 'hot topics'.

4.2.4 Fourth Trait: Articulateness

Another of Goodell's traits of the visible scientist is 'articulateness'. Hawking was a special case in terms of verbal articulateness. Both Larsen and Ferguson describe how witty and humorous Hawking was. "Hawking's sense of humour [was] contagious and likely to break out at any moment" (Ferguson 2011, 232). Hawking's "wry sense of humor" was displayed in both his books and in public lectures (Larsen 2005, 97). Leddy comments on Hawking's sense of humor too (2013, web). As an example: in *Brief Answers to the Big Questions* Hawking (again) explained he was born of the same day Galileo died, only 300 years later. He added: "However, I estimate that about 200,000 other babies were also born that day; I don't know whether any of them were later interested in astronomy" (Hawking 2018, 5). Fahy describes him as a charismatic and witty figure too (2015, 27). The computerized speech is worth mentioning here again. Hawking's speech was very slurred by the mid 1980s. Only people who knew him could understand him (Hawking 2013, 85). Pneumonia and a following tracheotomy turned out to be a blessing in disguise. He was offered a computer program, which allowed him to select words on a screen and send them to a speech synthesizer. The program brought back Hawking's ability to communicate. Yet, the synthesizer didn't vary the intonation from time to time. This way, the stories and anecdotes inherently always had the same inflection. The computerized voice came to be one of Hawking's trademarks (Hawking 2013, 87). Thus, as mentioned, also part of his image.

His ability to write in an interesting manner, certainly qualifies as being articulate too. In order to sell so many book, Hawking's style of writing has to be favorable in some way. As mentioned, Jenkins argues that a chapter of *A Brief History of Time*, which is an indication of his writing in general, is written in a simple language when considering text structure, linearity and cohesion, nominal group structure, lexical density, and the use of passives and negatives (1992, 529-30). Jenkins further argues that the content must be the reason for some people not completing his works. Thus, Hawking writes popular science books in a clear and simple language. One may also call this style exoteric, which is a writing style that a general audience will understand and not just peers in the same scientific field. Hawking has certainly mastered the arts of speaking exoteric, as it is one of the traits of the visible scientist.

4.2.5 Fifth Trait: Controversy

The last of Goodell's traits of the visible scientist is 'controversy'. As mentioned, controversy sells. This trait is also evident in Hawking's way to celebrity. One of the major controversies surrounding Hawking is the information paradox. Hawking believed that if a black hole evaporated due to Hawking radiation, then all information about the black hole would be lost (Polchinski 2003, 304). Yet, this violates the basic assumption that energy is conserved in a closed system (Young and Freedman 2012, 176). The scientific community was very skeptical of this violation. But Hawking stood his ground for several years until 2004, where he admitted in a public lecture to have been wrong about information being lost (Larsen 2005, 124, Fahy 2015, 33). Until that point, Susskind had led, what he calls, a war on black holes, which he considered a battle between himself and Hawking (2008). Bekenstein, a young scholar, initiated this battle, by questioning the analogy between thermodynamics and black hole dynamics. This Bekenstein believed was much more than an analogy (Hawking 1976, 192). Evidently Susskind conducted most of the warfare on black holes, yet, Hawking did engage in the battle and actually thought Susskind was the only one, who understood the full implications of his theories (Ferguson 2011, 169, Susskind 2008, 210).

A popular science book from 1996 called *The Nature of Space and Time* was written by Hawking and Penrose. The book displays a controversy similar to the one Einstein and Bohr had in the early 20th century. Penrose assumed the same position Einstein held and Hawking the one Bohr and the Copenhagen School represented. Thus, a whole popular science book, which is highly technical however, was devoted to the controversy between general relativity and quantum field theory (Hawking and Penrose 1996, vii). The debate was - and is - difficult to settle.

Hawking also had a controversy with Peter Higgs. Hawking didn't believe Higgs would ever find the long-sought God particle (Hawking 1996, 1). And Higgs judged Hawking's public status problematic in scientific terms. There was too much credibility associated with his celebrity status than with his scientific accomplishments (Fahy 2015, 32). Higgs may have been right, but Hawking definitely wasn't, as the Higgs boson was detected in 2012 (ATLAS 2012, 1). Thus, controversy has been a factor present in Hawking's career.

On the more humorous side, Hawking made several bets in his career. Perhaps the most famous one is a bet with Kip Thorne and John Preskill from 1997. Hawking bet Thorne and Preskill that nature doesn't allow a naked singularity (Hawking 2013, 70-1, Larsen 2005, 97). Naked in the sense that an event horizon wouldn't form around the singularity. This has to do with whether or not information is lost in a black hole (Hawking 2005, 4). The bet was never really settled, yet, Hawking admitted that he was wrong in his early assumptions.

Hence, drama and conflict may be saying too much, still, controversy has indeed been present in Hawking's career, as it is the last trait of the visible scientist.

4.2.6 A Public Intellectual

Fahy argues for a four-step process by which a scientist becomes a public intellectual. These steps can clarify matters surrounding Hawing's fame even more. The first step is similar to one of Goodell's traits. It is to become an expert in one's own field. It has been established that this was the case for Hawking. The next step requires the scientist to speak about other subjects than the ones belonging to his own field. As noted when examining Hawking's 'hot topics', these include: religion, politics, environment, population and artificial intelligence. He made such comments in his books for instance (Fahy 2015, 205). The next process is to make statements about topics that concern a broad audience. As religion, politics, environment, population and artificial intelligence indeed interest a far-reaching audience, the third process is connected to this already.

The fourth process, where the scientist gets a reputation for voicing his views on these subjects via broad-access media, is initiated in the same round. Hawking received much attention for his continuous mentioning of God and his involvement in political issues (Fahy 2015, 34, Sherwood, Kalman and Jones 2013, web). Hawking became a spokesperson for the disabled and an advocate for atheism among other things (Ferguson 2011, 247).

Hence, Hawking completed the four-step process of becoming a public intellectual. This process is much connected to the traits of the visible scientist. The communication with the press, about topics other than scientific ones, needs to be done in the right manner for the media to make use of it. The scientist must be articulate, may favorably engage in conflicts and should present a colorful image, which the press accepts and/or molds. As these traits are present, the public intellectual can gain a reputation for voicing views about subjects that are interesting to a broad audience, because the person fit the expectations of the media. In turn, the broad audience communication starts off the process of celebrification (Fahy 2015, 205).

4.2.7 Summary

Thus, all five traits of the visible scientist are present in Stephen Hawking's case. He had established a credible reputation in cosmology early in his career. Hawking radiation is attributed much of this early recognition. This made him appealing to the media, as the credibility transfers to the journalist via the article. Hawking also was connected to a 'hot topic'. Cosmology fit both the old and the new media fad of sciences. Hawking's appearance and wit turned out to be favorable when constructing an image. The image consisted of a man in a wheelchair, who spoke with a computerized voice. He was also a clever mind in a damaged body, by which he therefore fit the mold of the stereotype scientist. In large parts, the image was constructed from his public appearances, which were manifold. Hawking also made good use of anecdotes that were always told with the same wording. In addition, he was witty and charismatic, and could communicate in an exoteric manner. Lastly, controversies have also been present in Hawking's career. Hence, all five of Goodell's traits of the visible scientist are present in the case of Hawking. He thus fit the mold for the press to magnify him and turn him into a celebrity. The process of becoming a public intellectual also highlights some aspects of Hawking's career, but much is closely connected to the traits by Goodell. The public intellectual process maps the steps towards visibility, while the five traits exposes the characteristics present in the scientists, who are fit for such a career. Hawking proved willing to do much that would contribute to this process too. Writing popular science books and appearing in TV comedy shows have helped speed this process along.

This chapter has analyzed elements of Hawking's whole career. Yet, as mentioned, there is a difference between a visible scientist and a celebrity scientist. The difference is in time – the celebrity scientist was first a visible scientist. Hawking moved from being a visible scientist to a celebrity scientist, and the key to this movement was the publication of *A Brief History of Time* in 1988.

4.3 Becoming a Celebrity Scientist

The visible scientist can undergo three interconnected processes and become a celebrity scientist. This process is called a process of celebrification and will be presented below. The first modern celebrity scientist is presented as well, since he gave his name to a certain effect.

<u>4.3.1 Process of Celebrification</u>

Scholars of communication argue for celebrity in a technical sense. The process of celebrification should not be confused with a process of celebritization. Celebrification is the process where an individual is turned into a celebrity, whereas celebritization represents the changes on societal and cultural levels implied by celebrity (Driessens 2012, 643). To analyze Stephen Hawking's route to celebrity, the process of celebrification is useful. Scholars believe celebrity is formed from three interconnected processes:

> the first process portrays the scientist as having a merging private and professional life.
>
> The second process represents that a person becomes a product of culture. A product that is used to sell or advertise other cultural products.
>
> The third process concerns the way a person becomes synonymous with ideas, ideologies and issues.

The last process is by far the most complex one, where timing, luck and chance have a lot to say (Fahy 2015, 7). If the visible scientist – or public intellectual – undergoes the three processes of celebrification, he reaches celebrity status. The process of celebrification can be applied to any kind of public intellectual. It is not confined to relate to scientists. The process of celebrification can be used to enlighten circumstances surrounding Hawking.

At the end of the 20th century, the scientific public intellectual became the bridge between science and society forming a new culture. Or put in other, more accurate, words: science related items dominated culture in the form of processed foods, penicillin, energy sources etc. At this time, the scientific public intellectuals "came to dominate public discussion of science, publishing bestselling titles, receiving six-figure advances for books about esoteric topics like quantum physics, producing science documentaries, contributing to late-night talk shows, appearing in glossy magazines, being photographed by celebrity photographers, [and] lobbying Congress" (Fahy 2015, 13). Thus, some scientific public intellectuals evidently became celebrities. Fahy investigates the public lives of several celebrity scientists, including Stephen Hawking, who he calls "the most famous scientist of the modern era" (Fahy 2015, 20). However, it is interesting to view an earlier celebrity scientist too.

4.3.2 Carl Sagan

One of the first mass media stars of science was Carl Sagan. His personality was favored by the media, since he was articulate, attractive, eloquent, and enthusiastic (Fahy 2015, 4). Sagan was an astrophysicist who wrote popular science books too, of which he received a Pulitzer Prize in 1978. Then he took on his own TV show *Cosmos* which was estimated to have been viewed by over 10 percent of the world's population (Murray 1996, web). He came to symbolize the era when television met space. *Time* called him "the nation's scientific mentor to the masses" and America's "spokesman for astronomy and science" (Fahy 2015, 4, Murray 1996, web). He was a star in ways no modern scientist had ever achieved. Journalists reported on his private life, wrote about the trademark turtlenecks he wore and how he had to cope with the stream of women, who said they needed to see him. He also sat facing the wall in restaurants to avoid a herd of autograph hunters (Fahy 2015, 5). Yet, Carl Sagan also named the Sagan Effect, which meant that the celebrity status damaged his reputation in the scientific world. A section below will return to this point.

Thus, Carl Sagan was one of the first examples of a scientist being more than visible. He became a true celebrity scientist. As did Hawking – but they both faced some obstacles from this.

4.4 Celebrificating Stephen Hawking

As Stephen Hawking had become a visible scientist, there are ways to analyze his way towards becoming a celebrity scientist. Celebrification consists of three interconnected processes, which are most profound in the Hawking case as his "rise to pop supremacy demonstrates most vividly the characteristics and causes and the possibilities and pitfalls of scientific celebrity" (Fahy 2015, 20). The celebrification steps can also help deconstruct Hawking's complex journey towards being "the most famous scientist of the modern era" (Fahy 2015, 20). As mentioned, the three processes start with the scientist having a merging professional and private life. To explain how Hawking's private and professional lives started to merge, we need to take a look at *A Brief History of Time*, since this work serves as a landmark in the creation of a Hawking industry (Fahy 2015, 26).

As mentioned, Hawking needed money for medical support and his children's education, so he decided to write *A Brief History of Time*. Hawking chose Bantam Books to be the publisher, and secured himself a $250,000 advance, which also solidified him being a scientific public intellectual in the mid 1980s (Fahy 2015, 13). The book "did not seem a sure-fire best seller" (Fahy 2015, 25). It was a 198-page long description of cosmological phenomena to the general reader. However, it went and stayed on the bestseller lists for 237 and 147 week for *Sunday Times* and *New York Times* respectively. Today, it is the most sold popular science book ever (Fahy 2015, 25). A point is, that the reviewers seemed just as interested in the author as in the book. Perhaps because of this, a franchise emerged.

A Brief History of Time built a Hawking industry. As mentioned, with the book success Hawking became famous to a whole other degree than previously. There was even a race to commission similar titles, both in popular science books, but also in remote areas like cooking (Sample 2013, web). As Hawking became a brand, or perhaps due to this, the press started to investigate his private life. There were rumors of Stephen and Jane's intimate life. For Stephen, there were questions of abuse in the second marriage, which remained uncommented. There have been many other rumors about Hawking. However, none of these rumors have harmed Hawking's status in any significant way. Despite lack of comments from Hawking on gossips, Fahy argues that "Hawking indulged in the revelation of private details for commercial gain and public interest" (2015, 28). Yet, he didn't talk to the tabloids, he used personal details in his next popular science works. The next book, *Black Holes and Baby Universes,* was spiced up with additional anecdotes of Hawking's memories. The anecdotes took up nearly a third of the book, Mellor argued. This was a significantly larger percentage than in *A Brief History of Time.* He also included new private pictures in his following books (Fahy 2015, 38). Hence, it is reasonable to conclude that Hawking's private and professional lives started to merge. This the press and himself made sure happened. This is the first process of celebrification. Yet, since the release of the product, *A Brief History of Time,* initiated this merge of the private and professional lives of Hawking, these processes of celebrification aren't distinctly separate.

The Hawking brand was used to sell more books, but also other cultural products. As evident from a former chapter, some of the popular science books were: *Black Holes and Baby Universes, The Universe in a Nutshell,* and *Brief Answers to the Big Questions.* Also other books like *My Brief History* and children's literature have been written by Hawking. Considering other cultural products, as mentioned, Hawking starred in *Star Trek* (1993)*, The Simpsons* (1999-2010), and later in *The Big Bang Theory* (2012-2017). Thus, he diligently appeared in TV comedy shows. In addition, the Hawking image and name was used in the production of two movies: *Hawking* and *The Theory of Everything.* Hawking's voice was furthermore incorporated in a Pink Floyd song and the Hawking voice appeared in a commercial for British Telecom (Fahy 2015, 28). He also visited the show *Late Night with Conan O'Brien* in 2003, where he made a comedy sketch with Jim Carrey about science (Larsen 2005, 122). As mentioned, Hawking also hosted the opening of the Paralympic Games in London in 2012. This way, he reached an internationally broad audience. Thus, Hawking sold both more of his own books, but also a variety of other cultural products including, TV shows, songs, movies, and commercials. Thus, Hawking entered the second process of celebrification, as he became a product of culture himself and started to advertise other cultural and commercial products. One can also argue that Hawking used these shows consciously to advertise himself – reaching a much wider general audience.

The third process of celebrification is when a person becomes synonymous with a set of ideas and ideologies. The contemporary ideas must fit with a likable personality of the scientist for him to become a celebrity scientist (Fahy 2015, 7). The 'hot topics' and colorful image of the scientist must also intersect with history (Goodell 1977, 19, 31). As mentioned, Hawking – being a cosmologist – fit both the old and the new hot topic of the 1960s and 70s. The link between the stereotype scientist, Goodell's 'before' scientist, and Hawking being in a wheelchair has also merely magnified his image. Also, Hawking made continuous comments to new 'hot topics', which made sure he stayed visible until reaching celebrity. Luck and chance play a significant role in this last process – also for Hawking, and these can make the celebrification snowball (Bushnell 2000, 679). Even though the third process is the most complex and elusive one, Hawking did manage to complete this process too, as it is evident that he *was* considered a celebrity (Penrose 2018, web, Kaiser 2018, web). He "achieved [a] resonance with a worldwide public" (Durrani 2018, 7).

Thus, a Hawking franchise was established in the wake of the success of *A Brief History of Time*. Hawking became a cultural commodity, which he used to sell other cultural products like TV shows and songs. As Hawking underwent the last process of celebrification, he became synonymous with his own set of ideas, and his personality intersected with history in a perfect way.

But what about the time after a celebrification is complete? Is the newly constructed status rigid? How does the scientific community react to a celebrity scientist?

4.5 After Celebrification

The above explains in which mechanisms and processes Hawking turned into a celebrity scientist. Yet, what about afterwards: were there any downsides to being a celebrity? Did he maintain his status in the scientific community while being a public celebrity?

Following a presentation of how the scientific community reacted to Hawking's celebrity status, the tension between the visible scientists and the ordinary scientists is discussed. This tension might be the reason for critiques, rumors and questions about Hawking's professional and private lives. According to Goodell, the scientific community believes the press is no place for a serious scientist (1977, 120). Krauss argues that the more successful a scientist is as a popularizer, the less the scientific community will regard him as a real scientist (2015, 29). This is termed the Sagan Effect. Gazan is a little more blunt: "'Celebrity scientists' who cross into the public domain usually face conspicuous scrutiny from colleagues" (2013, 4). Thus, there evidently is a conflict present. The origin of this tension will also be discussed.

4.5.1 Reactions to Hawking's Celebrity Status

Following celebrity status, Hawking experienced questions, critiques and doubts about how he had reached his new status, and if he deserved it. Some came from the scientific world, while other questions and interests came from the press.

4.5.1.1 Inflated status?

Even though Hawking had increased public scientific literacy, Fahy argues that Hawking's public status had a negative impact on science in the beginning of the 1990s (2015, 208, 30). None of Hawking's theories have been tested. Therefore, some argued that Hawking hadn't conducted any real science, since it is impossible to verify his theories. Others simply believed he was turned into a celebrity because of his condition, and that he in fact hadn't made more of an imprint in cosmology than any other cosmologist (Ferguson 2011, 246). In the 1990s, when Hawking had just begun having public success, scientific papers started to be rejected merely because their conclusions disagreed with Hawking's ideas (Fahy 2015, 30). This does not belong in the scientific quest. Maybe because of this, or other factors: in 1999, *Physics World* conducted an investigation where leading physicists were asked to name five figures who had made a significant contribution to the field. "Only one of the 130 respondents put Hawking anywhere on their top-five list" (Fahy 2015, 30). Thus, this selection of scientists gave the impression that the all-important credible reputation in a scientific field doesn't last forever. There are several factors influencing this poll. Yet, the overall impression is a decline in Hawking's scientific credibility. Matthews argues in Fahy's book that "the media continue[d] to cling to the tabloid notion of Hawking as a genius trapped in a useless body" (2015, 30). And the media established a link between Einstein, Newton and Hawking, which is "absurd", Matthews thinks (2015, 31). By this, Matthews clearly establishes his view on the journalists' perception on Hawking. In addition, reviewers of later works co-written or written by Hawking, claim that he was merely there for name value. This may be a sign of the Sagan Effect. More on this later. Thus, in the 1990s the Hawking franchise grew, but, by the perception of many, it had become hollow.

Despite these critiques, Fahy claims not many would criticize Hawking in the open, because he was a sort of scientific Princess Diana (Fahy 2015, 32). Yet, to have somebody like this in the establishment isn't healthy, since the scientific community runs on peer review (Fahy 2015, 31-2). Not to say that nobody ever disagreed with Hawking or his ideas. But, Hawking's persona was untouchable. As mentioned, Bekenstein believed Hawking was mistaken about the analogy between black holes and thermodynamics. Bekenstein initiated what led Hawking to discover Hawking radiation, and thus did criticize his theory (Bekenstein 1973). In the same lines, Susskind initiated a war on black holes based on the information paradox (2008). Additionally, Peter Higgs opposed Hawking and his establishment, and Hawking answered that he never thought that Higgs would find his God particle – which he did in 2012 (Fahy 2015, 32, ATLAS 2012, 1). These controversies may or may not be a result from tensions in the scientific community.

As mentioned in an earlier chapter, Hawking had spiced up his popular science books with anecdotes for one, but also reviews of the history of science. These may be impactful tools when writing for popular science purposes. Yet, a problem arises, when Hawking hasn't got his facts straight. Gingerich, who is a professor of astronomy and the history of science, points to Hawking's faulty writings in *On the Shoulders of Giants* (2002). Gingerich was worried, since Hawking's status gave him instant credibility – also in cases where he was mistaken (Fahy 2015, 32). Thus, these are some of the critiques Hawking received, despite the fact that many preferred not to provide any.

By the 2000s, Hawking's image consisted of several narratives: the genius in a broken body, the loving father and husband, the scientist and additionally: "the overhyped star" (Fahy 2015, 32). Caiazza joins the latter perception on Hawking. Caiazza believes Hawking was more concerned with gathering "lubricious publicity" like a movie star "than in pursuing hard-won scientific truths" (2001, 3-4). This is part of the tension between traditional scientists and visible scientists. The tension will be elaborated later in this chapter. However, Fahy, Gingerich and Caiazza's opinions are indications of what happened to Hawking's image by the turn of the century. It was inflated with hot air (Fahy 2015, 32).

In the 1990s, the press would also prove to criticize and question the life of Stephen Hawking.

4.5.1.2 Rumors and Gossip

As already mentioned in a previous chapter, Hawking experienced the media making rumors and gossip about his personal life starting from the 1990s. This is evidently a consequence from being a full-grown celebrity (Tiger 2015, 340). As stated, the gossip helped shape a public perception of Hawking, since the readers of tabloid magazines are so manifold. The rumors highlighted in the previous chapter have been rumors of if and how Stephen and Jane maintained an intimate life, and what happened after they split. The next marriages for them both also carried a lot of speculation. For Stephen, there were questions of abuse, which Hawking wouldn't dignify with an answer. There have been various other rumors about Hawking, his wives and his children (Fahy 2015, 27). However, none of these rumors have harmed Hawking's status in any noteworthy way (Fahy 2015, 38).

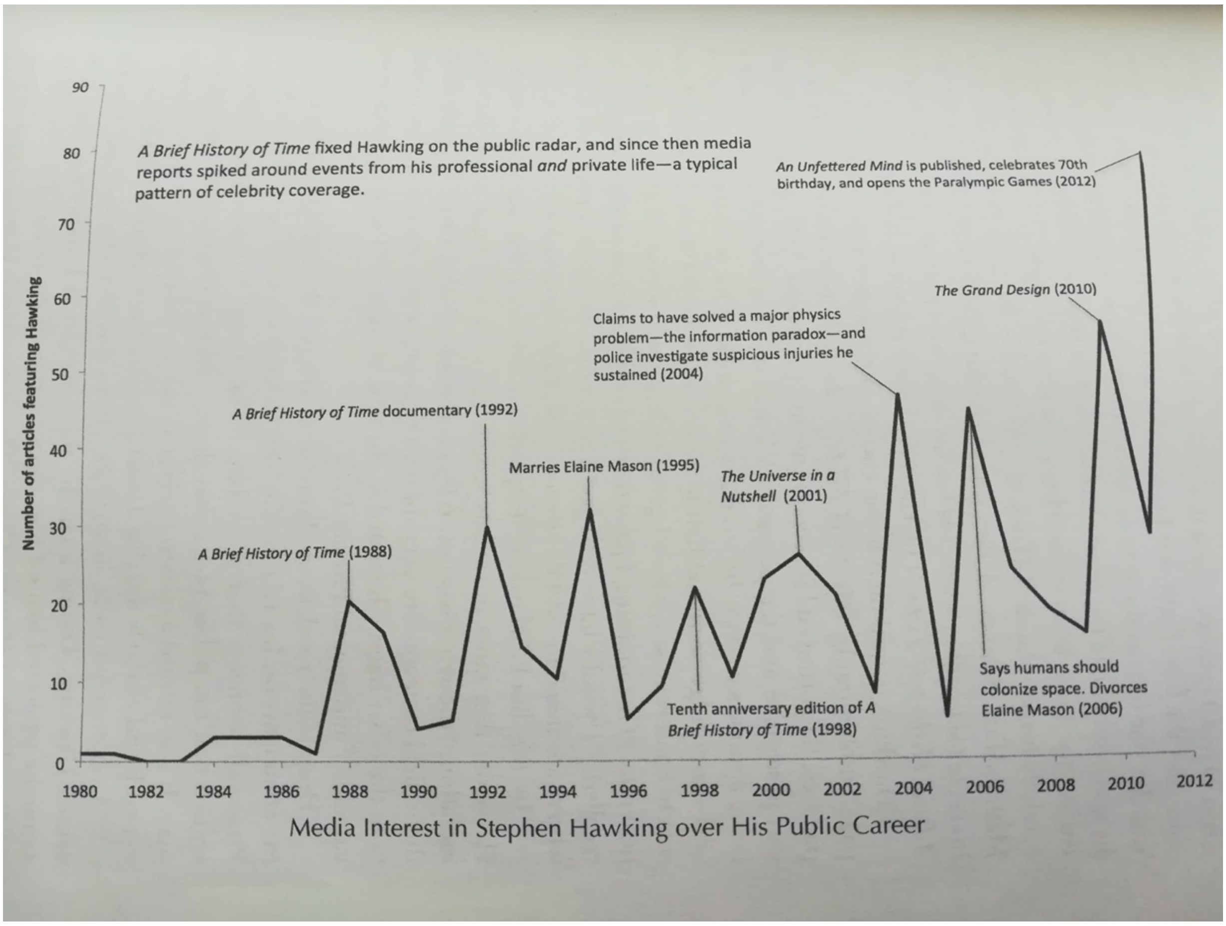
Still, it may be argued that gossip is one of the downsides to celebrity status. It is a demand from the public, which Hawking, is this case, did not fulfill by himself. He wanted to keep some things to himself and his family. This merely sparked speculation. Yet, as Goodell writes, visible personae are "required to share not only their achievements but their families, their idiosyncrasies, their past sins, their favorite foods" – even if they don't want to (1977, 7). This might well be the illustration of the gradual loss of control involved with a celebrification process. The public intellectual is somewhat in control of his visibility process, however, as it proceeds, control is taken by the media, which almost wholly forms the lasting image of the celebrity. Even though the media is so powerful, the scientist usually continues working to try and seek control once more.

4.5.1.3 Hawking Continues Working

Around the 2000s, it was difficult to determine if the Hawking brand was built to endure. Hawking was still persuaded that information was lost in a black hole evaporation. Yet, practically no one in the field shared this view (Fahy 2015, 33). This merely contributed to the notion that Hawking's fame was overly inflated. Many believed he had only done little significant work in cosmology since the 1970s (Fahy 2015, 34). Yet, he had published 2-3 academic articles a year until 2017 (Hawking.org, web). If it was significant enough or not was the more important question.

Maybe as a result from this tendency, or simply because he was a celebrity, Hawking aired several popular science works in the late 1990s and early 2000s. Some argue that "he was trying to regain his reputation within the physics community" (Fahy 2015, 34). Two movie productions portray Hawking's story as an early adult and several TV documentaries reveal Hawking as a master of the universe. The movies are *Hawking* (2004) and *The Theory of Everything* (2014) (Hawking.org, web). The documentaries are manifold. Here is a selection: *Stephen Hawking's Universe* (1997), *Stephen Hawking: Master of the Universe* (2008), *Into the Universe with Stephen Hawking* (2010), *Brave New World with Stephen Hawking* (2011), *Stephen Hawking's Grand Design* (2012) and *Stephen Hawking: A Brief History of Mine* (2013) (Hawking.org, web). It is up for speculation if the TV shows aided Hawking as he wanted to rebuild his scientific reputation. One may argue that these are the wrong settings to do so.

Despite a decline in scientific status, and a nosy press, by 2012, the Hawking franchise was thriving. Fahy constructs a diagram showing number of articles featuring Hawking over time (Fahy 2015, 37).



This diagram peaks in 2012, where Hawking turned 70, he opened the Paralympic Games in London, and Ferguson updated her biography of him once more (Fahy 2015, 37). In addition, London's Science Museum opened an exhibition of Hawking's life and work. Cambridge University forged a statue of Hawking, which is placed in the garden at the mathematical department. Also, a Permanent Hawking Archive was established at the university to house his books, articles, press coverage and much more. Fahy believes "the Hawking legacy is built to endure" (2015, 38). Rumors, questions and gossip are merely intricate parts of a complete celebrification process, as Goodell hinted in 1977.

The following will attempt to explain and discuss reasons for the belief that Hawking's status was overly hyped and why his professional and private lives were questioned and criticized.

4.5.2 Tensions Between the Scientific Community and Visible Scientists

The reactions Hawking experiences following his celebrity status were manifold. Perhaps some of them originated from the tension between the ordinary scientists and the visible scientists, of whom some were celebrities. The role of the university and norms of science are points to look at when discussing the cause of the tension. There are different perspectives on the tension that is manifested in the Sagan Effect. The Sagan Effect is named after Carl Sagan.

4.5.2.1 The Role of the University

The latter part of the 20th century drove a new kind of science communication forward. As mentioned, in the 1970s, there was a demand for more popular science and a moral incentive to supply this accurately (Broks 2006, 90, Lewenstein 1987, 30).

Yet, there is another perspective to the increase in popular science. The role of the university in society is manifold. The idea of the university has evolved through different traditions, where research and/or teaching was more important (Kristensen 2007, 24-44). Today, the university must fill more societal roles than ever before. Here, five of these functions are considered.

> The first function is being a bank of knowledge in order to preserve important knowledge for now and for the future.
>
> The second function is doing research. This function is held by scientists, who are also responsible for
>
> the third function: transferring knowledge to students.
>
> The fourth and very noteworthy function, in this context, is to transfer knowledge to the public. This is done to make sure citizens can make informed decisions in science policy matters and thus contribute positively to the democracy.
>
> The fifth and last function of the modern university is to help generate economic growth. This is the newest addition to the role of the university. This function can be fulfilled via preparing students for specific jobs in the business

community (CBS 2018, web, Kristensen 2007, 65-7). This function is also a result of the competitive capitalist state, where money is needed for funding etc.

The visible scientists and celebrity scientists meet the fourth function head on. They transfer knowledge to the public. Thus, they fulfill another function of the university than the ordinary scientists, who research and teach. Hawking expressed a feeling of similar responsibility: "As a scientist I felt obligated to communicate with the world what we were learning [...] I think it is important that people have a basic understanding of science so they can make informed decisions in an increasingly scientific and technological world" (Hawking 2018, 18, 99-100). From this point of view of the different roles of the university, there is no basis for calling a visible scientist anything but a serious self-respecting scientist. Adamski argues that the perception of the scientist has changed with the newest addition to the role of the university (2016, 399). He observes a change towards a need for more scientists that are more visible. Fahy and Caulfield agree, and argue that scientists should view celebrity culture as an opportunity to engage people in science and science policy. Scientists even have a responsibility to help set the term of debates on science, because celebrities have such a huge role in shaping the public perception of science (Caulfield and Fahy 2016, 24-6). However, there still is a tendency, in the scientific community, to dislike visible scientists. This may be connected to the norms of science.

4.5.2.2. Norms of Science

With the modernization of society, this visible scientist grew with the press and maybe became a celebrity scientist. Yet, this interdisciplinary field, between science and being a public figure, frustrated the traditional scientists. The usual way of influencing policymakers was to speak to them behind the scenes. But the visible and celebrity scientists went straight to the public, using the media to influence the public agenda on science (Fahy 2015, 5). Therefore, in opposition to Merton's norms: the visible scientists' reputation was established both within and outside science. But since the mid to late 20th century, scientists needed to communicate in an effective way to have any real influence in the public arena (Fahy 2015, 6). Yet, the mere fact that their reputation wasn't solely built in science made traditional scientists uncomfortable. More specifically: Merton's norms are called CUDOS. They represent communalism, universalism, disinterestedness and organized skepticism (Hansen and Johansen 2007, 31). Ordinary scientists worried that the visible scientists eroded the traditional, yet utopian, norms of science. To be present in the public media sphere, one needs to act quick to follow the fad of the time. In order to do so, some might argue that universalism, disinterestedness and organized skepticism was in danger of not being met. Criteria for science in public are different from science to work in the scientific world. The public demands actuality, significance, identification, sensation and conflict to even get picked up by the press and read by the average citizen (AiU 2018, web). These are not any of the criteria for accurate science. From the demand of the public, ordinary scientists might also question the visible scientist's disinterestedness and skepticism towards his own work. In these, and other ways, the visible/celebrity scientist and the ordinary scientist clash in norms and value. This may lead to the pejorative names of the visible scientist within science. This tension has led to the formation of a certain effect.

4.5.2.3 The Sagan Effect

The 'Sagan Effect' is the manifestation of these controversies, as Goodell, Krauss and Gazan argue. As mentioned, Krauss argues that the more successful a scientist is as a popularizer, the less the scientific community will regard him as a true scientist (2015, 29). The Sagan Effect represents the notion among researchers "that the level of a scientist's public fame [is] in direct opposition to the quality of their research" (Fahy 2015, 5). In other words: that visible scientists are second-rate academics compared to those scientists who do not engage in public discourse (Martinez-Conde 2016, 2077). As mentioned, Carl Sagan's story is the origin of the name of the effect. Sagan bid for tenure at Harvard University in the 1960s, but was denied. The National Academy of Sciences rejected him as a member and a number of "peers dismissed him as a mere popularizer and not a real scientist" (Fahy 2015, 5). Sagan was early in his career wining prizes for his popular writings. And his 1980s show *Cosmos* propelled him to global fame, as over half a billion viewers tuned in every week. However, before his media career, Sagan had established himself in astrophysics as a brilliant researcher – which is a necessity according to Goodell and Fahy. In addition: Sagan's rate of publishing articles is noteworthy: on average, he published one academic paper a month. Thus, the quantity is extraordinary – the quality is up for speculation. Fahy argues the Sagan Effect was false for Sagan, and that the effect was the result from prejudice about scientists operating in public (2015, 5).

4.5.2.3.1 Did Stephen Hawking experience the Sagan Effect?

The Sagan Effect has been present for many years since Sagan lived. Hawking's career suffered too from the Sagan Effect. In the 2000s, Hawking's image turned to include the notion that he was an overhyped star, as mentioned. There had been examples of distrust against Hawking during the 1990s. Some believed Hawking hadn't made any significant impact on cosmology. Thereby questioning his public and scientific status. No doubt that Hawking radiation was important, but maybe not more important than any other cosmologist's findings (Ferguson 2011, 246). Hawking received many prizes and awards, but not the most prestigious of all: the Nobel Prize (Castelvecchi 2018, web). As mentioned, this prize was not given to Hawking, because there is no experimental evidence to back up Hawking's theories. Thorne argues that gravitational waves may be the key to testing Hawking's theories about black holes, thus earning him a Nobel Prize in absentia – which has never been done (Introduction in Hawking 2018, xxi). Thus, the Nobel Prize will never be bestowed upon Stephen Hawking. Hence, some thought Hawking was brilliant and his theories vital to proceed with the history of the universe, including black holes. Others simply believed Hawking was overly hyped and that he did not deserve the fame he had received. Perhaps the fact that he wasn't given a Nobel Prize is a symptom of the distrust that was seeping into Hawking's scientific reputation – as the celebrity status took over. The investigation by Physics World in 1999, seemed to be an indication that Hawking's scientific status had receded, when he was compared to all other 20th century physicists. Scholars started to disagree with the otherwise untouchable Hawking. Higgs, Gingerich and Caiazza expressed their opinion that Hawking's image had become hollow. Many believed he hadn't done any significant work since the 1970s (Fahy 2015, 32-4). Therefore, Hawking's career was influenced by peers who believed he should spend more time working on science that on typing down his lines for a TV show appearance. Rumors and gossip are other downsides to celebrity status, yet, these do not necessarily have anything to do with the Sagan Effect and thus the scientific community.

The Sagan Effect wasn't dominating Hawking's career, yet, elements of it made themselves known every once in a while. Thus, Hawking was awarded several scientific prizes and honorary degrees – also after the 1980s. Among others: Albert Einstein Award (1978), Lucasian Professorship (1979), Paul Dirac Medal (1986), honorary degree from Harvard (1990), Copley Medal (2005) and the Fundamental Physics Prize (2013) (Ferguson 2011, 157, 237, 277, 371, Hawking 2013, 122). These are a few examples in a line of 40-some awards, prizes and honorary degrees. Thus, the Sagan Effect wasn't permeating and it seemed the Hawking name was built to last (For a list of prizes Hawking won, see the appendix).

What about the Sagan Effect today? Is it thriving or is it gone?

4.5.2.3.2 The Sagan Effect Today

Fahy claims the Sagan Effect has almost vanished by 2015. He argues that celebrity grants scientists the opportunity to take on several public roles without any loss of scientific authority (Fahy 2015, 217). Martinez-Conde does not agree. She points to several investigations, which find "that scientists who engaged with society were in fact more active academically than the average scientist" (2016, 2078). Thus, disputing the Sagan Effect. Another analysis "found that scientists with popular publications also had higher levels of academic publishing, as well as higher academic rank" (2016, 2078). These outcomes are consistent across countries and research fields. Martinez-Conde wonders if the practice in writing, both academically and popular, increases the overall output of academic articles, because one is trained in writing with a purpose. She tells her own experience with writing and that she believes she has become a better writer overall from writing popular science works too (2016, 2078).

Martinez-Conde claims there is a consciousness present about the duties of science communication. Scientists have a duty to communicate their findings to lay people. However, scientists also believe that science communication is done by substandard researchers (Martinez-Conde 2016, 2078). Thus, reviving the Sagan Effect. The negative perception stand in contrast to institutional statements that such efforts are prioritized. Rödder (in Martinez-Conde) tries to explain the reasons for the academic community's ambivalence towards dissemination. He found that for the scientific community to deem a scientist's visibility legitimate, there are three conditions that must be met:

> one: credible reputation and credible research.
>
> Two: Reference to an institutional role as a leader, since visibility is acceptable from the head of an institute for example.
>
> Three: No proactive media contact. The journalists need to approach the scientist and not vice versa (Martinez-Conde 2016, 2078).

Thus, the scientific community can accept and even applaud visibility, but only if some conditions are fulfilled. A Royal Society survey (2006) concludes that are more positive impacts associated with a visible scientist than negative ones. About 50 % of scientists answered that visibility entails 'mostly positive impacts' on a scientist's reputation and about 4 % answered 'mostly negative impacts' (Martinez-Conde 2016, 2079). However, a more recent survey indicates that the perception on visibility in science hasn't changed in over 30 years. Thus, there are both positive and negative consequences to being a visible scientist (Martinez-Conde 2016, 2081). Hence, Martinez-Conde does not present unequivocal evidence that the Sagan Effect is about to vanish any time soon.

4.5.2.4 Summary

Here, the tensions between ordinary and visible scientists have been discussed. Scholars note that the scientific community dislikes the attention brought upon visible scientists by the press. The visible scientists need to break rules of norm to be visible to any degree, since the norms that apply in public are wholly different from the ones that apply in the scientific community. The tension is present even though a researcher's job includes a responsibility to communicate knowledge to the public. However, this is one of the newest additions to the purpose of the universities, which might explain why traditional scientists haven't embraced this facet yet. This tension is manifested by the Sagan Effect, which too influenced Hawking's vocation. Some colleagues questioned his status and if he deserved it. Rumors in the press also started to emerge. However, the effect wasn't permeating, as Hawking did receive many scientific awards and prizes throughout his career. Thus, from what was presented here, Hawking's legacy was built to last.

4.6 Summary

This chapter has analyzed the underlying processes and mechanisms that made Stephen Hawking into a visible scientist at first – and then a celebrity scientist with the publication of *A Brief History of Time.* The visible scientist, termed by Goodell, is considered similar to Fahy's scientific public intellectual. The processes of celebrification can turn a visible scientist into a celebrity scientist. The five traits by Goodell has been defined and illustrated in the case of Hawking. Stephen Hawking fit all five traits, which include articulateness, a colorful image, an element of controversy, a hint of relevance and humanness, and last but not least: a credible scientific reputation to build this upon. Hawking was a special case of verbal articulateness, yet the written ability was not shortcoming. Hawking created a colorful image that included his appearance, as he was in a wheelchair for most of his life. Furthermore, the image consisted of Hawking embodying the stereotype of a scientists being a brilliant mind in a body with no earthly desires. Next, he managed to connect several anecdotes of his life to his image. These skits were told over and over again. Hawking's public appearances weighted heavier than his professional endeavors in the making of a colorful image. The public contributions were various, as evident in the former chapter. In regard to 'relevance', Hawking was in a prominent position, as physics was in vogue for a long time. However, a new fad was extraterrestrial life. Hawking was a cosmologist, which put him right in the middle between the new and the old fashion. The wheelchair, too, gave Hawking a sense of humanness. In addition, he was a husband and father of three. Several conflicts and controversies have influenced Hawking's career, some more humorous than others. And most importantly, Hawking had made himself a credible reputation at a young age, which made him fit the mold of the press in order to become a visible and since a celebrity scientist. The process of becoming a public intellectual also featured some aspects of Hawking's career. These were closely connected to Goodell's traits. This way, both the *how* and the *why* has been examined.

The last steps towards celebrity indicated that his private and professional lives started to merge. This they did especially with the publication of *A Brief History of Time*, whose popularity constructed a Hawking franchise in the late 1980s. Hawking became a cultural commodity and started to be able to advertise other cultural products like TV shows and songs and the Paralympic Games. It seemed, his personality intersected with history in a perfect way. Thus, Hawking became a true celebrity scientist with all the possibilities and pitfalls that come with it.

Then something interesting happened once he was an established celebrity. The scientific community was frustrated. His reputation seemed to prevent some articles from being published. His status was sacred, and not compatible with a field that runs on peer review. Some believed his status was inflated with hot air by the 1990s and 2000s. Yet, Hawking continued writing popular science books and voicing TV documentaries. Some argue that the Sagan Effect had a firm grip on the scientific community to explain the reluctance towards Hawking. Others simply believed Hawking filled out another role of the university than the ordinary scientist. Hawking could engage the public and increase scientific literacy, which is also part of a researcher's job. Yet, the skepticism towards Hawking may be a symptom of the tension between ordinary scientists and visible/celebrity scientists in general.

Thus, this was Stephen Hawking's stepwise journey towards becoming "the No 1 celebrity scientist" (Penrose 2018, web).

5. Conclusion

Stephen Hawking was one of science's faces for many years. Obituaries described him as "a full-blown celebrity", "an icon of modern physics" and "the most famous scientist of the late 20th and the early 21st centuries" (Kaiser 2018, web, Lloyd 2018, web, Page 2018, web). However, one does not become a face of anything by a simple and obvious route available for anyone. This master thesis has analyzed and discussed factors, characteristics, and circumstances leading to Stephen Hawking's celebrity status. This thesis has presented various parts of Stephen Hawking's life. A life both lived in the scientific world and in the public eye. Three chapters have depicted, analyzed, and discussed his career is cosmology, his life in the public sphere and lastly studied the development towards celebrity status.

More specifically, the first chapter presented Stephen Hawking as a scientist, a physicist and more precisely: a cosmologist. This chapter portrayed which 'special' things Hawking did for science. An overview of Hawking's physics career was provided and phenomena such as the second law of black hole dynamics, Hawking radiation, the information paradox, the 'no-boundary' proposal, the Hartle-Hawking state, wormholes, and time travel were depicted using only very few equations. The field of cosmology was changing at the time Hawking started his scientific career. The field moved from having a philosophical inclination to a physical and mathematical. The steady-state theory competed with the big bang theory to be a model of the universe. Stephen Hawking contributed to the resolution of this competition, as the big bang theory took the lead. Hawking radiation, in particular, helped Hawking secure a credible reputation in science. He used both quantum mechanics and relativity to deduce this phenomenon. Thus, this chapter highlighted discoveries, theories and proposals Hawking made throughout his career in cosmology. A few prizes, awards and honorary degrees were also included here, as well as a few personal elements that are closely connected to his story in general. By this, it was clear that Hawking made substantial contributions to theoretical physics in the 20th century. Thus, Stephen Hawking was a credible scientist. However, if that is all it takes to become a celebrity, then there would be a lot more celebrity scientists in the media. Thus, there are other factors that are important as Hawking made his way to fame.

The second chapter presented Stephen Hawking's life in the public eye. Hawking's public life had considerably more influence on his general status, image and reputation, than his scientific career. The scientist can do great things, but in order to reach fame, the world must hear of those achievements. Therefore, it was useful to look at which and how Hawking made contributions to the public mass-market, thus, how he became visible to the public. The contributions were mostly in the form of popular science books, which Hawking wrote himself. The most successful one was even written and published at a time where popular science in general was flourishing. Thus, *A Brief History of Time* was published at a time where the was a demand for such books and scientists sought more control over the process and product of popular science in general. However, this does not demean the exceptional success that *A Brief History of Time* turned out to be. Hawking wrote other books as well and six were analyzed in this chapter. These were: *A Brief History of Time, Black Holes and Baby Universes, The Universe in a Nutshell, My Brief History*, several children's books, and *Brief Answers to the Big Questions.* Both *My Brief History*, which is an autobiography, and the children's literature were other versions of the genre of popular science than the rest of the books. Hawking appeared in other areas of the public sphere too. He was the subject of a few movie productions: *Hawking* and *The Theory of Everything*, he starred in TV comedy shows and voiced TV documentaries. Cinematic science is also a popular science, yet its objective is to portray fiction. Thus, the genre is quite unreliable, since the audience might end up believing inaccurate science or not believing accurate theories. Thus, cinematic science can merely present samples of science in an entertaining way to a very broad audience. All the TV appearances, together with the books, were to be placed on a popular science spectrum. Thus, following an analysis, they were all ranked from popular to scientific on the popular science spectrum. The most popular ones were appearances on *Star Trek, The Simpsons* and *The Big Bang Theory.* At the other end, *A Brief History of Time*, *The Universe in A Nutshell, Black Holes and Baby Universes* and *Brief Answers to the Big Questions* were placed. These works were located somewhat on the same position on the spectrum, and constituted the most scientific popular science to which Hawking lent his name. However, all the popular science works analyzed here were overall considered more popular than scientific. Nevertheless, none of the books had an overall narrative to drive the story. Therefore, these books were neither particularly *popular* science books nor popular *science* books. This may suggest a problem. Yet, it has not stopped people from reading, watching, and buying such works. This may be connected to the perception and status of Hawking. Thus, this chapter showed how Hawking became visible in the public, how he maintained that status and what the context was.

The last section in the second chapter displayed some of the very last effects that comes from being a celebrity. Rumors and speculations of private character about Hawking started to appear in the 1990s. These influenced Hawking's public image and reputation too. It seemed the celebrity will experience less and less control with the process of celebrification as the process proceeds – as tabloid gossip appears when the celebrity becomes famous enough. The loss of control is gained by the media instead. Speaking of celebrification, this was the scope of the third and last chapter.

The third chapter analyzed the underlying processes and mechanisms that made Hawking into a visible scientist – and later a celebrity scientist. Elements from the two former chapters appeared here to substantiate claims. Goodell's visible scientist is similar to the scientific public intellectual by Fahy. Goodell presented five traits of the visible scientist and Fahy argued for a four-step process from ordinary expert to public intellectual. The public intellectual can originate from all possible fields; however, the scientific public intellectual comes from the sciences – as does the visible scientist. The traits and four-step process towards visibility were examined and illustrated using the case of Stephen Hawking. Hawking fit all five traits, which include articulateness, a colorful image, an element of controversy, a connection to a 'hot topic', and finally: a credible scientific reputation to build all this upon. Hawking's speech synthesizer made him a unique case when it comes to verbal articulateness, yet the written ability was not deficient. Hawking mastered the art of writing exoteric. This entailed using a clear and simple language. His colorful image consisted of several facets, which include his appearance, his voice, his devotion, and his personality. The image was determined more by public appearances than scientific contributions. ALS both made Hawking's story a tragedy and a triumph (Eicher 2016, 51). The disability made Hawking extremely human and it indeed affected his appearance. Furthermore, the illness made Hawking embody the stereotype of a scientist being a brilliant mind in a broken body in more than a figurative way. These traits of his image were strong. What sometimes vanished in the crowd, was the fact that he also was a husband and a father of three. Regarding relevant topics, Hawking was a cosmologist, as mentioned, and this put him in a favorable position. The fad had moved from physics to extraterrestrial life. This put him right in the middle between the new and the old fashion. Hawking also made comments to other 'hot topics' over the years. To mention a few: religion, politics, artificial intelligence and the future of the planet. Several controversies also affected Hawking's route to visibility. Some more harmless than others. Yet, most importantly, Hawking had made himself a credible scientific reputation at a young age. The discovery of Hawking radiation was a particularly important factor in this. All these traits made Hawking fit the needs of the press, which then molded him to become a visible scientist.

The process of becoming a public intellectual also featured some aspects of Hawking's career. These were closely connected to Goodell's traits, as they featured which topics the scientist commented on, in what forum and how a reputation was also built upon this. This way, both the *how* and the *why* has been analyzed. By the above, it was concluded that Hawking was a visible scientist and a scientific public intellectual. However, the obituaries described him as a celebrity, and a visible scientist will not necessarily evolve to be a celebrity scientist. Therefore, the process of celebrification was useful to examine.

Celebrification starts off with a merging of the private and professional lives. This happened for Hawking with the publication of *A Brief History of Time*, whose popularity constructed a Hawking franchise in the late 1980s. This made him mare appealing to the tabloids, which examined his private life including his love and family life. Yet, he also used the interest in his private life to incorporate more and more anecdotes from his life in his popular science books. Following this, Hawking became a cultural commodity and started to advertise other cultural products like TV shows and songs and the Paralympic Games in London. The last process of celebrification was very complex, but it represented the way a person becomes synonymous with a set of ideas and ideologies. This happened to Hawking and he became "one of science's most recognizable faces" (Barr 2018, web). Thus, Hawking became a true celebrity scientist with all the possibilities and pitfalls that come with it.

Once Hawking's celebrity status was sealed it didn't remain rigid. Hawking's celebrity status challenged traditional norms and values of the scientific community. By the turn of the millennium, some believed his status was inflated with hot air. Colleagues were worried Hawking's image would harm science internally. In addition: some didn't think he had done anything extraordinary in cosmology. Others appreciated what he had done for science and scientific literacy. By this time, rumors and gossip about his persona and private life appeared. Speculations about physical abuse and how the marital life worked were some of the rumors. This was some of the downsides to celebrity status. The negative perception was not isolated to apply to Hawking, as many visible scientists experience what is called the Sagan Effect. The effect is the manifestation of tension between ordinary scientists and visible scientists. The role of the university has furthermore evolved over the last century and taken on new facets. One of the additional features is, to a high degree, handled by the visible scientists: communicating knowledge to the public. This merely adds to the tension between the scientific community and the scientists who are visible, since different norms and values dominate the public or the media and science. However, Hawking wasn't too affected by the tension in the form of the Sagan Effect and thus continued to be the face of science, as described in the obituaries (Barr 2018, web). He also continued writing popular science books and voicing TV documentaries – along with writing academic articles every year – until his death. Stephen Hawking died on the 14th of March 2018. In the same lines as his own anecdote of being born on the same day Galileo died, only 300 years later: Hawking died on the same day Albert Einstein was born, just 139 years later (Kaiser 2018, web).

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Appendix 1

Hawking Lists

The lists below are not comprehensive and do not display everything Hawking has ever written, done, or received. They illustrate what came up during the writing of this thesis. The lists display popular works, biographies, TV appearances and prizes of multiple kinds.

Year	**Name**	**Specification**	**Reference**
1988	A Brief History of Time	Popular science book	Hawking 1988
1993	Black Holes and Baby Universes and Other Essays	Popular science book	Hawking 1993
2001	The Universe in a Nutshell	Popular science book	Hawking 2001
2002	On the Shoulders of Giants	Popular science book	Fahy 2015, 32
2002	The Theory of Everything: The Origin and Fate of the Universe	Popular science book	Books.google 2002, web
2013	My Brief History	Popular science book	Hawking 2013
2018	Brief Answers to the Big Questions	Popular science book	Hawking 2018

2005	God Created the Integers: The Mathematical Breakthroughs that Changed History	Anthology, Edited by Hawking	Hawking.org, web
2010	The Dreams that Stuff is Made of: The	Anthology, Edited by Hawking	Saxo 2019, web

	Most Astounding Papers of Quantum Physics and How They Shook the Scientific World		

1996	The Nature of Space and Sime	Co-written popular science book	Hawking and Penrose 1996
1997	The Large, the Small and the Human Mind	Co-written popular science book	Penrose, Shimony, Cartwright and Hawking 1997
2003	The Future of Space-Time	Co-written popular science book	Hawking, Thorne, Novikov, Ferris, Lightman and Price 2003
2005	A Briefer History of Time	Co-written popular science book	Hawking and Mlodinow 2005
2007-2016	Children's Literature (5 books on George)	Co-written books for children	Stephen and Lucy Hawking
2010	The Grand Design	Co-written popular science book	Hawking and Mlodinow 2010

1991	A Brief History of Time	TV Documentary	Fahy 2015, 27
1997	Stephen Hawking's Universe	TV Documentary	Fahy 2015, 31
2005	The Hawking Paradox	TV Documentary	Fahy 2015, 33
2008	Stephen Hawking: Master of the Universe	TV Documentary	Hawking.org, web

2010	Into the Universe with Stephen Hawking	TV Documentary	Hawking.org, web
2011	Brave New World with Stephen Hawking	TV Documentary	Hawking.org, web
2012	Stephen Hawking's Grand Design	TV Documentary	Hawking.org, web
2013	Hawking	TV Documentary	Hawking.org, web

2004	Hawking	Movie - BBC Television Production	Hawking.org, web
2014	The Theory of Everything	Movie - Hollywood Production	Hawking.org, web

1993	Star Trek: The Next Generation	Appearance on TV comedy show	Star Trek 2018, web
1999-2010	The Simpsons	Appearance on TV comedy show	Fahy 2015, 38
2012-2017	The Big Bang Theory	Appearance on TV comedy show	Big Bang Theory 2018, web

1991	Stephen Hawking	Biography (Different subtitles for different editions)	Ferguson 1991, 2001, 2011, 2012
1992	Stephen Hawking - A Life in Science	Biography	White and Gribbin, 1992
2005	Stephen Hawking - A Biography	Biography	Larsen, 2005

Year	Name	Specification	Reference
1966	Adams Prize	Prestigious award given by the University of Cambridge	Ferguson 2011, 86
1974	Fellow of Royal Society	Given on the grounds of contributions to science, elected through peer-review	Ferguson 2011, 141
1975	Titled 'Reader' at Cambridge	Given to a senior with a distinguished international reputation	Ferguson 2011, 153
1975	Pius XI Gold Medal	Scientific award given by Vatican City. Given to a promising scientist under 45 years.	White and Gribbin 1992, 163
1975	Eddington Medal, shared with Penrose	By Royal Astronomical Society (UK) for outstanding merit in theoretical astrophysics	Ferguson 2011, 147
1976	Hopkins Prize		White and Gribbin 1992, 163
1976	Dannie Heineman Prize for Mathematical Physics	Given by American Physical Society and American Institute of Physics	White and Gribbin 1992, 163
1976	Maxwell Prize	By Institute of Physics for outstanding early-career contributions to theoretical physics	White and Gribbin 1992, 163
1976	Hughes Medal	The Royal Society's medal for an original discovery in the physical sciences	White and Gribbin 1992, 163

1977	Titled professor in gravitational physics	UK, Cambridge	Hawking 2013, 76
1978	Honorary doctorate	Oxford	Ferguson 2011, 157
1978	Albert Einstein Award	For high achievements in theoretical physics US	Ferguson 2011, 157
1979	Lucasian Professor of Mathematics	UK, Cambridge	Hawking 2013, 84
1981	Franklin Medal	Science Award by Franklin Institute	Franklin Institute 2019, web
1985	Gold Medal in Astronomy	Royal Astronomical Society UK	RAS 2019, web
1987	Paul Dirac Medal	By Institute of Physics UK for outstanding contributions to theoretical physics	Ferguson 2011, 237
1988	Wolf Prize	International award granted by Israel. Given to scientists or artists for achievements in the interest of mankind	Wolf 2019, web
1989	Prince(ss) of Asturias Awards for Concord	Award from Spain, given to individuals or organizations for notable achievements in science, humanities or public affairs	Fundación Princesa de Asturias 2019, web
1989	Companion of Honor	By the Queen for major contributions to science or arts or medicine over a lasting period of time	Ferguson 2011, 384
1990	Honorary degree from Harvard	US	Ferguson 2011, 277

1998	Andrew Gemant Award	By American Institute of Physics	AIP 2019, web
1999	Naylor Prize and Lectureship	By London Mathematical Society for works in applied mathematics and lecturing gifts	LMS 2018, web
1999	Lilienfeld Prize	American Physical Society for outstanding contributions to physics	APS 2019, web
1999	Albert Medal	By Royal Society of Arts. To SH for making physics accessible, understandable and exciting. Given for books and TV programs	Independent 1999, web
2003	Oskar Klein Medal	At Stockholm University. By The Nobel Committee and the Royal Swedish Academy of Sciences.	Ferguson 2011, 355
2006	Copley Medal	By Royal Society UK. To SH for outstanding contributions to theoretical physics and theoretical cosmology	Ferguson 2011, 371
2008	Fonseca Prize	For Science Communication and popularization. By a Spanish University	USC 2008, web
2009	Presidential Medal of Freedom	By the US president (Obama) for significant contributions to world peace or significant public endeavors	U.S Senate 2018, web

2013	Breakthrough Prize in Fundamental Physics	By a non-profit organization for physicists involved in fundamental research.	Hawking 2013, 122
2015	BBVA Foundations Frontier of Knowledge Award	A Spanish Award for significant contributions to science or culture	Romero 2018, web

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