

Cars in Sweden's Cinema & Television

AI-Guided Research of Automobiles in Sweden's Images from 1950-1980

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Department of Media Studies

Degree Master of Arts 15 Credits

Cinema Studies

Cinema Studies Master Program 60 Credits

Spring Term 2021

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**Stockholm
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Abstract

This research project centers around cinematic and societal representation of the automobile in post-war Swedish cinema and television. Due to political neutrality during World War II, Sweden's economy benefited from an extensive surplus immediately after Germany's capitulation in 1945. Economic prosperity was in return transferred onto Swedish society, which enabled an already high degree of motorization of Swedes in mid-1950s, while neighboring European countries struggled rebuilding overall infrastructures, basic food supply lines and often entire cities. Naturally, this would conclude that Swedes presumably had a favorable attitude towards cars from the beginning, ultimately being reflected in some sort of cultural memory. However, Stig Dagerman's 1948 short story "To Kill a Child" (Att döda ett barn), later on realized as short film in 1953, outlines a rather suspicious and cautious attitude towards automobiles. Cars' mass-media portrayal in Swedish cinema and television was analyzed with current AI-techniques, therewith observing notable changes in imagery, themes and attitudes surrounding cars over 30 years in history. *Filmarkivet.se* served as main source with 114 currently available media artifacts from 1950 to 1980, including a wide spectrum of footage i.e., weekly newsreels, private filmmakers' collections, television commercials, movie trailers, political campaigns and documentary formats. This source material proved diversified in nature as well as redrawing accurately representations of Swedish mass media of its time as it varied between cinema and television, whilst focusing in on daily life of individuals or daily life in Sweden's cities. While artificial intelligence object recognition helped identifying pertinent sections within a large corpus of film data, subsequently, a qualitative tf-idf-analysis of selected films based on speech-to-text output was conducted, counterbalancing quantitative research approaches.

Keywords

archive, AI, cars, cultural memory, digital humanities, film, New Cinema History, object detection, speech recognition, Swedish film

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Introduction



Figure 1
Scene from short film *To Kill a Child* (Gösta Werner, 1953)

What if history was remembered incorrectly? It is not far from anyone's understanding that history constantly rewrites itself as present events shape fatefully circumstances. Nonetheless, countless documentaries, books and anecdotes about "forgotten" history circulate vividly in myriad contexts, implying deliberate neglect of something inevitably obvious when looked at again. A recent restoration project "Luta Ca Caba Inda" points at a film archive in Guinea-Bissau, lacking financial means to secure its continued existence, thereby forcing the small country's cultural legacy captured on celluloid to vanish.¹ Consequently, destroying a unique history of revolution against European overlords and subsequent fall of Portuguese dictatorship thousands of miles away. This makes one wonder, how long images from archives can survive in peoples' heads after initial exhibition.

Studies concerning cultural memory suggest audiences remembering less the films, rather the circumstances surrounding them.² For example, the friends accompanying them, the road leading to the movies, or the emotions being felt while sitting in the theater. Interestingly, one might inconsequently disregard efforts of saving a film archive, when its content never was to be remembered in the first place. However, if the same assumption were to be exposed to new technology, then would it continue holding true? The notion of computer-guided analysis of film is not substantially original in itself but has seen considerable change over the past 25 years. One of the first film studies projects commenced in the late 1990s at the verge of the

¹ Miguel Cardina, "Luta Ca Caba Inda: From Archive to Fragement," in *Memoirs ERC*, (Brussels: ERC, 2020), last accessed: May 15, 2021, link: https://www.academia.edu/38506049/LUTA_CA_CABA_INDA_FROM_ARCHIVE_TO_FRAGMENT.

² Daniel Biltereyst, "Film history, cultural memory, and the experience of cinema: a conversation with Annette Kuhn," in *The Routledge Companion to New Cinema History*, Daniel Biltereyst, Richard Maltby and Philippe Meers eds., (Routledge, 2019, E-book), 36.

internet becoming popular, which resulted in an anthology called *Suchbilder* (German for search images).³ In the late 2000s, earlier ideas were reworked as movements in media studies emerged, highlighting practical usability of contemporary digital tools.⁴ Within the past 5 years, quantitative analysis and its immediate benefits have been outlined in several projects on mapping and graphing⁵ as well as renewed measuring techniques for spectatorship.⁶ Latest progress in Artificial Intelligence (AI) makes advanced object and voice recognition possible on average end-user-devices. This gives researchers an opportunity to test hypotheses under new circumstances. For cinema studies, it could mean an increase in simultaneously analyzable content as AI recognition can assist in filtering images through large corpora of films based on simple requests. In a Swedish context, this question seemed tremendously pertinent for something assumed to be remembered well - the history of cars. Feared as futuristic bringer of death, acceptance of automobiles was initially low in 1950s Sweden. However, soon, Swedes and cars became inseparable as time progressed which sparks curiosity on how attitudes managed to change. Therewith, this paper attempted conducting research in a trifold way: (1) confirming if a statistical increase of cars was distinctly visible in Swedish film, cinema and television imagery from 1950 until 1980, (2) assessing change in imagery, themes and attitudes surrounding cars through contextual/textual analysis of sound/language and (3) providing an overview of current AI methods employable in film, while testing technological feasibility and verifiability. Research was deemed especially interesting in a country like Sweden, where high early-on motorization rates, vast numbers of media outlets for cinema and television, and lately, digital archive practices were in favor for such research opportunities.

Traditional cinema studies do not hold methods employable for this task as it would take years to complete analysis, yet thanks to AI, this can be achieved within several days. Thereby, this project falls in line with *New Cinema History*⁷ as it combines methods from two academic disciplines, namely computer science and cinema studies, in order to harness results from 114 films within a time frame of over 30 years. The thesis follows a structure of 6

³ Wolfgang Ernst et. al., *Suchbilder: Visuelle Kultur zwischen Algorithmen und Archiven* [Search Images: Visual Culture in between Algorithms and Archives], (Berlin: Kulturverlag Kadmos, 2003).

⁴ Michael Ross et. al., *Digital Tools in Media Studies: Analysis and Research. An Overview*, (Bielefeld: transcript Verlag, 2009).

⁵ Marta Boni, "Working with Maps," in *A History of Cinema Without Names II*, Diego Cavallotti ed., (Mimesis International, 2017).

⁶ Katalin Balint, Andras Balint Kovacs, "Focalization, Attachment, and Film Viewers' Responses to Film Characters: Experimental Design with Qualitative Data Collection," in *Making Sense of Cinema: Empirical Studies into Film Spectators and Spectatorship*, Carrie-Lynn D. Reinhard ed., (London: Bloomsbury, 2016), 187-210.

⁷ Referring to practices mentioned in *The Routledge Companion to New Cinema History*, not to be confused with Tom Gunning's approach of New Film History, where early cinema is key object of study.

chapters: (1) *Historical Context: Young Rebels, Wild Strawberries and Free Television*, (2) *Theoretical Framework: From Archive to AI*, (3) *Methodology: Making Images Talk*, (4) *Evaluation*, (5) *Future Research: Back to the Future?* and (6) *Conclusion*. Each chapter intends giving readers an adequate overview of the techniques, findings and implications. *Historical Context* will situate cars, cinema and television in its national context between 1950 and 1980 as the Swedish model deviates substantially from common patterns found during this era. The text should offer insights on historical circumstances for films to circulate in Sweden and help readers understand the Swedish film industry during this time. *Theoretical Framework* picks up on archival theory and implications of film as archival medium in face of new technologies such as AI. This step is important as an online film archive (*filmarkivet.se*) was used as point of departure. *Methodology* describes the means of extracting valuable data from digital video files within the chosen research environment. In particular, it will focus on technical hurdles, conceptualization of data output and implementation methods in regard to the programming language Python. *Evaluation* will interpret results harnessed through AI-analysis in video (object recognition) and sound (voice recognition). Readers will be presented with findings grouped into their corresponding decade from 1950 until 1980. Initially, the thesis assumed that there would be a gradual increase in images of cars over the course of time as car ownership statistics point into that direction. However, that assumption could only be confirmed in parts by the data found. *Future Research* delivers concrete ideas for new projects based in particular on this project as well as on concepts for cinema studies and beyond. It could serve as foundation for improvements in terms of accuracy, or more generally draw a mental image of currently available state-of-the-art techniques, borrowed from computer science, employable in cinema studies. *Conclusion* will summarize research with critical reflections added in order to balance out perspectives from in- and outside of this project. Therefore, the methods employed were attempted to be balanced in nature. Some of the techniques used require only very little programming knowledge, whereas others might offer insightful tips, when confronted with large quantities of data, needing to be organized. In other words, where could viewers find images of cars in a Sweden of the 1950s, -60s and -70s?

Historical Context: Young Rebels, Wild Strawberries and Free Television



Figure 2
Scene from short film *To Kill a Child* (Gösta Werner, 1953)

Stig Dagerman's 1948 short story "To Kill a Child" (Att döda ett barn) portrays a gruesome history of the automobile's introduction into Swedish daily life. Within the narrative, a couple drives around untroubledly the countryside in their convertible, while a child is asked to carry out a seemingly unimportant task. The short story as well as the 1953 short film accelerate suspensefully until rural life collides violently with modern lifestyle. Contrary to common assumption, the fictional events playing out on the silver screen described above, might be directly related to factual history. Sweden's drastic economic uplift after World War II facilitated rapid socioeconomic change, subsequently establishing norms around the world. An example of this would be carmaker Volvo's 3-point belt system, which was registered as a patent in 1959, ultimately becoming an industry-leading safety standard. Hence, the observation of automobiles through a filmic lens could prove highly valuable in analyzing how motor vehicles were normalized as an everyday phenomenon in Swedish society. This chapter will focus on the historical context that enables an in-depth discourse about images of cars in Sweden's 1950s, -60s and -70s. It will (1) lay out the state of film industry and movie theaters at the time, (2) explain the country's economic background enabling a steep increase in car ownership and (3) address transition from cinema to television as dominant audiovisual entertainment form. Aim is it to provide readers with a thorough understanding of the country's triangular relationship between cinemas, cars and television as it diverts greatly from models found in other countries around the world during the same time span.

First, Swedish post-war cinema benefited from the country's speedy recovery due to neutral politics. A significant positive difference in the overall economic performance can be

pointed out in harsh contrast to immediate neighbors Denmark and Norway, as well as the majority of continental Europe, which had been occupied by Nazi-Germany (with exceptions of Switzerland, Italy and Spain) from 1939 until 1945.⁸ For example, neighboring country Finland was drawn into war with the Soviet Union, which resulted in a 10% loss of territory, abandoning of Finland's 4th largest city and decades of economic migration in between the two nations.⁹ Neutrality as Sweden's founding principle since the early 19th century secured the country's independence in diplomatic, economic and social negotiations.¹⁰ Even though Swedish neutrality during World War II is considered controversial by some scholars, one could argue regardless that this independence was extended to its film industry.¹¹ Competition from foreign films had largely decreased during the war, which allowed Swedish films to dominate as primary supplier.¹² However, a sharp increase in competition can be noticed in 1945 when previously unreleased foreign films started flooding the local market.¹³ On the one hand, post-war economic success led to Stockholm's city council removing a law preventing construction of new cinemas in 1954.¹⁴ On the other hand, Swedes benefited thereby from a wide variety of programs in numerous locations continuing to foster uninterrupted interest into going to the cinema with its peak in attendance in 1956.¹⁵ Statistics lead to the interesting observation that early 1950s Stockholm had the highest density rate of cinemas in terms of city area size in all of Europe due to its neutral policies which had prevented economic or military destruction within the film industry.¹⁶ However, this does not mean that Swedish film wasn't exposed to restrictions. A high entertainment tax dampened undertaking in the field, so that Swedish film industry with help of government initiatives went into strike, ceasing film production for 6 months in 1951 with minor exceptions.¹⁷ This strong stance in negotiations was made possible as a result of successful film politics of previous decades, such as the Swedish Golden Age (1916-1924), which in part was responsible for a lively exchange rate between American Hollywood, German UFA studios, and Swedish Filmstaden in the following

⁸ Maria Larsson, "Hollywood's Influence after the War?," in *Swedish Film: An Introduction and Reader*, Maria Larsson & Anders Marklund eds., (Lund: Nordic Press, 2010), 144.

⁹ Jussi M. Hanhimäki, "Containing Coexistence: America, Russia, and the 'Finnish Solution' 1945-1956," (Kent, Ohio: Kent State University Press, 1997), 7.

¹⁰ Larsson, 144.

¹¹ Larsson, 144.

¹² Ibid.

¹³ Ibid.

¹⁴ Carina Sjöholm, "Biograf- och Filmhistorisk Bakgrund," in *Gå på bio: rum för drömmar i folkhemmets Sverige*, (Lund: Brutus Östlings Bokförlag Symposion, 2003), 51.

¹⁵ Ibid.

¹⁶ Peter Kristensson, "Att Gå På Bio I Folkhemmets Sverige," in *Natttidningen Svensk Historia*, March 24, 2007, last accessed: April 2, 2021, link: <https://svenskhistoria.se/att-ga-pa-bio-i-folkhemmets-sverige/>.

¹⁷ Larsson, 144.

years.¹⁸ What had followed World War II was a highly creative era that brought forth auteur Ingmar Bergman, defined director Hasse Ekman's works as critically acclaimed as well as earned an Oscar for *Symphony of a City* (*Människor i stad*, Arne Sucksdorff, 1947).¹⁹ Additionally, film benefited greatly from post-war social and economic reforms constructing



Figure 3
Premiere of *The Seventh Seal* (Ingmar Bergman, 1957)
found in Veckorevy 1957-02-25



Figure 4
Walt Disney's first visit to Sweden and Filmstaden,
found in Veckorevy 1959-08-31

its welfare state as people's home (Folkhemmet), resulting in consumerism to be established early on through high purchasing power.²⁰ Within this strategy of reform fits the creation of a new public identity for the country:

As important an aspect of the modernisation was the Swedish self-image. Few societies have been so scared of conflicts. Every time we saw ourselves in the mirror, we were successful, healthy, rational and just. There could be accidents but Sweden was in practice a country without tragedy.²¹

Therefore, it doesn't seem surprising that film scholars attempted reading Swedish film of this era as a response to the newly built society.²² Others claim that Sweden's idealistic self-image, which had been already medially constructed in cinemas during the 1940s, was one of the key enablers for social reforms, ultimately shaping Swedish society until today.²³ As mentioned in the quote above, therewith implying a more explicit cinematic influence on society, as well as an importance of outward self-representation through moving images.

¹⁸ Anders Marklund, "The Golden Age and Late Silent Cinema," in *Swedish Film: An Introduction and Reader*, Maria Larrson & Anders Marklund eds., (Lund: Nordic Press, 2010), 74.

¹⁹ Larsson, 155.

²⁰ Erik Hedling, "Ingmar Bergman and Modernity: Some Contextual Remarks," in *Swedish Film: An Introduction and Reader*, Maria Larrson & Anders Marklund eds., (Lund: Nordic Press, 2010), 219.

²¹ Life Zern, *Se Bergman*, Stockholm: Norstedts, 1993, 23 [Found Larsson, 220].

²² Hedling, 219.

²³ Ibid, 221.

Second, post-war Swedish societal wealth enabled cars as an everyday sight in different contexts. Economically speaking, the country developed into one of the wealthiest nations in the world, thereby not only raising general levels but improving economic success of individuals as well.²⁴ During World War II, car ownership rates decreased significantly due to shortage in the car making industry but improved after the war with a noticeable rate of change of 396% between 1943 and 1948.²⁵ Immense growth in car sales continued until late 1980s when the market started to become saturated.²⁶ During most of this time, Sweden continued to outperform within the Nordic region (Denmark, Finland, Norway) as it easily had approx. double or triple the number of cars per capita from 1955 until 1970. Cinematically speaking,

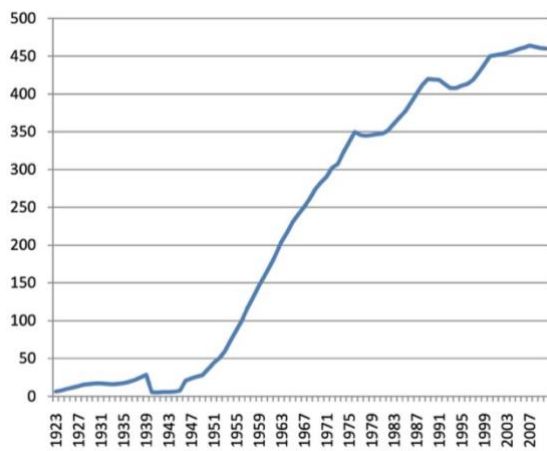


Figure 5
Sweden's ownership of car rate in capita from 1923-2010,
found in Tristan Jaques' MA thesis



Figure 6
International car salon 1958 in Copenhagen, found in
Veckorevy 1958-03-03

scholars trace back a distinct connection between film and cars when considering iconic works, high budget productions and common cinema outlets of the time. One case is represented by American cult classic *Rebel without a Cause* (Nicholas Ray, 1955) in which a 1949 Mercury is used in the so-called chicken run scene: two restless teenagers challenge each other to drive a race towards seashore cliffs, implying whoever is staying longer in the car wins the race. Another example is Ingmar Bergman's *Wild Strawberries* (Smultronstället, 1957) in which the aging protagonist is drawn into a series of dream-like reflections on his life, while traveling to student city Lund. His 1937 Packard South becomes the central tool to remember nostalgically core memories. Last but not least, the 1960 Mercedes Benz 180B that takes thought-to-be-lost love interest Geneviève back to her Normandy hometown in *The Umbrellas of Cherbourg* (*Les Parapluies de Cherbourg*, Jaques Demy, 1964), where main character Guy's lifework is

²⁴ Tristan Jaques, "On the Road to the Automobile Age: Sweden (1923-1973)," (MA thesis, School of Economics and Management, Lund University, 2011), 20.

²⁵ Ibid., 19.

²⁶ Ibid.

represented through building, managing and protecting a gas station as his home. This interwoven connection can be traced back to 1930s Hollywood cinema in which the oil industry invested heavily to sell its product.²⁷ The connection between restless mobility, cars as modernity's central image and timeless reliability was established in the Hollywood-studio system.²⁸ Whether audiences recognized certain models or brands might be secondary in nature, overshadowed by the presence within the films as primary nature. *Back to the Future* (Robert Zemeckis, 1985), *Titanic* (James Cameron, 1997) or Disney Pixar's *Cars* (John Lasseter, 2006) as commercially successful, pop-culturally impactful and technologically advanced examples might be read as evidence of this trend's longevity.

Third, post-war Sweden's television advanced rapidly into a mass medium, thereby

	1950	1955	1960	1965	1970
Sweden	28	75	145	215	273
Norway	19	31	54	111	180
Denmark	25	43	77	142	208
Finland	5	17	37	89	140
UK	42	60	93	155	201
France	36	48	95	163	234
Belgium	25	49	76	132	184
Italy	6	15	33	89	168
Austria	5	10	49	97	149
Portugal	7	10	17	23	46
Average	20	36	68	122	178
Canada	120	163	212	261	303
USA	234	289	327	370	422

Figure 7

Car ownership rates in selected OECD-countries, found in Tristan Jaques' MA thesis

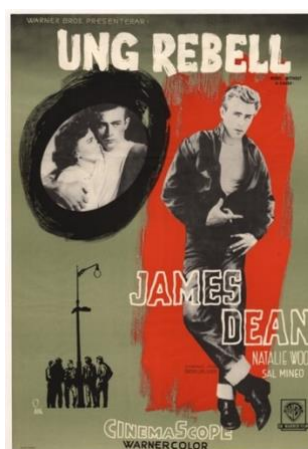


Figure 8

Swedish original cinema release poster of *Rebel without a Cause* (Nicholas Ray, 1955)

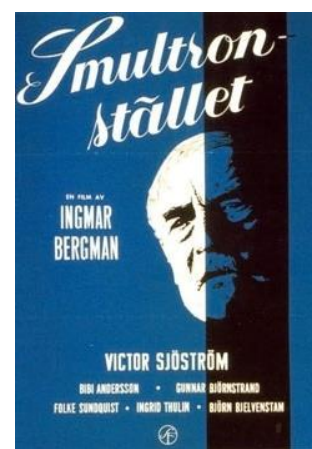


Figure 9

Swedish original cinema release poster of *Wild Strawberries* (Ingmar Bergman, 1957)

normalizing home entertainment much faster than other countries. Ownership rates skyrocketed within 4 years from 1,000 in October 1956 to 750,000 in April 1960, which leads to the assumption that nearly every 3rd household owned a tv by 1960.²⁹ At the time, the report's prognosis leading to a household saturation rate of 99% by 1965 was exceeded and can be assumed to be already reached by 1963.³⁰ As a comparison, post-war West-Germany had been

²⁷ Marina Dahlquist, "Petroleum and Hollywood Stardom: Making Way for Oil Consumption through Visual Culture," in *Petrocinema: Sponsored Film and the Oil Industry*, Marina Dahlquist, Patrick Vonderau eds., (Bloomsbury Academic & Professional, 2021, E-Book), 118.

²⁸ Ibid., 119.

²⁹ Jan Gillberg, "TV I SVERIGE – första halvårsrapporten 1960," (Industrial Report, Industriens Utredningsinstitut, Stockholm, 1960), 8.

³⁰ Ibid., 37.

exposed to television in theory since the Berlin 1936 Olympic games, yet received harsh criticism as television was mostly used for propaganda during Hitler's time.³¹ American democratic opposition and personal reluctance caused refusal of the intellectual bourgeoisie in obtaining a television set. It wasn't until the mid-1970s when West-Germany started reaching

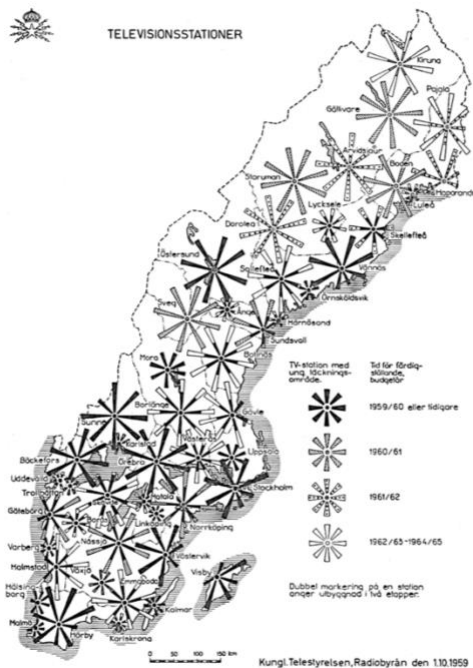


Figure 10

Sweden's television broadcasting tower network with construction time frames from 1959-1965, found in Jan Gillberg's "TV in Sweden – First Half Year Report", touched up

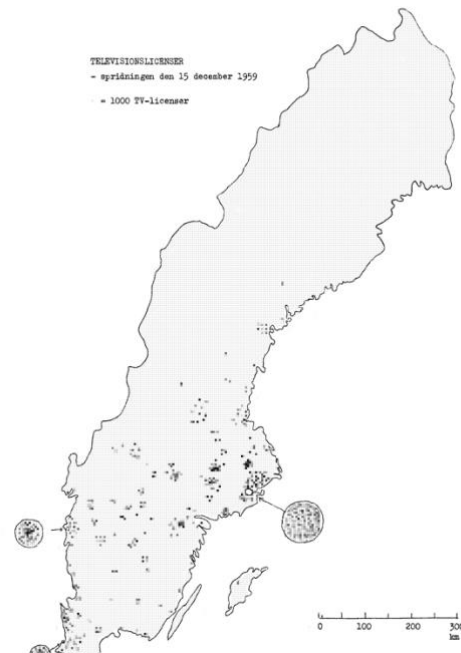


Figure 11

TV license density in Sweden December 1959, found in Jan Gillberg's "TV in Sweden – First Half Year Report", touched up

similar levels of television ownership to Sweden. Regularly programmed television was officially introduced in 1956 after several experimental broadcasts by the Royal Institute of Technology (KTH) under the condition that it would be monopolized, state-controlled, license-financed and public service (Sveriges Television, SVT). Aim was it to provide the country with objective, educational and high-quality entertainment.³² Even though strictly regulated, television proved to be still experimental in its first years allowing for a high degree of creativity. For example, already internationally recognized Ingmar Bergman agreed on directing live several critically acclaimed August Strindberg plays under television's novelty from 1960 until 1963.³³ Furthermore, global events of utmost importance were broadcast live

³¹ Peter Hoff, „German Television (1935–1944) as subject and medium of National Socialist Propaganda,“ in *Historical Journal of Film, Radio and Television* 10 no. 2 (1990), 227-240.

³² Larsson, 145.

³³ Staffan, Ericsson, “Stormy Weather: The Pre- and Post-History of Television,” in *International Journal of Communication*, 10 (2016), 5304.

on television such as reports on Vietnam from 1967 until 1972, Dr. Martin Luther King Jr.'s assassination in 1968 or NASA's Moon Landing in 1969. Sweden's neutral character traits voiced political interest in American black civil rights movement³⁴ and stark skepticism towards U.S. bombings in Vietnam.³⁵ Spiking viewer rates and numbers of tv licenses as a result of wide public interest led to the formation of a second public channel in 1969 (TV2).³⁶ Throughout that, technical development was marked by fast progress. Swedish taxpayers had funded a television broadcasting network that covered nearly the entire country in size, while over 90% of the population had theoretically access to this network by 1960.³⁷ Further coverage was guaranteed by 1965. Large funding enabled Swedish film and television industry to make use of a 16mm standard for daily broadcasts, which entails a significant image quality difference to the more common 8mm- or video-tape format used in other countries around that time.³⁸

In conclusion, Sweden's 1950s were marked by a dominant, creative and successful film industry that nurtured a strong cinema going culture. In films released around that time, cinema made use of cars as central theme not only in a national context such as *To Kill A Child* (*Att Döda Ett Barn*) and *Wild Strawberries* (*Smultronstället*) but beyond that as well, namely *Rebel without a Cause* (Swedish title: *Ung Rebell*) and *The Umbrellas of Cherbourg* (*Paraplyerna i Cherbourg*). Local yet international films of high-quality, entertainment value or popularity were shown in the highest density of movie theaters by city area size in Europe, which led to cinema's peak in attendance in 1956. Simultaneously, the same year marked the official beginning of public broadcasting culture in television, which eventually would become the dominant form of audiovisual entertainment by the mid-1960s. Industry reports show that more than 33% of households already owned a television set that could be connected to an extensive broadcasting network by April 1960. Furthermore, creative and successful methods were translated from literature, theater and cinema into the new mass medium. On a technical level, image quality of Swedish daily broadcasts was higher than the industrial norm of the time. Notably, Ingmar Bergman can be considered a product of this era's strong cinema and television culture. Parallely, cars were rapidly transforming urban and rural landscapes as

³⁴ The Black Power Mixtape 1967-1975 (2011), *The Swedish Film Database*, last accessed May 14, 2021, link: <http://www.svenskfilmdatabas.se/en/Item/?type=film&itemid=70059>.

³⁵ Malin Wahlberg, "Vietnam in Transmission: Documentary Film and Solidarity Programming in Swedish Broadcasting Culture (1967–72)," in *Journal of Scandinavian Cinema* 7, no. 1 (2017), 44. (43–64)

³⁶ Nils-Olof Franzén et al., *Hört och sett: radio och television 1925-1974*, (Stockholm: Sveriges radio, 1974), 299.

³⁷ Gillberg, 5.

³⁸ Malin Wahlberg, "Inledning: Filmavdelningen – en historisk överblick," in *TV-pionjärer och fria filmare. En bok om Lennart Ehrenborg*, Malin Wahlberg, Tobias Janson eds., (Stockholm: Kungliga Biblioteket, 2014), 13.

ownership rates grew dramatically. Sweden continued having numbers nearly twice as high as the OECD-average in rate of car ownership per capita between 1950 and 1970. For the research project at hand, it leads to the general assumption that footage from that time period was exposed to a wide degree of spectatorship. A centralized public television infrastructure, high number of cinemas with quality programming and advanced technical image quality favor this kind of argument. However, this does not automatically imply that average viewers were making use of all media outlets regardless of cost and time efforts but gives images of cars a high penetration rate. This sets the Swedish triangular model between cinemas, cars and television distinctly apart from other countries in the 1950s, -60s and -70s as growth occurred not singularly but collectively. It allows researchers to explore this time era through media footage unlike any other.

Theoretical Framework: From Archive to AI

Ernest Lindgren and Henri Langlois shaped quietly how films from the past should be looked at. Lindgren as a representor of the National Film Library, which today is part of the British Film Institute, focused on preservation of film over any other means. His film library was impeccably structured, implementing a registry card index system, neatly storing film reels and limiting access to a general public by allowing only few selected people to enter and exit the library.³⁹

Langlois' approach on the other side of the Canal prioritized showcasing as many films as he could obtain in front of large audiences. Thereby, he established a culture of cinephile reflection in post-war France which enabled vivid discussions on film. Eventually, placing it as an institution on top of the list of respected arts, thereby receiving government funding and support in larger scope.⁴⁰

However, both pioneers of film archival work faced immanent challenges unique to their very own position. Lindgren created a vast and comprehensive film archive which was lacking recognition. Meanwhile, Langlois exposed films so much that his archive was

³⁹ Christophe Dupin, "Je t'aime...moi non plus," in *The British Film Institute, the government and film culture*, ed. Geoffrey Nowell-Smith (Manchester: Manchester University Press, 2012), 46.

⁴⁰ *Ibid.*, 52.

destroying itself through overuse.⁴¹ It could be criticized that both representatives failed to preserve the past by altering artifacts, denying access and hindering recontemplation.

This chapter is going to address key theoretical issues that determine the structure of research around images of cars in Swedish film archives. It will discuss in detail (1) film as archival medium, (2) the digitalization of the archive and (3) basic video-AI concepts. Aim is to delimit theoretical approaches by giving an overview of current research opportunities.

First, film's unique archival quality entails consequences in terms of archive theory as it is situated in between the dichotomy of internal idealistic preservation and external grotesque exclusion. That means, while it attempts capturing objectively an image of the world, it is forced to hide most of it away due to the constraints of the medium. Film's prototype can be traced back to several inventions being made in the late 19th-century. In an American context, film is considered a byproduct of an expensive, yet simple bet placed by industrial Leland Stanford.⁴² At the time, science had no technical possibility of repeating precisely nature's movement after initial execution, causing much knowledge to be based on assumption. Stanford's curiosity in horse racing led to questions surrounding animal movement, which then were recorded by Eadweard Muybridge in an experimental setup. In a French context, Étienne-Jules Marey studied not only animal but also human motion, resulting in a similar process involving overlapping of positions on a single plate.⁴³ Though cinema, television and internet altered perception of film over a 120-year-period, film remained always in parts an archival apparatus, shaped by scientific nature, allowing to preserve something previously irretrievable. This notion entailed possibly a movement of preservation in the years that followed the invention of film. For example, banker Albert Kahn financed independently an ambitious archive of the world (*Archives de la Planète*), for which he employed dozens of camera men travelling the world from 1909 until 1931 in order to capture it on film and in photographs.⁴⁴ The Parisian project ended abruptly after Kahn went bankrupt during the Great Depression, even though it succeeded in capturing some remarkable moments in history.⁴⁵ The unfinished Kahn archive brought forth new issues, previously peripheral in written archives as access, storage and inscription differed significantly. If one were to look at this archive only, then the

⁴¹ Ibid., 50.

⁴² John Sanford, "Cantor exhibit showcases motion-study photography," *Stanford Report*, February 12, 2003, last accessed: May 14, 2021, link: <https://news.stanford.edu/news/2003/february12/muybridge-212.html>.

⁴³ Marta Braun, *Picturing Time: The Work of Etienne-Jules Marey (1830-1904)*, (Chicago: University of Chicago Press, 1999), 31–34.

⁴⁴ Paula Amad, "Introduction," in *Counter-Archive: Film, the Everyday, and Albert Kahn's Archives de la Planète*, (New York: Columbia University Press, 2010), 22.

⁴⁵ Ibid., 6.

world would have ended in 1931 and everything it did not capture would be excluded, such as the universe, which could not be entirely captured then nor today. Another issue lies in the question if an archive could ever be completed. Years later, French film theorist Jean Epstein pointed out film's unique ability to visualize the previously unseen dimension that only had been theorized by physicists and mathematicians – time. Epstein's theoretical claim described how film captures “reality” with mathematical precision unlike any other medium.⁴⁶ Furthermore, he said that it could manipulate spatial and temporal figurations, such as through time-lapse, slow motion or ellipse montage.⁴⁷ Famously, Nouvelle vague films as product of critical film studies, pushing boundaries of temporal concepts even further, included scenes such as in *Pierrot Le Fou* (Jean-Luc Godard, 1969) or *Last Year in Marienbad* (*L'Année dernière à Marienbad*, Alain Resnais, 1961), in which sometimes beginning and end occurred within the same shot. Therewith, archival theorist Michel de Certeau referred to the archive as a perversion of time, since it constituted its own spatial and temporal figuration secluded from the present.⁴⁸ If one were to model the future based on what is contained in the archive only, the future will probably remain within much proximity to the past. In its worst case, it will remain a simulation of it. However, history demonstrated that there are unpredictable events, which data could not foresee. Much like the trend sparked by IT that initiated an overtaking “Archival Fever” in the digital age, which altered the relationship between researcher and archive.⁴⁹ Hence, the interaction with archival films has to be in a considerate amount, implying that the camera captured possibly a moment in time that was asynchronous to everyday behavior or excluded much of what was factually there. For example, D.W. Griffith's *The Birth of a Nation* from 1915 refused to show actual people of color, even though it was set during the American civil war, which had slavery as its most pertinent motivation. 60 years later, Kodak as color film manufacturer was still facing problems with celluloid photochemical processes. During the 1970s, the company as one of the largest film material producers in the world was not able to balance high and low tones so that people of different skin colors could be in the same frame without over- or underexposing certain parts of the image. The issue became pressing when dark wood furniture trends exposed film's faulty nature. Therefore,

⁴⁶ Jean Epstein, “Die Regel der Regeln,” [Le loi de lois, 1946] in *Jean Epstein: Bonjour Cinéma und andere Schriften zum Kino*: 83-86.

⁴⁷ Ibid.

⁴⁸ Michel de Certeau, “Der Raum des Archivs oder die Perversion der Zeit,” [The space of the archive or the perversion of time] in *Archivologie: Theorien des Archivs in Wissenschaft, Medien und Künsten*, Knut Ebeling, Stephan Günzel eds. (Berlin: Kunstverlag Kadmos Berlin, 2009), 116.

⁴⁹ Jaques Derrida, “Archive Fever: a Freudian impression,” (Chicago: University of Chicago Press, 1996).

quality, origin and framing have to be considered by researchers in order to assure a nuanced approach as it can cause otherwise dangerous assumptions about past, present and future.

Second, the archive's digitalization reshapes storage, metadata and access by means that allow for new archival approaches. Much of Swedish film was preserved, digitalized and uploaded to *filmarkivet.se*.⁵⁰ Once analog film is scanned and converted to a digital file, it can be duplicated, manipulated or viewed endlessly.⁵¹ Digital conversion allows for easy extraction of film without damaging the "original", which was one of the biggest concerns in previous years. British Film Institute's Ernest Lindgren complained in many letters to his French equivalent Henri Langlois that borrowed film reels were returned to the UK in dramatically worse condition.⁵² Another problem occurred during German occupation of France in World War II, which was rooted in film reels' metadata and retrieval. Precautions were taken to save precarious films from the Nazis by relabeling them with insensitive fake names.⁵³ Due to secrecy and length of war, most of the relabeled reels were forgotten and cannot be located anymore, which causes Cinémathèque Française's archive to be inconsistent until today.⁵⁴ Digital archives reduce commonly known issues as files can theoretically be accessed and transferred from and to anywhere in the world without concern of overuse. Human labor is not as intensively needed to carry out basic tasks such as searching for specific artifacts. Faster than humanly possible algorithms take over the execution for the workload's majority. Simultaneously, metadata generated from files becomes as valuable as the films themselves. Duplicates can be identified effortlessly through comparison of file size, name or content. Human input is no longer necessary to spot plagiarism, video pirating or online hate. However, these methods come with strict limitations as simple algorithms cannot learn to adapt or change, which occurs frequently as files are renamed to something more innocuous, the speed of video streams altered so that computer recognition is slowed down, or slurs adapted to avoid content filters. New issues arise as files are irretrievable if deleted by accident. Archives become subject to new external threats such as cyberattacks, power outages or hardware failure. Furthermore, digitalizing alters analog artifacts and their experience horizon thereby creating newly derived digital audiovisual copies. For many years, disadvantages of digitalization

⁵⁰ Filmarkivet.se, "About Filmarkivet.se: Rights clearances", last accessed April 15, 2021, link: <https://www.filmarkivet.se/english/>.

⁵¹ Jon Wengström, "The Coexistence of Analogue & Digital Strategies in the Archival Film Collections of the Swedish Film Institute," in *Archives at Work*, April 2017, 63.

⁵² Dupin, 50.

⁵³ A. Scott, "A Great Man of Movies, Who Never Shot a Frame, Created a Way of Seeing," *New York Times*, October 12, 2005, last accessed: May 14, 2021, link: <https://www.nytimes.com/2005/10/12/movies/a-great-man-of-movies-who-never-shot-a-frame-created-a-way-of-seeing.html>.

⁵⁴ Ibid.

seemed more numerous than their corresponding advantages, which in return caused archives to refrain partly or mostly from the expensive overhauling process. One example would be that file formats dominate for a few years then to be replaced by new optimized equivalents. Another issue relates to the amount of data becoming unsurmountable as video material tends to consume storage quickly. However, computing capacity in several technical areas increased steadily according to Moore's law which made it possible to counteract these issues and for "big data" to be harnessed.⁵⁵ The term "digital humanities" refers to research projects that match technologically advanced IT with established fields in philosophical domains. Some concrete examples can be found in *New Cinema History*⁵⁶ approaches that favor optical character recognition (OCR) in combination with text analysis in order to carry out film historical research in trade press.⁵⁷ Other projects utilized digitalized historical maps in combination with movie theater ticket sales to reconstruct audience behavior on transnational levels.⁵⁸ With a digitalized archive and combined methods from IT and humanities, research opportunities become more numerous.

Third, AI-guided research will significantly increase research output, flexibility and application. Video-AI is now on the verge of a 99% recognition reliability in terms of object detection at high speeds even on slower hardware. Industry leader Apple renewed foremostly their chip architecture in late 2017, thereby altering irreversibly their line of production. Latest computer, phone or tablet models are equipped with so-called Neural Engines.⁵⁹ This dedicated part of the computing chip is designed as a number of 2-digit cores, which improves machine learning (ML) and artificial intelligence tasks.⁶⁰ Neural networks compute parallelly thereby increasing exponentially performance of high intensity calculations. The core concept behind today's AI approach is a compartmentalization of probability through implementation of statistics. AI projects were already in existence during the 1980s, where the biggest issue was

⁵⁵ Moore's law is the statistical observation that circuits in a newly built computer chip double in number every 2 years.

⁵⁶ Referring to practices mentioned in *The Routledge Companion to New Cinema History*, not to be confused with Tom Gunning's approach of New Film History, where early cinema is key object of study.

⁵⁷ Martin Loiperdinger, "Early film stars in trade journals and newspapers: data-based research on global distribution and local exhibition," in *The Routledge Companion to New Cinema History*, edited by Daniel Biltereyst, Richard Maltby and Philippe Meers (Routledge, 2019, E-book), 138.

⁵⁸ Daniel Biltereyst, Thunnis van Ort, and Philippe Meers, "Comparing historical cinema cultures: reflections on new cinema history and comparison with a cross-national case study on Antwerp and Rotterdam," in *The Routledge Companion to New Cinema History*, edited by Daniel Biltereyst, Richard Maltby and Philippe Meers (Routledge, 2019, E-book), 96.

⁵⁹ Apple.com, "Apple unleashes M1", November 10, 2020, last accessed: May 14, 2021, link: <https://www.apple.com/newsroom/2020/11/apple-unleashes-m1/>.

⁶⁰ Ibid.

represented in attempting to counteract irregularities in data.⁶¹ The larger the amount of data, the higher the tendencies for small deviations, mistakes or blank spots. Simple computing tasks unlike humans are not equipped to alter behavior when encountering issues. The default response is pausing or aborting the task at hand in order to prevent further damage to the machine. However, when conceptualizing uncertainty as probability, then tasks can learn to handle exceptions that aren't defined by the book. For example, when road marks are missing in an image, then an autonomous vehicle has to decide independently whether this is only a sensory misinformation of the camera, weather induced erosion causing the marks to disappear, or the end of the road. Therefore, autonomous vehicles use a wide range of different sensors in combination with up-to-date map data, weather information and previous on-the-road experience to navigate this type of situation.⁶² IT-research improved the rate of accuracy and speed by employing so-called neural networks.⁶³ These networks are based in part on actual neurochemical/biological mechanism, allowing computers to learn autonomously and adaptively from given data. Terminology refers to inputs and weights corresponding to linear functions in each neural node.⁶⁴ Input can be any data such as images, videos or text. The neural network then can be modified through training with selected examples. Weights are similar to pliable molds in pottery or baking, taking on shape through the process of training. During training, certain parts of the image receive fictional starting weights placed on them, so that after applying a linear mathematical equation, the output of that node represents a probability value between 0 and 1 of how likely it is. For example, indicating if there is a cat in an image.⁶⁵ The novelty lies in the interplay of these nodes as they are connected in different layers and output only a final probability at the end of the process. Therein, individual neural nodes respond singularly to specific properties such as shapes, colors, sizes, position, orientation and so on. Therefore, neural networks are unique after training, implying that they have to be retrained when wanting to detect other objects. If 100 images of cats were used in order to train it to recognize cats, then the cat-neural network wouldn't be able to identify dogs for example. Even though theoretical framework of neural networks in IT existed already in the 1960s, only recent development in graphic cards made it possible to obstruct them to carry out AI tasks on

⁶¹ Anna Esposito et. al., "Recent Advances of Neural Networks Models and Applications: An Introduction," in *Advances in Neural Networks: Computational and Theoretical Issues*, (Cham: Springer International Publishing, 2015), 4.

⁶² Ibid.

⁶³ Ibid.

⁶⁴ Building AI, "Logistic Regression," Neural Networks, University of Helsinki, last accessed: May 14, 2021, link: <https://buildingai.elementsofai.com/Neural-Networks/logistic-regression>.

⁶⁵ Ibid.

a wide scale, which in return spiked interest in research.⁶⁶ Namely graphic processor manufacturer Nvidia, tech giants Amazon, Apple and Google push forward research in white papers in order to create feasible commercial profit. However, the ingenuity behind this technology lies in its scalability. Neural networks can be replicated on more than one graphical processor, which improves speed by the number of graphical processor times their computing speed.

In conclusion, film's archival quality is deeply rooted in the medium itself. A few film archives attempted to save the world's "reality" on celluloid, which lead to theorists confirming film's mathematical precision in preservation as well as theoretical opposition claiming that film archives represent a "perversion of time". The overall dichotomy in film archival practices can be divided into internal idealistic preservation and external grotesque exclusion, which has to be considered by researchers interacting with archives. Technical progress led to digitalization of film and film archives, which altered interrelations of access, collection, inscription, storage and metadata. *Filmarkivet.se* provides a contemporary Swedish example. Dynamic changes as well as high cost of film's digitalization influenced archives' reluctance in digitalization, ultimately amplifying certain aspects of commercial distribution. Digital alteration, loss and retrieval pose new questions and challenges to film archives. Trends in the tech industry hint at a further intensification and acceleration of less human labor intense work within film archives. AI with the usage of so-called neural networks enables research projects to be more flexible, applicable and faster. Statistical uncertainty as a concept of probability improved AI performance drastically, thereby allowing neural networks to be trained autonomously and adaptively on images to detect objects in so-called Convolutional Neural Networks (CNN). AI research requires high investments in knowledge, and sometimes in hardware, in order to show presentable results, which is currently its strongest disadvantage. However, the flexibility of this technique is only limited to creativity after the initial hurdle has been overcome. Beyond that, it offers capability to harness IT's precision on a highly quantitative level. Furthermore, Sweden is already in possession of high-performance cloud computing infrastructure (Swedish National Infrastructure for Computing, SNIC) that can be utilized on basically any researcher's private computer. Finally, when presented with results, assumptions made based on selected data from archives in general, but furthermore digital archives, need to be weighed in carefully as a problem of overfitting might occur. In other

⁶⁶ Elements of AI, "AI Winters," About Predicting the Future, University of Helsinki, last accessed: May 14, 2021, link: <https://course.elementsofai.com/6/1>.

words, results might be flawed due to the nature of samples and therefore cannot represent ultimate findings in their entirety. However, when extracted with qualitative research methods from humanities, they could become invaluable knowledge. As for example, this can lead to reverse engineering from image detection to image generation.

Methodology: Making Images Talk

The following chapter is going to focus on methodological aspects of this research. Within the introductory paragraphs, the text will address technological hurdles, data safety concerns and legal issues that have to be considered before conducting research. The main part will consist of descriptions about (1) datamining, video conversion and video detection as well as (2) sound conversion, sound detection and natural language evaluation methods. In a third part, the chapter will discuss improvements in terms of efficiency based on the smaller first iteration of this project and propose data visualization approaches for researchers. Concluding remarks will summarize main elements of the overall process. Purpose is it to help readers understand how the data was generated, selected and evaluated in order to guarantee transparency. Furthermore, it should provide technical insights on the evaluation that is to follow in the chapter of the same name.

A two-step-method was applied in order to facilitate a textual analysis of 114 media artifacts found on *filmarkivet.se*. The two steps resulted from film having a strong emphasis on the auditive as well as on the visual. In a first step, AI analyzed videoframes containing cars based on an object-detection-algorithm. In a second step, an end-to-end speech-recognition tool was used for a selective textual analysis of spoken word within 30 media artifacts. A simple dynamic tool was created in order to interact with the findings directly through a web browser. This project required an intermediate understanding of programming languages Python, HTML, CSS and JavaScript. The first one was used only for the actual video and sound detection. The latter three were necessary for the interactive tool mentioned above. Python provided simplicity, already available programming libraries and privacy protection, even though it might not be the fastest programming script in comparison to others. For context, there are other technological end-user solutions available such as Google's Vision AI, Amazon's Rekognition and Apple's Vision. All three software products are well-equipped and advanced video-analysis tools but tend to be difficult to implement for small-scale projects. Their basic set-up requires a virtual environment including sub-elements such as online storage, network traffic

and usage cost. The obvious downsides of these services are currently untransparent billing options, which calculate cost based on a multitude of independent variables such as geographic location of the server in use, data transfers through local/global networks and number of write/read tasks on hard disks. This ruled out a simple-usage approach for researchers as they tend rather to cater needs of major television networks, streaming services or archives in supporting them categorizing content in rapid time. Additionally, these tools demanded a constant connection to the internet, so that files could be processed online, entailing a less obvious issue to consider in advance: data privacy. In recent years, Google failed upholding its own privacy regulations several times,⁶⁷ whereas other service providers might not fall short from that either. Google guarantees complete privacy of data being processed on its servers according to its website's privacy statement. However, it is fair to mention that alternative methods (like Python's *Yolo* library for video detection and Mozilla's *DeepSpeech* for speech detection) exist, allowing end-users to process data entirely on their own machine, without any internet connection needed. Furthermore, it can cause costly and judicial consequences when conducting research without consideration of legal frameworks. *Filmarkivet.se* digitalized and published only films which had lost, unknown or expired copyright agreements during this time period, which can be found within the website's disclaimer.⁶⁸ Therefore, copyright infringement could not take place. In other research projects, hard copies might have to be purchased or agreements to be made with legal right holders of films in use.

Step1: Webscraping, OpenCV, Yolo, MoviePy, Openpyxl

A simple *webscraping* algorithm was employed to download automatically 114 video files from *filmarkivet.se*. This required a basic http-request in combination with a search function on the website's source code. It locates each file on the server, downloads it to the researcher's machine and names it accordingly. File names should entirely be handled by the machine only as human error can result in faulty data. For example, weekly newsreels were all named in the format "*veckorevy YYYY-MM-DD*", so that one typo could alter accuracy. Consequences of this can entail hour-long manual searches, which can be prevented. The benefit of this method lies in its reusability, so that any link request can be made to the website. This was necessary as sampling from a wide pool of film formats was intended. The project made use of private filmmakers' collections, television commercials, movie trailers, political

⁶⁷ Nick Kolakowski, "Weekend Roundup: New Google Privacy Concerns, Facebook Crisis," in *Dice* (June 2020), last accessed April 15, 2021, link: <https://insights.dice.com/2020/06/05/weekend-roundup-new-google-privacy-concerns-facebook-crisis/>.

⁶⁸ Filmarkivet.se, "About Filmarkivet.se: Rights clearances", last accessed April 15, 2021, link: <https://www.filmarkivet.se/english/>.

campaigns, public service announcements and documentary formats all focusing on city developments. Goal was it to provide yearly evaluations of Swedish film, the arithmetic mean of 3-4 films (aiming at 40 minutes of film for every year), in order to be able to make statistical assumptions.

The Python library *Yolo* (You-Only-Look-Once, Version 5 currently available) is a powerful, freely available AI image recognition tool which was used for the means of the project. Its basic library is equipped with a pre-defined set of recognizable objects such as humans, dogs and planes but can be modified to recognize any object. It uses a pre-built object-classifier model which was trained by an AI neural network at an earlier stage. During training, positive images (containing the to-be-recognized object) and negative images (containing backgrounds or other objects) are analyzed by a neural network. Due to selection of positive and negative images or through annotation of a handful of images, AI neural networks learn adaptively, determining separate elements of an image through extensive iteration, probability and image compartmentalization. After training, a *cascade*-file can be created containing recognition “patterns” for future imagery. This pre-trained model allows speeding up the recognition process exponentially.

A prerequisite for this project consisted of looking at processing capabilities of the computer in use. A MacBook Pro 13-inch model from Mid-2016 was employed, which limited processing capability to 4.1 frames per second due to the graphics processor built-in. For the example at hand, *filmarkivet.se* digitalized media artifacts either at a rate of 24 or 25 frames per second. However, without conversion to a lower frame rate, the algorithm would require 6 seconds to process 1 second of film. With a processing ratio of 1:6, analysis would slow down extensively. A simple method to counteract this technological obstacle lies in converting original video files to lower frame rates. It was decided that 4 extracted frames from each second of original film would be sufficient enough to recognize whether there would be cars visible in the image or not. The decision was made on the basis that source material was not extracted from experimental film which tends using superimpositions or rapidly changing editing patterns. Another reason was that the human’s eye’s visual perception needs at least 12 frames per second to recognize motion, implying that if cars were shown in less than 2 consecutive data points, human eyes would most likely not pick up on them, therefore eradicating the findings themselves. This method allowed using 4 data points, each with a quarter of a second distance to each other, for every second of film, regardless of the original frame rate. In case of contradictory findings, this would help to identify the source of errors quicker as multiple data sets per second existed.

Python's library *MoviePy* helped converting 114 files by lowering their frame rate to 4 frames per second, which then could easily be processed by the *Yolo* library to detect cars in each individual shot. Ultimately, this reduced core data needed to be processed by 83%. In the following table processing time estimations can be seen (see table 1):

Estimation <u>without</u> extraction method	$\frac{10 \text{ min video} \times 60 \frac{s}{min} \times 24 \text{ fps}}{4.1 \frac{fps}{s} \text{ processing time}} = 3,512 \text{ s processing time} = 58 \text{ min}$
Estimation <u>with</u> extraction method	$\frac{10 \text{ min video} \times 60 \frac{s}{min} \times 4 \text{ extracted fps}}{4.1 \frac{fps}{s} \text{ processing time}} = 585 \text{ s processing time} = 9 \text{ min } 45 \text{ s}$

Table 1 Estimation Times for AI-Object Detection

The *Yolo*-algorithm saved 2 orientation coordinates in combination with width and height information for each car recognized in a single shot into a text file (TXT) while the entire snapshot ("condensed") video file was being analyzed. Python's *OS* library read subsequently all text files, simultaneously calculating the number of cars in each frame, then determining beginning and end of the video file, recalibrating empty data sets in between frames and finally, saving results of each video file into one comma-separated-value file (CSV). Another Python library called *Openpyxl* converted CSV-files to XLSX-files with an automatized creation of column charts for each video. Further evaluation of results was handled entirely in Microsoft Excel visualizing cars-per-frame-values as car histograms allowing export to a JPG-file-format. The generated car histograms could be used as a verification method of data consistency as overlaying histograms with their corresponding original video file at 24/25 frame rate proved sound (see fig. 12):



Figure 12
Overlay method for confirmation of data validity

However, this simple method proved time and energy consuming, when carried out on a large scale of 114 videos. This led to the creation of an interactive visualization tool, which will be discussed further in detail later in this chapter.

Step 2: Speech-to-Text, Mozilla DeepSpeech, Common Voice, tf-idf

In a second step, sound processing was implemented with 30 randomly drawn samples under the condition that each year would be represented once. This wouldn't allow for statistical observations assessed realistically over 30 years in history but would rather represent about one quarter of the films already analyzed with object detection previously. If strong deviations would occur from film's image to sound or themes surrounding cars wanted to be explored, then this setup would provide the most data without creating conflict in terms of the research project's time frame as technological hurdles will be described later in this chapter. There are different options for speech recognition currently available. The first paragraph will give readers an overview of current speech recognition solutions. The second paragraph is going to describe the methods applied for this project. The third paragraph will focus on chosen evaluation methods such as tf-idf (term frequency – inverse document frequency).

At the moment, speech recognition is one of the most actively researched fields due to advancements made through applications of neural networks. Speech-to-Text technology faces hurdles as audio input alters greatly depending on its surroundings. For example, a constantly alternating relative position of microphone to user, inconsistent background noises or physiological changes in human voices require high processing capability in order to adapt to each situation. In early 2010s, high-tech companies avoided these technological issues by

relocating analysis to company-side servers requiring a simple internet connection only on end-users' side. However, in recent years, this behavior has been condemned by many users due to privacy concerns. Companies such as Google or Amazon advanced more quickly in the field by exploiting users' voice data. Their business model offered so-called smart speakers at a low price, which after initial purchase could be highly customized to individual needs entailing convenience. Users interacted daily with smart speakers as they asked devices to write down shopping lists, set up reminders or play music. Data gained from these interactions was then obstructed to build more accurate language models without customers' consent. As response, developers shifted their approach to guarantee data processing on end-devices only. Developer Mozilla designed a neural network allowing intermediate programmers to train custom language models on private machines. Mozilla's *DeepSpeech* requires input of an alphabet in use, written samples of text and their corresponding spoken equivalents. As audio books have become widely popular, in which trained voice actors read out loud content of written books, these datasets can be used to train *DeepSpeech* efficiently. After a short amount of time, developers realized a common need for freely available language models, which resulted in the *Common Voice* project. The idea lies in the donation of one's voice to the website, which then is validated by hundreds of users through an iterative feedback system. Smaller language groups tend to have a longer waiting times than larger language groups. Swedish falls into the smaller group, which in return requires more patience by researchers. The list of similar projects can be extended by naming *PicoVoice*, *Vosk* or *CMU Sphinx*. On the end of large-scale solutions, Google offers speech recognition as an API (Application Programming Interface), which is the same algorithm used for their translation software. Their API's implementation is difficult, cost-related and requires additional time-intense video-to-sound-file conversion prior to upload, set-up and analysis. It is advisable for individual researchers to opt out for manageable solutions, which will be described in the following paragraph.

Easily accessible tools for research purposes exist in most word-processing applications or operating systems. Tech companies attempt to improve user convenience by implementing Speech-to-Text into the basic framework of their programs. Operating systems such as Windows, MacOS or Linux provide already tools integrated into their core-systems. Therefore, changing a computer's sound output to become its input, is a simple yet reliable approach in speech recognition. The advantages lay in avoidance of extensive programming, video-to-sound-file conversion or text exporting. On Mac, this can be done with a free program called *Soundflower*. On Windows, there is a similar solution called *VB Cable*. Beyond that, options are theoretically limitless as many tech companies endeavor strongly into the field. Researchers

could use Google's Chrome browser in combination with *Google Translate* or employ any other free translation software such as *Bing Translate* or *Microsoft Office*. Depending on the video files in use, some archives already provide metadata-files with transcribed audio. Fiction film will most likely be released with subtitle-files embedded into the Blu-Ray/DVD, which can be digitally extracted and searched. Furthermore, there are independent subtitle-file-databases online offering same content for free, whereas some of them operate at limbo in their jurisdictions. However, beyond the popular scope of entertainment films, subtitle files might be difficult or impossible to acquire. This project employed *Microsoft Office*'s built-in dictate function from MS Word when transcribing speech content from video files, avoiding thereby legal issues as well as disconcerting privacy concerns due to the nature of the database the films were originally extracted from. Simultaneously, this method offered the benefit of results being saved directly into a DOCX-file without further conversion. During this process minor difficulties arose. Unfortunately, some newsreels seemed having lost original sound tapes for certain sections. In other cases, sound was present, yet some parts were not commented by narrating, which in return forces the researcher to actively watch the transcription process and intervene, when necessary, in order to prevent the tool from deactivating after a long phase of silence. These problems could be fixed in the near future once reliable *DeepSpeech* models are available for the Swedish language or by using an API processing instantly entire files. However, due to lacking availability of models and pressing time constraints, this project focused on simpler methods as described above.

When evaluating data, it showed clearly sound's complicated nature in comparison to imagery as more nuances had to be considered. For example, emotional qualities such as excitement or surprise in a narrator's voice will not be picked up by Speech-to-Text software. On a secondary level, music tended to play an important role as compositional element in relation to a shot. Late 1950s newsreels adopted more frequently imposing music alongside their display of the latest car models, creating affective compositions. Without consultation of the original material, these nuances would completely be lost if the researcher only looked at transcriptions. Additionally, narrating voices would not necessarily address presence of cars in an image unless he/she was presenting the car or mentioning a detail about it. However, this method can be extremely useful when conducting research in a foreign language as the recognized text can be easily machine-translated and searched for content later on, restoring context and feeding into a textual analysis. Furthermore, natural language processing based on AI concepts can add a statistical component to research. Tf-idf (term frequency – inverse document frequency) utilizes text analysis based on term occurrences:

$$w_{i,j} = tf_{i,j} \times \log\left(\frac{N}{df_i}\right)$$

$tf_{i,j}$ = number of occurrences of i in j

df_i = number of documents containing i

N = total number of documents

Formula 1 tf-idf

This method assumes that highly valuable content in a text is less frequently mentioned than repetitive filler words. Tf-idf allows calculating individual values (between 0.0 and 2.0) for each term in a document. Taking this concept one step further, then the tf-idf values for car related vocabulary should change over time. A decrease in its percentage value over 30 years could hint at a normalization of car related vocabulary in a Swedish media context. For more intuitive readability tf-idf values in this thesis were ranked for each document and received a corresponding percentage value. 1% would mean that a word would be common as “but”, “when” and “so”, whereas 99% would imply that a term was scarce yet important such as “rocket science”, “evolution”, or “cognitive behavioral therapy”.

Part 3: Technical Improvements & Data Visualization Approaches

This type of project required baseline automatization while theorizing clearly the delimitations of the tools implemented and contextualizing data as much as possible when evaluating. In similar cases, file handling should be formalized by internal standards. For example, moving a file from one folder to another occurs only after a certain process has been carried out. Converted files are to be found in a specific folder, while analyzed videos are

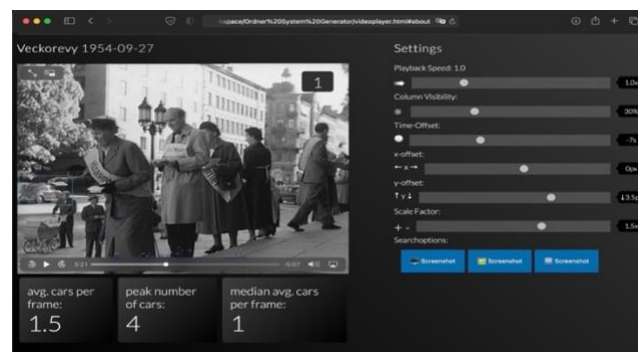


Figure 13
Interactive Database Interface (1 car recognized in frame on lower left-hand side)

transferred to another folder. These rules can be as strict or loose as researchers deem them productive at different stages of the project. However, these processes become useful when connecting them with concepts mentioned in the earlier chapter *Theoretical Framework: From Archive to AI*. A strict folder structure enabled a verifiability in terms of the small-scale archive

on the researcher's machine. An algorithm could thereby verify if certain files were still lined up in processing queues or lacking an updated version. Within the first iteration of this research, coordinates of cars in each picture were not considered necessary in further processing. However, when confronted with vast amounts of data generated by the project, falsifiability became a critical issue, so files were re-analyzed adding coordinates in a second phase. Therefore, adequate storage of files became just as important. Coordinates could then be used to extract images of cars from tens of thousands of frames without having to recalculate dimensions. They could also be utilized to identify video files in reverse as each video has a

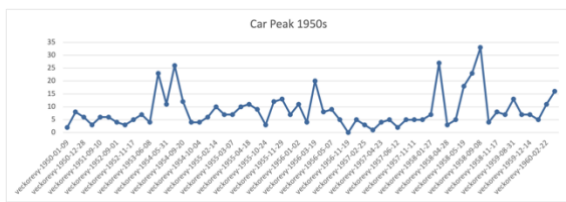


Figure 14
Car Peak (Individual) 1950s

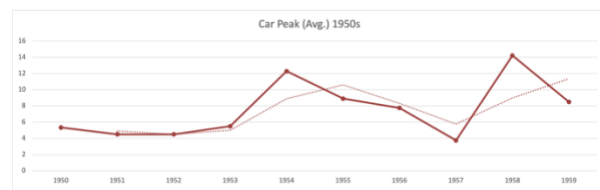


Figure 15
Car Peak (Average) 1950s

unique car histogram that only matches one specific file. Even if filenames would be manipulated, this metadata could be used to re-identify videos correctly. Furthermore, the speed of analysis could be improved by implementing an updated version of the original object detection algorithm. Within a time frame of 6 months, recognition rates increased thereby from 2.4 frames per second to 4.1 frames per second, which means an improvement of 70% in speed. Additionally, a byproduct of this research is a simple yet interactive database, which helped validating AI-results. The database can be locally accessed on the machine, providing the object detection results as direct overlay on the playing video file (see fig. 13). It can be paused or resumed at any point. The aim was it to validate reliability while enabling researchers to interact with the results. For example, this meant they could jump to certain sections in the videos or replay them for further analysis without having to carry out intensive calculations localizing a frame and its corresponding car value while the video was playing. A basic screen capturing function was added to help researchers exporting images of cars that could then be plugged into online databases for further research on models or brands if desirable. Another thought went into the visualization of vast amounts of data. This led to the conceptualization of different graphs that would make data easily comprehensible. For example, each individual video file's car histogram would not be able to describe macro-changes. The following graphic in blue shows for example the fluctuating yet steady increase of peak numbers of cars found in individual frames during the 1950s (see fig. 14). However, this graphic does not show the actual scope of transformation, therefore, it was converted in the red graph, which displays the

average peak number of cars based on each year (see fig. 15). The second graph helps showing that cars were already present in the media landscape as well as their presence more than doubled within 10 years.

Evaluation

*Self-portraiture is something one should never get involved in, since it is wrong to lie even though one endeavours to tell the truth.*⁶⁹ – Ingmar Bergman

At the risk of perpetuating an already well-known cliché, cinema continues touching peoples' lives. Decades later, many remember all too well youthful adventures sparked by friends in the theater, a first love's kiss concealed by darkness in the loveseat at the back of the room, or ever-lasting impressions of cinematic moments they had never seen before. Annette Kuhn's research on cultural memory argues cinema providing a medium reinvigorating memory like no other.⁷⁰ Kuhn describes meticulously how people remembered vividly emotions, triggered by the films they watched, recalling the friends accompanying them to the showing, or reimagining the route taking them to the cinema itself. A *New Cinema History*⁷¹ project on Italian cinema audiences in the 1950s and -60s conducted a reception study using oral history, in which video testimonies became central in interviewing participants.⁷² Albeit participants attempted recalling past events from over 60 years ago, video recordings captured successfully so-called embodied memory.⁷³ For example, one participant reenacting perfectly, yet seemingly unconsciously a 1955 James Dean performance, even though he had not been re-exposed to the film ever since.⁷⁴ Trond Lundemo describes how memory was mobilized as one of the first film archives *Les Archives de la Planète* came into existence, thereby allowing individuals dynamically producing consciousness and subjectivity.⁷⁵ Regardless of which

⁶⁹ Ingmar Bergman, "Ingmar's Self-Portrait", *Se* No. 9 (March 3, 1957).

⁷⁰ Daniel Biltereyst, "Film history, cultural memory, and the experience of cinema: a conversation with Annette Kuhn," in *The Routledge Companion to New Cinema History*, Daniel Biltereyst, Richard Maltby and Philippe Meers eds., (Routledge, 2019, E-book), 36.

⁷¹ Referring to practices mentioned in *The Routledge Companion to New Cinema History*, not to be confused with Tom Gunning's approach of New Film History, where early cinema is key object of study.

⁷² Daniela Treveri Gennari et. al, "Analyzing memories through video-interviews: a case study of post-war Italian cinemagoing," in *The Routledge Companion to New Cinema History*, Daniel Biltereyst, Richard Maltby and Philippe Meers eds., (Routledge, 2019, E-book), 344.

⁷³ *Ibid.*, 348.

⁷⁴ *Ibid.*

⁷⁵ Trond Lundemo, "Mapping the World: Les Archives de la Planète and the Mobilization of Memory," in *Memory in Motion; Archives, Technology, and the Social*, Ina Blom, Trond Lundemo, and Eivind Røssaak eds., (Amsterdam: Amsterdam University Press, 2017), 213.

approach one might follow, the center figure is film in its core, helping us remember. Therefore, an online archive such as *filmmarkivet.se* becomes a pertinent place of research as it subsequently poses questions of patterns in film transcending the medium itself, creating memories in individuals about the past which did not exist in the first place. As within the Bergman quote above, national film archives constitute some sort of self-portrait regardless of their benevolent intentions. What do they create then? (Even though Bergman's comment should be regarded with an ironic connotation, as it originates from a piece titled „Ingmar's self-portrait“.) This chapter will present immediate findings of AI analysis conducted in video and sound. Moreover, it will also point at patterns that might have not been explicitly assumed there in the first place, but that were noticed in the sum of media artifacts analyzed. Evaluation was carried out parallelly on two levels. On a first level, a statistical analysis was executed to confirm whether an increase of cars over the course of 30 years was distinctly visible or not. Intuitively, increasing car averages and car peak numbers would confirm that assumption. Less intuitively, rising car frequency rates would indicate cars becoming scarcer in films as they were shown at greater temporal distance from one another, whereas decreasing frequency rates would indicate cars being shown more often and therewith proving assumptions right. On a second level, a contextual/textual analysis was performed assessing change in imagery, themes and attitudes surrounding cars. For legibility reasons, analysis results were split into three parts corresponding to their relevant decades: (1) *1950s – From Fear to Fortune* (2) *1960s – High, Higher, H-Day* and (3) *1970s – Owing up to the Oil Crisis?*. Each section will briefly describe findings, give examples and situate content in a broader context. At the end of this chapter, a summary with concluding remarks on the findings will follow.

1950s – From Fear to Fortune

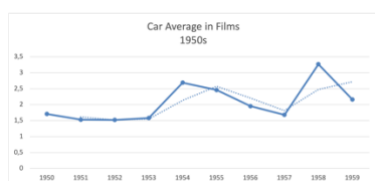


Figure 16
Car Average in Films 1950s

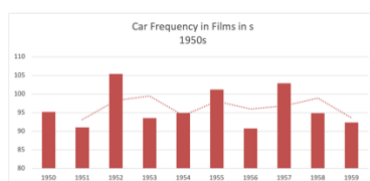


Figure 17
Car Frequency in Films in sec. 1950s

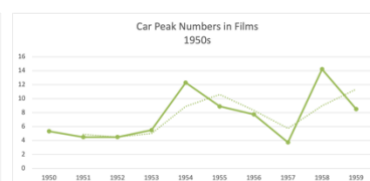


Figure 18
Car Peak Numbers in Films 1950s

Imagery of cars increased gradually from 1950 to 1960. A 3-phase development becomes noticeable when consulting data. From 1950 until 1953, an average of 2-3 cars was shown in a single frame in combination with low to medium frequency of appearance in

Swedish weekly newsreels *veckorevy*. From 1954 until 1956, the average increased slightly to 4-5 cars with higher frequency rates in comparison to phase one. Simultaneously, the peak number of cars being shown also doubled. During phase one, a maximum of 9 cars per frame were shown (*veckorevy* 1950-09-04), whereas in phase two up to 22 cars were visible (*veckorevy* 1954-09-06). Phase three from 1957 until 1960 increased the peak number by 11 to 33 cars per frame (*veckorevy* 1958-09-08). The average during that time period was raised to 5 cars per frame, while frequency rates did not significantly increase. This overall upward trend reflects positively findings made in other fields such as economic history and can be linked to motorization statistics through data from the department of motor vehicle registrations. However, a generalization cannot be made due to the nature of samples provided by *filmarkivet.se*. Albeit there are newsreels, such as from March 1958, depicting up to 27 cars per frame, there are likewise other extremes, such as one news reel from November 1956, not showing any cars at all (*veckorevy* 1956-11-19). As explanation, the November reel was presenting preparations for the soon-to-come Santa Lucia festivities only including indoor shots. Technically speaking, both newsreels fall (almost) into the same phase (phase three) but exemplify stark contrast that can be found in data. Therefore, it is highly encouraged to regard findings as plateau-development, implying slow increase over several years. At this point, a statistical approach might become counterproductive, when only considering high numbers, as the sheer number of cars in a single frame does not necessarily reflect importance of the automobile as part of its *mise-en-scène*. For example, the 1958 January news reel featured entirely King Olav V of Norway's coronation (*veckorevy* 1958-01-27). In comparison, a news reel from June 1953 showcased the Swedish royal family taking out a horse carriage on national flag day, being escorted by one police car (*veckorevy* 1953-06-08). Within a relatively short historical period, namely 5 years, the Norwegian king chooses to arrive in a 1939 Buick Roadmaster for his impending coronation. In this case, only few cars were depicted, however, the importance surrounding these events is undeniable from a historical perspective. This change in mode of transport captures how swiftly cars were associated with modernity as many governments employ high budgets for their transportation needs until today. Similarly, this imagery does not substantially diverge from today, as politicians still arrive most commonly in black cars. Furthermore, it exemplifies harsh contrast between the two films' *mise-en-scène*, even though a similar number of cars on display was employed.

Themes associated with cars changed drastically over the course of the 1950s. In phase one from 1950 to 1953, cars tended to be kept at a safe distance in the background of reports. An example would be a news reel on a 6-day-bicycle tour in September 1950 (*veckorevy* 1950-

09-04). The news reel showcased several cars in the frame as they were part of the news reporter teams that followed the trip simultaneously. Focus was directed more at the sport event itself, however, the car as object was distinctly visible as well. In phase two from 1954 to 1956, cars, mobility and their impact on society became concerns of mainstream media. News reel sections on car saloons or technological advancements in the car industry became more frequent. An example of phase two would be a report on one of the first female taxi drivers in Sweden (*veckorevy 1956-03-05*). Therewith, film aligned cars as synonymous with social and technological progress. Phase three from 1957 to 1960 glorified imagery of cars with summaries on the latest car salons and several selected models being shown as if advertised. Themes included were car races, fuel-sustainability competitions and old-timer rallies. Public attitude shifted away from a cautious point of view inherently envisioned in *To Kill A Child*, more towards excitement in anticipation of the future. Cars were not just rated by appearance but also by usability and versatility. A historical dimension was added when in a November 1959 news reel the history of the first Swedish mass-produced automobile was shown and the climax of that section displayed Volvo producing its 500'000th vehicle in one of their factories as a milestone (*veckorevy 1959-11-23*).

Tf-idf analysis of 10 sampled audio tracks from the 1950s aligns similarly its results. It shows car-related vocabulary being statistically more significant in phase one as it occurs only in the upper 10-th percentile at 92%. Nonetheless, from there on experiencing more frequent mentions in following phases, arriving in the upper medium spectrum of mentions around a tf-idf-value of 62% in 1959. Especially in phase one, improvements of city infrastructure became central topoi, while focusing on addressing the greater good for city development, not only car traffic. Phase two saw a tremendous jump, where “driving” began replacing the term “traveling”. Admittedly, both words are sometimes used synonymously in Swedish, however, the increase in usage with later on distinction remains interesting. A similar pattern of change in usage can be noticed for other terms as well. In 1950, “traffic” was mentioned broadly one time. On the contrary, in 1958, derivatives of the word “driving” appear 7 times and variations of the term “car” 5 times within a ten-minute period.

In conclusion, imagery of cars can be considered indicative for social change and economic progress in 1950s Sweden. An underlying theme is cars’ appearances in important social, political and cultural events such as royal weddings, political summits or state festivities. As mentioned above, the Volvo example points at medial construction of a country’s well-being through redrawing its relatively long history of automobiles and strength in car manufacturing. Subsequently, its well-being and success was connected to social areas as cars

were used to display equality of women and forward mobility of a new generation. Distinct affectual colorizations of joy, excitement and trust can be noticed with increasing years as rallies, competitions and long-distance races were frequently on display. Thereby, cinematic imagery of automobiles created a collective memory within a Swedish context, which otherwise would have been inaccessible to average spectators at home in the countryside. Regardless of this research's precision, it might still become difficult to recreate a definitive mental image prevailing at the time, due to the impossibility of tracing groups of spectators, surveying them on their attention levels during each news reel and inquiring them on their specific impressions on each section. Nonetheless, newsreels were a standardized part of the cinema-going experience during the 1950s, which suggests evoking some sort of impression in audiences. Kuhn's cultural memory study tends favoring contextual factors as more easily memorable in spectators than actual film contents. Arguably, that would destabilize this research's findings, whereas the *New Cinema History* project on 1950s Italian cinema with embodied memory would argue counter-wise. Most fittingly, Lundemo's approach would side with these results, as they build on prevailing cultural memory, reflecting the already seen as true, therewith shifting processes of individuation and reflection into individual spectators. As these 3 theories diverge greatly, it might prove helpful assuming another angle of analysis in order to verify legitimacy. On the contrary to singular theories, the result behind producing each newsreel section can be thoroughly analyzed, thereby standing its test of time. For example, a similarity in cinematic patterns prevails in today's media. Film's digital video-equivalent remains employed by mass-media in perpetuating radical social and technological change. Contemporary YouTube reviews resemble much of the car saloon summaries depicted in the 1950s. Furthermore, YouTubers, influencers and reviewers often organize small-scale events reminding of rallies, competitions and long-haul tests. Therefore, it might arguably be difficult for spectators to remember exact content as media strategies have been retained while not diverting dramatically since then. Similarly, the *New Cinema History* findings could support this as younger generations imitate (presumably) subconsciously previous filmic patterns, which had been proven already successful. Even more so, Lundemo's angle would deliver evidence in the sense that prevailing imagery reconstituted this worldview. All in all, this would suggest that by looking at the past, research shows marketing strategies repeating themselves in similar product categories. This would not ultimately alter current perception but does lead to the question, if these media strategies can be translated into different areas for greater good. For example, how could media strategies be improved to increase electric vehicle acceptance. The problem lies in electric cars seeming to come with numerous advantages

compared to their fossil-fueled equivalents, that ultimately could improve life in many cities, such as being quieter, not emitting dangerous micro-particles and more importantly combustion emissions polluting the air, yet they still face far greater hurdles in terms of acceptance as they are coined inferior to fossil-fuel cars.

1960s – High, Higher, H-Day

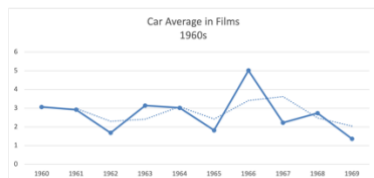


Figure 19
Car Average in Films 1960s

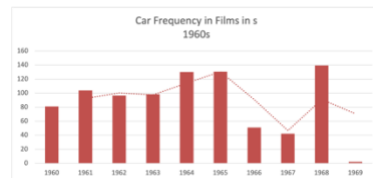


Figure 20
Car Frequency in Films in sec. 1960s

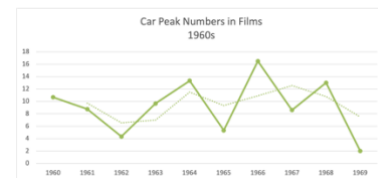


Figure 21
Car Peak Numbers in Films 1960s

Imagery of cars culminated around the events leading up to H-Day (*Högertrafikomläggningen*, right-hand side traffic restructuration). *Dagen H* refers to a Swedish traffic reform policy, which was originally passed through parliament in 1963 with a 4-year preparation period to be enacted on September 3rd, 1967. Traditionally, Swedes drove on the left side of the road, which later on was concluded as less safe compared to the more commonly spread European model of right-hand side traffic in accordance with statistical research. For example, when attempting to surpass a car in front, drivers will experience more blind spots in their field of sight compared to right-hand side traffic model, leading to a higher number in fatal accidents on country roads and near pedestrian crossings. Additionally, all of its immediate neighbors were driving on the opposite of the road, with high exchange rates at its borders, further complicating matters. Regardless of scientific reasoning, public opposition was initially strong, which was reflected in a referendum resulting in a 83% vote for remaining on the left-hand side in 1955. Disregarding its outcome, the Swedish government decided in 1963 to implement necessary change as the number of cars on roads was predicted to triple from 1955 until 1967. Reasonably, difficulties of such events lie in its reliance on cooperative and simultaneous change in an entire country, in which all road signs, intersections and traffic marks required over-night replacement. Most importantly, as opposition was strong only 12 years earlier, Swedes had to be convinced that this change was necessary and important, requiring everyone's trust and cooperation. Therefore, it does not seem surprising that media attention was directed at the event on a larger scope.

AI-video analysis output suggests similar results mentioned as groundwork for car traffic policy reforms. During the 1960s, a noticeable upward curve in car average per frame culminates in the years 1966/1967. The average number of cars in filmic images was

fluctuating around 3 for the majority of the decade, which is nearly twice as high as in the beginning of the 1950s. Key difference lies in a jump to 5 cars per frame in 1966, which remains the highest average in a 30-year period from 1950 until 1980. Car frequency rates stagnated in the first three years of the 1960s, however, increased slightly in the years 1964/1965, implying that cars were shown at a longer temporal distance from one another. In 1966/1967, these rates were shrinking to one third of the previous years. This indicates sections of cars becoming predominant, as images including cars could be seen on average every 40 seconds of film. In the year following H-Day, car frequency rates returned to their pre-H-Day average. 1969 showed a dramatic fall in frequency rates, suggesting every other second of film showed cars. In part, this can be explained by a transition in film formats from lengthier reports to shorter commercials. For example, many weekly newsreels from the 1950s remained in part very artistic, not only presenting news at a quick pace, but allowing scenes to articulate themselves. These formats condensed slowly yet consistently content over time. Aside from the events surrounding H-Day, a variety of programs tended marketing urban life to local markets while advertising Swedish progressiveness to international markets. For example, a series (even though not intentionally produced as that) on different centers of urban life in Sweden can be found. Gothenburg is promoted as the foremost industrial center in all of Scandinavia (*Göteborg – Hjärtpunkt i Norden*), which includes interestingly the second highest number of cars shown during the 1960s. Besides that, historical urban development (*Storstadens puls*, *Karlshamn 300 år*, *Raka spåret till Jämtland*) becomes key as well as urban problems such as a higher need for police presence (*Polisbil 36*) or road development (*Vår väg*). For the majority of the 1960s, it seems as if media attempted integrating cars as integral part of modern life rather than only showcasing them singularly compared to the 1950s. Vehicles brought forth new issues, impending adjustment, however, they were metaphorically paving the road to a better future at the same time. Interestingly, larger numbers of cars were contained in political campaigns (*Fritt fram för Centern 1*, *Fritt fram för Centern 3*), which indicates political interest in modernizing infrastructure as key “sales point” for a political party’s program. This is similar to the connection of national well-being and prosperity in the 1950s yet differs in alignment to a specific group rather than an entire nation. Beyond centralized means of distribution for film, private collections of film point at an increase of cars’ visual presence in daily life. From a private collection in 1962 (*Einar Dahlins samling nr 038*) to 1968 (*Zilva och Henning Söderbergs samling nr 4/5A*) the number of cars on average and peak number doubled or tripled from 1.5 to 3.1 on average. If one were to include another private film collection from early 1970 (*Hans Permbos samling nr 21*), then the increase would be considered even more

dramatic as the peak number of cars went from 4 in 1962 to 18 in 1970, which is 4.5 times as much.

Attitudes towards automobiles shifted most notably during 1960s as cars were not seen as a luxury product any longer and became a necessity for everyday means of life. Documentaries emphasized the importance of modernization of road infrastructure, employing simplified cartoons, cost-benefit analyses and vivid examples for businesses' productivity approaches (*Vår väg*). This a considerable shift from the joy and excitement perpetuated in the late 1950s, since it disconnects completely its previous dimension of affect from the luxury product, which is typically the main feature of advertisement in luxury segments. This ties in



Figure 22
Scene from *Souvenirs from Sweden* (Henning Carlsen, 1961)



Figure 23
Scene from *Souvenirs from Sweden* (Henning Carlsen, 1961)

with an economic resituating of oneself in a Nordic, as well as a global context. Surprising to common belief, a film from as early as 1961 (*Souvenirs from Sweden*), attempts already marketing Sweden as attractive tourist destination in English language. In the 20-minute short film, a customer walks into a souvenir shop in Stockholm, being confronted with flashbacks when looking at the products on sale as the salesclerk does not attend him, since she is restrained to a personal phone call in the back of the shop. The narrative voice attempts a seemingly self-reflected tone as he describes the local regions of Sweden with their distinct souvenirs, then climaxing in a clichéd melodramatic moment, when he decides to take home the simplest of souvenirs – “tack” – the Swedish word for “thank you”, symbolized as silver heart in an expensive jewelry box. The color palette, montage, self-reflective and odd voice narration remind of *Breakfast at Tiffany's* (Blake Edwards, 1961), a highly popular American film of the time, playing out in the metropolis of New York with a neurotic main character classifying as shopping addicted to today's standards. Interestingly enough, the tourism film mentions facts about Sweden having the highest car ownership rates per capita in all of Europe, while giving potential tourists tips on parking in the city, reminding them to use parking meters

and recommending them to stroll rather than drive through downtown Stockholm for a better experience (*Souvenirs from Sweden*). In fact, this already hints at the American target audience it was designed for but seems unconventional from today's tourism marketing, which would recommend cities with good and reliable public transport more. Additionally, the copy-cat style of recreating a film look from one of the most popular films of its time, hints at an intensification of global modernity needs. The afore-mentioned salesclerk attends finally the lost customer at the end of the film, while audiences remember the numerous cars driving outside the souvenir shop. She first begins very politely the conversation in Swedish, but then switches to perfect English in an instant when confronted with silence, then on listening patiently to the confused customer. The values implied, such as wealth, patience and education, draw a picture of Sweden before it was common to do so. Additionally, the documentaries did not seem to target only Swedish audiences even though produced in Swedish. Moreover, they seemed to have other audiences in mind as well. Due to the fact that Finland used to be part of Sweden, enabling many Finns (including Finland-Swedes) to speak Swedish and Norway having a language that is mutually intelligible to both native speakers, there could have been intentions to market oneself implied when producing the films. Especially during the 1960s, Sweden was an excellent working environment, which drew in immigrants mostly from its neighboring countries thanks to the foundation of the Nordic council in 1952, ultimately granting people freedom to roam freely in the Nordic countries. Beyond that scope, the films produced could be easily subtitled or dubbed into different languages when needed as dialogue scenes were often avoided.

Tf-idf analysis mirrors similar results to the textual analysis above. During 1960s, cars were surrounded by sentiments suggesting “trust”, “reliability” and “safety”. The 1961 Volvo Amazon was marketed with a strong emphasis on “quality” that would “last” (*Volvo Amazon*). An interesting deviation from image and sound is contained in 1963's *Vår Väg*. Even though images of cars are present, there are no mentions of typically car related vocabulary. The film addresses frequently “progress”, “economic prosperity” and “safety”, yet never mentions “cars”. In 1967, the word “drive” becomes one of the most commonly used words at a tf-idf-value of 6%. In comparison to that, words like “but”, “if” or “then” score similar values (3. *September*). In 1969, terms related to “parking” and “driving” become extremely common at tf-idf-values lower than 10% each. The novelty here lies in the concept of “parking” grabbing a foothold in film.

In summary, images of cars were deeply ingrained into 1960s Swedish film landscape. There is a bidirectional movement visible, channeling attempts towards internal and external

audiences. Swedes were exposed to their own progress made through cars, infrastructure and social change. From an outsider's perspective, it seemed as if Swedes were constantly to be persuaded that the modern way of urban life with cars as central momentum, was indeed giving them a distinct advantage that needed safeguarding through new measures like road modernization, implementation of safety regulations and baseline upgrading to cars as a necessary business investment to keep with the times. Marketing abroad, mainly aimed at American audiences, was designed to evoke an image of Sweden as attractive tourist destination, with much to offer for anyone's taste, but mostly showcasing its car centric society, which was proclaimed as the only mode of transport fully enabling individuals to see the vast Northern country. However, this trend was also noticeable in locally targeting films, where often Sweden's cities were compared in historical or geographical dimension to their Nordic neighbors. If one would see the 1950s newsreels, Swedish film seemed to exclude itself more from its outside world, whereas in the 1960s it was reflective of time and circumstances on a Nordic but international scale as well.

1970s – Owning up to the Oil Crisis?

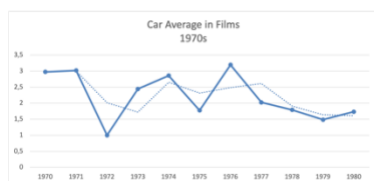


Figure 24
Car Average in Films 1970s

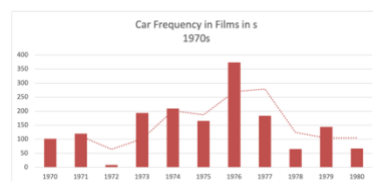


Figure 25
Car Frequency in Films in sec. 1970s

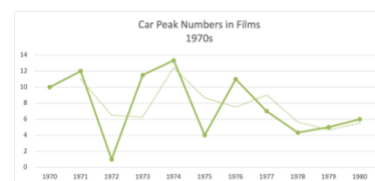


Figure 26
Car Peak Numbers in Films 1970s

Imagery of cars decreased during 1970s in Sweden correlating to global events such as two major oil crises in 1973 and 1979. Despite that, the oil crises might be less relevant in regard of the decrease than originally assumed. Years 1970 and 1971 represent extensions of the previous decade, where the car average in images fluctuated around a value of 3. There are no extensive deviations from a slow upward increase model visible. However, this average decreased drastically to 1 in 1972. The following years recover to similar values from the 1960s of around 3 in 1973/1974 but then slowly peter out over the rest of the decade. In terms of car average and car peak numbers, this mirrors almost perfectly curves over a 30-year period with 1966 at its center and peak. When consulting car frequency rates, then scarcity of images of cars becomes visible. On average this meant that a 60% increase in frequency rates was common, where average frequency rates of 87 seconds in the 1960s was transformed into 148 seconds in the 1970s. There are three points in time, which generally fall outside this rule,

namely 1972, 1978 and 1980. 1972 and 1978 correspond to the years directly before the oil crises, which draw generally a low frequency rate, implying cars being shown very often.

Themes in relation to cars shifted away from automobiles as central element of modernity. A pertinent example is the 1973 film *Göteborg*, which resembles in style and content a similar film from 1964 named *Göteborg – hjärtpunkt i Norden*. The key difference here lies in how the perception of urban life had shifted. For example, the 1973 film lacks an audio commentary and only consists of music and ambient sounds on an auditive level. Its audiovisual style seems cosmopolitan as it translates Gothenburg's name into several languages on a blinking map while contemporary electronic and synthesizer music guides audiences through the film as well as the city events on display. Interestingly, cars are almost lacking in a city that previously had promoted itself through its abundance of cars. The christening of a new ship in its shipyard by the Japanese empress, opera concerts and theme parks seemed pushing out images of modern city life including cars. Drunk and drive campaigns started emerging, informing viewers on the effects of alcohol on the human body and its reduced sensory abilities (*Tänk före*). To some extent, Swedish society appeared fighting urban development related to car improvements. For example, a citizen initiative produced a film as opposition to the planned construction of a garage underneath Kungstorget in Gothenburg. In November 1976, protesters occupied the public square in downtown Gothenburg for an entire week, demanding the construction to be cancelled. In the film, their signs read slogans such as "cars – the worst environmental destroyers". This can be taken with a grain of irony as Gothenburg is traditionally home to car manufacturer Volvo and therewith represents the heart of Swedish car industry. Another example is how a need to travel or commute decreased suddenly. Swedish postal services Postverket produced a film showcasing two best friends living approximately 2 hours away from each other (*Eva & Kristina*). Instead of using the car to drive 2 hours from Stockholm to Örebro or vice versa, the two friends keep in touch with letters. Even when one invites the other, she rather takes the train than the car, which is a dramatic change in comparison to the attitudes held in the 1960s. Additionally, a common theme is a shift away from personal to public transport. Truck and bus manufacturer Scania released a film during that time, explaining the benefits and economic advantages of public transport (*Buss Non Stop*). Most interestingly, the oil crises are not directly mentioned in any material during the 1970s sampled for this project. More so, within its source archive *filmarkivet.se*, there is only one result when entering the search query for the oil crisis. Hence, the impact of the oil crisis on car ownership rates might not be as pressing as originally assumed. For example, economic historians attempt explaining a decrease in growth sale rates by

applying a saturation model, claiming that after a certain point, the market cannot grow further as needs are covered in its majority. For example, this project's main source on economic history excludes the period after 1973 as it claims the oil crisis being too complex with the "automobile system" being questioned at the same time.⁷⁶ Based on the data gained here, the oil crisis might not have been as impactful in Sweden as originally assumed. Furthermore, the saturation model appears as relatively too simplified method, which was obstructed from natural sciences explaining a human induced system. When consulting growth rates with car averages, car peak numbers and car frequency rates in film then parallels can be drawn. For example, during a period of high growth, images of cars were connotated only positively. During periods of medium high growth, first car related issues started arising and during the phase of "market saturation", the problems reported seemed outweighing their benefits. These patterns are interwoven in the material, when assessing closely. During 1961, tourism approaches were still joking about the parking situation in Stockholm (*Souvenirs from Sweden*). In 1968, the film report on the events around H-Day describe the infrastructure conditions as already outdated for the needs of city development. In 1973, one of the first don't drink and drive campaign appears in the archives. In 1976, people are opposing strongly further car centered development of Swedish cities. Hence, implying that a market saturation rate might not be related to the decrease in growth, rather than a social, environmental and political set of problems counteracting car growth. In other words, a car did not come with enough benefits for Swedes in the 1970s as it did in its previous decades, which changed attitudes and therewith purchase behavior of people living in Swedish cities.

Tf-idf analysis outputs interesting results correlating to the observations above. Vocabulary related to cars fluctuated tremendously during the 1970s. Either it was distinctly present together with negative connotations or it was missing completely. In a car related context, new concepts were introduced. For example, "consideration for others" (tf-idf value of 34%), "environmentally damaging" (tf-idf values between 30% and 90%) or "underestimated danger" (tf-idf value of 65%) were terms more commonly used during the 1970s. In a 1970 private film collection, the idea of "social cost" was addressed (*Hans Permbos samling nr 21*). Presumably Hans Permbo himself narrated the private film in its documentary style, pointing at social issues entailed by the massive car boom experienced in the city of Malmö. Permbo mentioned repetitively numerous problems entailed by the planned construction of the inner Ringväg, which is a semi-circular highway system built in the middle

⁷⁶ Jaques, 6.

of Malmö hoping to remove congestion from smaller roads in the city center. He described “noise caused by car accidents” (tf-idf value of 71%) and “emissions/smoke” (tf-idf values in between 60% and 70%) as leading reasons for locals’ frustrations and concerns. These results diverge greatly from the linguistic trends set in 1950s and -60s films. Connotations seem to have shifted from positive to negative only, while car related terminology appears sporadically and in extremes, either present at a high degree or absent at a low degree.

Summarizing the 1970s, imagery of cars started decreasing distinctly during this time period. Even though film formats did not differ greatly from the decade before, their related attitudes were changing. Whereas up to the late 1960s, cars were seen as driving motor of an ever-modernizing Sweden, the 1970s proved the same hypothesis wrong. Strong opposition to parking development, a desire in diversification of public transport means and the individual dangers connected to drinking and driving were common themes during this era. Joy and excitement were replaced by cautiousness and resentment. Imagery of cars were less frequent than in the two preceding decades. Global events such as the oil crises in 1973 and 1979 were reflected in the material, when regarding frequency rates of images containing cars. However, as there is no direct mention of these events within the material itself, this can only be considered as coincidental without further research. Given the data from *filmmarkivet.se*, it is more likely that car sales began petering out as automobiles were no longer perceived as driving motor of modernity, rather as source of problems for larger developed municipalities. Interestingly, the graph on rates of car averages in images mirrors almost perfectly in a vertical line drawn at 1966 over the course of the 30 years explored within this research project. Until 1967, there was a continuous upward trend noticeable, that slowly reversed itself over the latter half of the time period.

Concluding Remarks

Images of cars in Sweden’s 1950s, -60 and -70s were subject to tremendous change. Initial fear in the early 1950s was quickly replaced with excitement. Cars were becoming a more common sight as numbers increased. Swedish weekly newsreels were keen on portraying cars in frameworks of thrilling races, luxurious international car saloons and metaphorical drivers of socioeconomic progress. This stands in direct opposition to Stig Dagerman’s and Gösta Werner’s *To Kill A Child*, where modernity was framed as a threat. Small-scale linguistic analyses based on 10 audio track samples from the era’s films points at car related vocabulary becoming increasingly more common. Words such as “to drive” and “car” become everyday

terms in late 1950s newsreels. In the 1960s, cars become a substantial part of society as they are connotated with feelings of trust, safety and content. Swedish film attempts marketing inwards to local markets and outwards to international markets, where cars are a unique selling point. Images of cars appear often in contexts of road modernization development, implementation of new safety guidelines and business investments during this era. Imagery hints already at problems of inner-city congestion, invasive road development and car-related social dilemmas to come, yet frames issues more commonly in joking manners. Linguistic analyses of 10 audio track samples from films in this era conclude that economic prosperity, progress and social well-being were connected to cars. Peak moment for cars is the year 1967 which relates to H-Day on September 3rd when Sweden switched traffic side from left to right. Terminology such as “parking” and “right-hand-side traffic” became everyday language in Swedish film outlets. Presumably, 1967 will be the year in Swedish history with the most frequent uses of “car”, “drive” and “right-hand side traffic”, when they were as commonly used as words “but”, “so” and “that”. However, further research has to be carried out in order to confirm this result. In the 1970s, images of cars become less yet increasingly related to pressing social issues. Invasive city development based on needs of cars, environmental concerns as well as fear of drinking and driving became evident. This constitutes a tremendous shift from two largely positively connotated decades to a negative attitude calling for a diversification of public transport means. Linguistic analyses of 10 audio track samples from films in this decade indicate a similar negative attitude towards cars, where presence of car related terminology fluctuates at extremes of presence and absence, which is an extensive change from previous trends set in the prior decades. 1973 and 1979 oil crises are distinctly visible in evaluation of findings. However, they seem inconclusive at this point as the crises were nowhere directly mentioned. Research concludes negative impacts being more indicative for a lesser display of cars in media and therewith a decrease of car sales growth rates in the market sphere as parallels can be found.

The AI technology employed for this research, namely object recognition in videos and speech recognition in sound, provided this project with vast, reliable and largely objective results. Even though the chosen method of snapshots (elsewhere referred to as “condensed” frames) might have not been ideal use in some of the material as well as an online archive as source can only deliver so much in terms of media artifacts. This is based on legal frameworks of copyright that the Swedish Film Institute (Svenska Film Institutet) is operating within as well as the speed of digitalization of film material from each time period. The 1950s and -60s provide simply more source material as their copyrights were already expired. Nonetheless,

this enabled this research project to analyze a vast corpus of 114 film that otherwise would have been impossible to investigate. Simultaneously, findings implied require an emphasis on a need for both quantitative methods from computer science as well as qualitative methods from cinema studies in order to present reliable results. The tendency to interpret results in alignment of a perceived historical dimension might be stronger if not assessing critically enough the material itself. Additionally, looking at media from the past could deliver a more accurate picture of circumstances as arguably traditional historical approaches oversimplify historical life. Were cars really becoming saturated as a product on the market or were they becoming a nuisance for society, which slowed down growth? Car ownership rates lack ability to express how cars were actually used on a daily basis. Therefore, their implications might be less productive for the generation of new knowledge, challenging old knowledge.

This approach of research might be deemed interesting for film theoretical considerations as it surprisingly does not devalue any of the three approaches mentioned above. Kuhn's theory about contextual factors higher importance might be proven right as media strategies did not alter greatly, yet could be seen as repetition. Hence, it seems considerably easier to remember differences than similarities. The *New Cinema History* project on Italian cinema audiences might take away from this research an embodiment of iconic cars as audiences remember popular cars from that time as equivalent car image for each decade. Lundemo's conceptualization might benefit as it is proven in numbers relating to car development and images of cars in film.

Future Research: Back to the Future?

*Technology alone is not enough – it's technology married with liberal arts, married with the humanities, that yields us the results that make our heart sing.*⁷⁷ – Steve Jobs

Questions surrounding film's utilization followed immediately its invention. Early film theoretical discourse can be traced back to Hugo Münsterberg's Photoplay in mid-1910s. Societal debate in the sense of cinephilia originated around Henri Langlois' Cinémathèque Française in post-war France during late 1940s. First film study-programs were established as an academic discipline in early 1960s.⁷⁸ At the time, universities tended integrating programs into existing English or theater departments, which in return shaped irreversibly film studies' character in line with humanities. Recent years showed development from film to cinema and media studies influencing one another as film continues its relocation to different outlets such as online-streaming.⁷⁹ While these smaller disciplines were able to claim importance as technology had no feasible means of challenging cinematic understanding, they simultaneously accepted placement in departments at the periphery of commonly studied subjects. However, data scientists, IT-students and AI-researchers increasingly venture into the field of film lacking adequate contextualized understanding of the medium.⁸⁰ Presumably, this approach will most likely dominate as it can easily be modified to meet commercial needs. Nonetheless, societal understanding of history cannot be excluded from the list of opportunities due to it seeming less commercially attractive. Film's archival ability in combination with AI unlocks invaluable research possibilities offering a new understanding of the past. This chapter will focus on illuminating future approaches, aiming to present readers with concrete AI-based ideas. Concepts are grouped in the following 3 categories: (1) possible project extensions, (2) AI-baseline research opportunities, (3) reverse-engineered production of knowledge. Each paragraph will briefly describe methods with related examples and implications.

First, research on images of cars could be extended with this project as a point of departure. Due to its constraints, current research could not consider car brands as unit of

⁷⁷ Jonah Lehrer, "Steve Jobs: 'Technology Alone Is Not Enough'," *The New Yorker*, October 7, 2011, last accessed: May 15, 2021, link: <https://www.newyorker.com/news/news-desk/steve-jobs-technology-alone-is-not-enough>.

⁷⁸ On the other end of the spectrum, there were so-called "filmology" university programs situated within psychology and sociology departments already in 1940s and -50s France. However, their approach altered extensively from what film and cinema studies are today, therefore, they were excluded from the main text above.

⁷⁹ Francesco Casetti, "Relocation," in *The Lumière Galaxy: Seven Key Words for the Cinema to Come*, (New York: Columbia University Press, 2015), 17.

⁸⁰ AI.se, "About AI Sweden", last accessed: May 15, 2021, link: <https://www.ai.se/en/about-0>.

analysis. This implies a lack of information on local and foreign carmakers' representation. Some studies point at a distinct oversaturation of Swedish manufactured cars in early 1950s,⁸¹ which could become a valuable research question for AI-based image recognition. Swedish media might have possibly favored showcasing certain brands over others, which could not be answered with current data available. This project's research corpus could be widened by adding other types of film as it focused mostly on documentary/educational content found on *filmarkivet.se*. Therefore, the question would follow up as 'How does the relation of images of cars alter, when exposed to commercial entertainment film?'. In fact, this consideration was briefly mentioned in *Chapter 2: Historical Context*, where contemporary examples of American, Swedish and French cinema were highly influential on the perception of cars. Beyond a national context, transnational or international research with similar methodology could prove invaluable in reconstructing historically the introduction of cars into different countries' modern life. How did American images of cars differ from Swedish, German or French representations? Car manufacturing was decentralized and mostly restrained to national borders at first, even though exceptions can be found. Despite that, carmakers' identities are largely connected to cultural or national contexts. For example, Volkswagen markets itself continuously abroad as German innovation with slogans like "Volkswagen. Das Auto", regardless of its scale of international cooperation in research, production and sales. In another example, *A Man Called Ove* (*En man som heter Ove*, Hannes Holm, 2015) includes an underlying conflict between main character and former best friend due to diverging opinions on car purchases, thereby reflecting rivalry between Swedish brands Saab and Volvo. Hence, extracting cars from a national context might alter results in damaging ways. Beyond this research's time frame, material was excluded from earlier than 1950 and later than 1980 due to a lack in consistent availability on *filmarkivet.se*. However, ownership rates document the existence of cars in Sweden well before World War II.⁸² Therefore, collection and digitalization of media artifacts from still missing decades would fill in gaps in data. On the other side of the temporal spectrum, the assumption lies near that images of cars as in terms of public relation changed drastically after the 1970s' oil crisis. In recent decades, environmental concerns force complete renewal of technologies that enable cars' proper functioning. These events and their impact have not been studied yet, which presses urgency as measures counteracting climate change fail. Hence, the study of convincing billions of humans in adopting new modes of

⁸¹ Jaques, 31.

⁸² Ibid., 19.

transport with its underlying patterns of success, could become useful with designing similar attempts in mind.

Second, cinema studies and adjacent disciplines might benefit significantly from AI-baseline research. Contemporary cinema studies force necessary practices such as specialization on topoi upon researchers, therewith delimiting vast acquirable knowledge into senseful units, i.e. *œuvres* of auteurs, artistic film movements or national production contexts. AI-research enables a reduction in time efforts when training scholars on those topoi, while still being able to produce reliable and high qualitative results. In practice, film scholars spend years researching for example an individual artistic movement, which could be reduced to several months or weeks of AI-research. Object-detection's flexibility entails any object-related research question becoming feasible. For example, restricting an algorithm to identify humans would output a character design database on level of *mise-en-scène*. In the near future, interested researchers could analyze Roy Andersson's film characters as his *œuvre* is known to include quirky, pale and offset characters. In specific combinations of more than 1 object, spatial configurations could be tested. A search query for sets of couches, coffee tables and televisions would most likely generate images of living rooms. This could be utilized in analysis of representation of certain spatial figurations in auteur films or initiate historical research on typical family life during a time period. Beyond the scope of cinema studies, adjacent disciplines like fashion studies could benefit from the same database. Specific costume design traits in Andersson's films, or 1950s, -60s, -70s everyday fashion extracted from weekly newsreels, become practical approaches as data collections from hours of footage, respectively years of production are already available. Speech recognition tools could provide insight on films' audio tracks, quickly returning text output. Furthermore, the text itself stands in as valuable source of information, however, in addition with natural language processing techniques such as tf-idf (term frequency-inverse document frequency), the significance of certain words could be extracted on statistical basis. Tf-idf calculates a value in relation to incidences in text units and documents, thereby helping filtering words less and often mentioned. For example, an article might include dozens of "is/are/could/because/so" but only few mentions of "neurochemistry/reformation/molecularization" implying significance based on statistical repetition. For example, global media studies could trace the number of word occurrences in order to analyze press freedom by searching critical terms next to governmental terms. Additionally, this could provide insights on not only digitally subtitled files but also historic footage which had been digitalized at a later point in time. Thereby, eliminating the need of manual transcription, when subtitle files are missing.

Third, scientific and practical advantages can result from reverse-engineered production of knowledge. AI-research focuses currently on recognition techniques that output high qualitative data. However, trained models contain subsequently knowledge which can be extracted in reverse. Recognition models can be used in generative neural networks to “draw” images. An example would be Google’s *DeepDream* project which amplified search patterns in a convoluted neural network so that a hallucinogenic dream-like impression is imprinted on a picture.



Figure 27
AI-generated dream image by Google DeepDream

Graphic cards manufacturer NVIDIA is momentarily holding a strong position in the research field with their StyleGAN project. StyleGAN is a neural network that trains itself in recognizing low- and high-detail features in an image. The software made headlines when it generated hundreds of thousands of pictures with photorealistic faces that belong to no living human being on earth.



Figure 28
AI-generated faces by NVIDIA's StyleGan

The software can be implemented on any object, so that for example thousands of photorealistic images of cats can be made in an instant. Historic remodeling could take on new dimensions with this technique in mind when applied to speculations on past events. An audio example can be found in neural-network-generated voices. *Resemble AI* allows users to create a synthetic yet realistic sounding computer voice with 5 minutes of audio material. Apple’s voice assistant Siri was updated with their so-called neural text-to-speech engine, supporting users with a more realistic voice, being distributed slowly to more languages over time. When transferring this

SYSTEM PROMPT (HUMAN-WRITTEN)

In a shocking finding, scientist discovered a herd of unicorns living in a remote, previously unexplored valley, in the Andes Mountains. Even more surprising to the researchers was the fact that the unicorns spoke perfect English.

MODEL COMPLETION (MACHINE-WRITTEN, 10 TRIES)

The scientist named the population, after their distinctive horn, Ovid's Unicorn. These four-horned, silver-white unicorns were previously unknown to science.

Now, after almost two centuries, the mystery of what sparked this odd phenomenon is finally solved.

Dr. Jorge Pérez, an evolutionary biologist from the University of La Paz, and several companions, were exploring the Andes Mountains when they found a small valley, with no other animals or humans. Pérez noticed that the valley had what appeared to be a natural fountain, surrounded by two peaks of rock and silver snow.

Pérez and the others then ventured further into the valley. "By the time we reached the top of one peak, the water looked blue, with some crystals on top," said Pérez.

Figure 29
AI-written short story by OpenAI

knowledge to film, then the idea could root for re-dubbing of silent films. There are sound recordings from radio broadcasts or later sound films available which could be obstructed for this purpose. A text example would be *OpenAI*'s story generator. Their neural network was trained with hundreds of literary texts enabling it to write captivating stories. With only a few lines of input from a user, the software constructs a storyline, including characters, actions and details.

The implications for cinema studies could entail AI completing unfinished projects of auteur filmmakers. From a production point of view, computer-written film scripts seem realistic in terms of expectations in the near future.

In conclusion, this project could be improved with alterations in the search query such as time period, corpus or categorization. Similar projects would benefit from this approach as object-related research questions can output valuable data when designed appropriately. Possible applications go beyond a cinema studies context into adjacent disciplines such as fashion or media studies. Reverse-engineered knowledge could help hypothesize when assessing historical assumptions, evaluating an œuvre or remodeling original material based on synthesized information from archives. Despite its advantages, there are negative implications to be considered as well. For example, deep fakes as pop-cultural phenomenon act as indicator for AI's downside of dangerously realistic images, text and audio purporting legitimacy and credibility. Simultaneously, they embed philosophical questions into AI-research as its nature alters significantly between toy, tool or research depending on context. Regardless, as within Jobs' quote mentioned above, the benefits outweigh the disadvantages as they open new research possibilities in cinema studies as well as beyond it. Apart from that, cinema studies

research will definitely change as already indicated by machine learning trends in tech industries. Therefore, film scholars could not only extract but generate knowledge in its original medium, thereby amplifying research visibility and accessibility.

Conclusion



Figure 30
AI-selection/generated historical cars of the 1950s in Sweden

Was history remembered incorrectly after all? That depends on where one would look for an answer. If one would consider the compilation above, then there might be a new reply, as these images come from a neural network that was trained on footage of Swedish weekly newsreels in the 1950s. This would be what a computer learned to see, taught itself to replicate and then “picked” to represent the decade. Even though the images seem realistic, they were never captured through a camera lens, but synthesized through thousands of iterations in a generative adversarial network. It could be an advance way to discover patterns in films like it hasn’t been done before. However, this is only one idea to work with AI, a digital archive and film. More importantly, this requires more research on the method itself as the implications are not fully comprehensible yet. In other words, history was in parts correct, but in others it simply was not. *New Cinema History* takes a novel approach, looking at film from a historical point of view by combining academic methods in- and more importantly outside cinema studies. During 1950s, -60s and -70s, Swedish cinemas, cars and television were arranged in a unique constellation making the country’s digital archive *filmarkivet.se* a potent place of research. Therewith, the implications of film archival theory have to be taken into consideration as archives might involuntarily create simulations of the past, barring out the generation of new knowledge. AI technology as in object detection, voice recognition or text analysis can help researchers analyze vast corpora of film such as it was done with 114 media artifacts for this project.

Findings tend to redraw tremendous shifts in themes surrounding cars. During the early 1950s, cars were still observed at a safe distance, whereas later in the same decade, they were source of excitement for many, as shown in extravagant car salons and thrilling speed races. In the 1960s, automobiles were connected to more nuanced emotions such as safety, trust and reliability by displaying them as never-resting motor of modernity for the Swedish economy. However, visible hints indicated already greater issues further down the line. Regardless, cars were portrayed as unquestionable drivers of economic prosperity in city centers and rural areas as well as facilitators of social progress in political film campaigns until late 1960s. Within the 1970s, cars were largely viewed negatively as pressing issues of invasive road development in inner cities, drinking & driving public service announcements and unavoidable environmental concerns became obvious. Statistically, the number of cars in images increased from early 1950s, culminating in its peak around 1966/1967's *H-Day* with slow decline until the end of the 1970s. Frequency rates of images of cars decreased slowly until early 1970s, implying cars to become more often visible in more parts of films than before. A noticeable increase of frequency rates occurred parallelly to oil crises in 1973 and 1979. However, based on the analyzed corpus, this development has to be concluded as coincidental as there is no direct mention of the crises within the films themselves. It is rather likely that cars negative connotation during this time period made them unpopular on screens, hence, their frequency rates grew larger. Tf-idf analysis suggests a steady normalization of car-related vocabulary over the course of 30 years with its peak in 1967, when words "driving", "cars" and "right-hand side traffic" were as common in film archival material as connectors "but", "if" and "then". However, within the 1970s, the extremes of linguistic presence and absence become more visible in findings. Moreover, cars' linguistic connotation shifted from slightly negative in the early 1950s to largely positive until late 1960s and back to distinctly negative in the early 1970s.

These findings were made possible by employing a series of common techniques borrowed from computer sciences, namely webscraping, digital video conversion, Yolo-video object detection, voice-to-text recognition and tf-idf evaluation. By using 4-snapshot samples (sometimes referred to as condensed frames) of each second of film, technological hurdles could be overcome to analyze 114 films within several hours, effectively increasing efficiency by 83%. The results of each film's unique car histogram were then statistically evaluated deriving 3 variables: car (median) average, car peak number and car image frequency. For yearly evaluations, the arithmetic mean of 3-4 films (aiming at 40 minutes of film for every year) was employed, depending on availability of footage found on *filmmarkivet.se*.

Lastly, these findings help assess film and media strategies of over 30 years, while simultaneously providing valuable insight into historical events. For cinema studies, this approach can be altered to fit fictional as well as non-fictional content, sometimes converging with adjacent academic fields. In the near future, computer-written scripts, AI-generated film characters or AI-database-composed-soundtracks might be valuable tools in the advancement of film and its research. However, that step will require film scholars to venture more into fields such as computer science. This might be more difficult seeming in the beginning but prove useful in the years to come. In return, both academic disciplines, computer science and cinema studies, gain invaluable knowledge as they near each other, ultimately enabling researchers to re-assess previous paradigms in rapid time, thereby ameliorating research environments. Last but not least, this would allow cinema studies to communicate its findings in images, which it so passionately seeks to understand.

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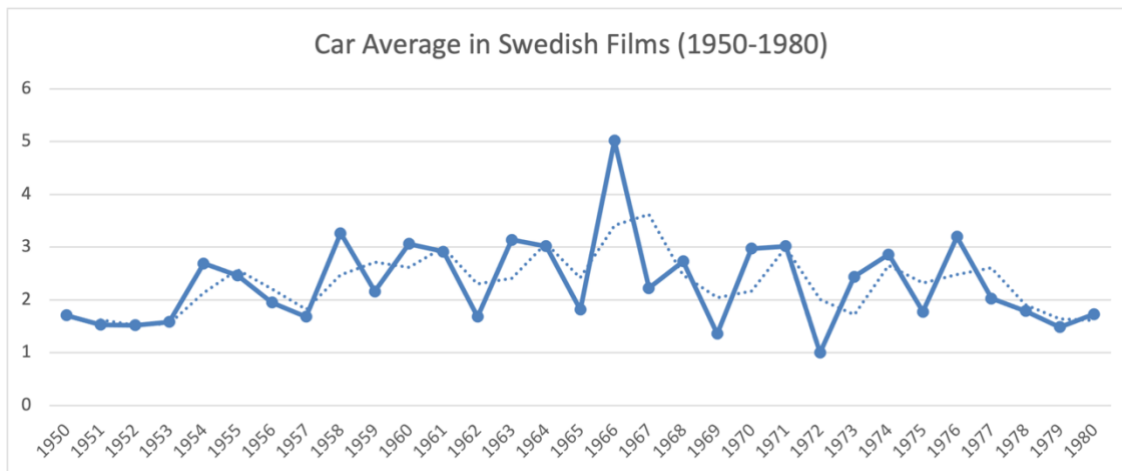
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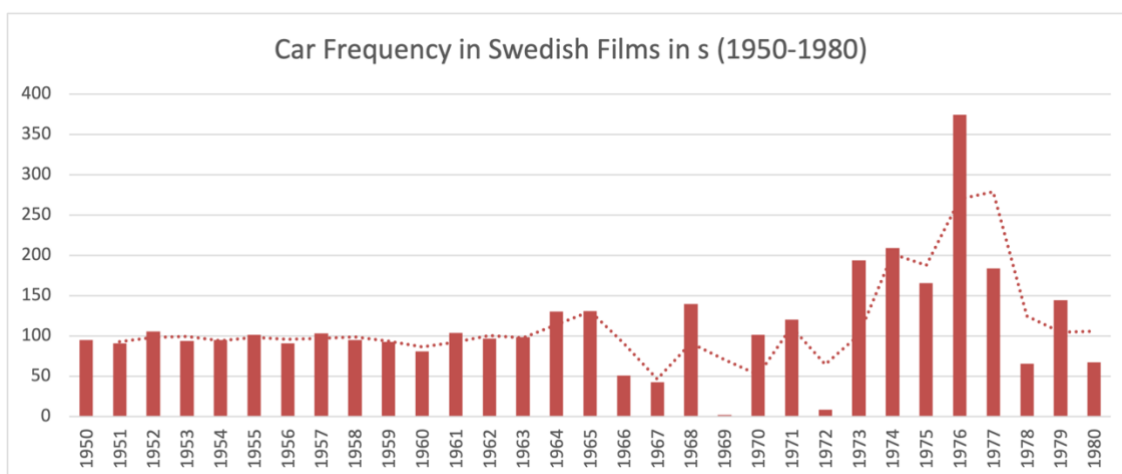
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Appendix

Graph Appendix 1 – Car Average Swedish Films (1950-1980)



Graph Appendix 2 - Car Frequency Swedish Films (1950-1980)



Graph Appendix 3 - Car Peak Numbers Swedish Films (1950-1980)

