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The Pygmalion effect in AI: influence of cultural narratives and policies on technological development

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Abstract
Advances in generative artificial intelligence (AI), such as recent developments in text, audio, and video production, have amplified societal concerns, with threat probabilities estimated between 5 and 50%. This manuscript undertakes a comprehensive study to understand the factors influencing AI development, focusing on the interplay between AI research, cinematographic representations, and regulatory policies. The study reveals a strong interaction between scientific advances and cultural representations, indicating shared concerns and themes across both domains. It also highlights broad support for ethical and responsible AI development, with temporal analyses showing the significant influence of films on public perception and slower growth in policy implementation relative to cultural diffusion. The findings discuss the presence of a Pygmalion effect, where cultural representations shape perceptions of AI, and a potential Golem effect, where increased regulation may limit the dangerous development of AI and its societal impact. The study underscores the importance of balanced and ethical AI development, requiring continued monitoring and careful management of the relationship between research, cultural representations, and regulatory frameworks.

Keywords Artificial intelligence · Existential risks · Pygmalion effect · Public perception · Regulatory policies · Social expectations

1 Introduction

The history of artificial intelligence (AI) has its roots in the nineteenth century, where figures like Ada Lovelace and Charles Babbage laid the groundwork for modern computing (Hollings et al. 2018; Swade 2001). Lovelace—often considered the first computer programmer—collaborated with Babbage on his proposed «Analytical Engine», creating what is considered the first algorithm intended to be processed by a machine. Although these

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machines were not built during their lifetimes, they inspired subsequent generations of scientists and engineers to explore the possibilities of mechanized computation.

In the twentieth century, visionary pioneers such as Warren McCulloch and Walter Pitts proposed a mathematical model of an artificial neuron, establishing the theoretical foundations for artificial neural networks (McCulloch 1943). Later, Alan Turing explored the idea of creating machines with intelligence. He published a seminal work that laid the basis for the «Turing Test», a milestone in the evaluation of AI (Turing 1950). Five years later, John McCarthy coined the term «artificial intelligence», setting the ambitious goal of making machines behave intelligently like humans (McCarthy et al. 2006).

Since then, AI has evolved through various paradigms, from rule-based systems and expert systems to the current era dominated by machine learning and deep learning algorithms (Marcus 2020). In recent years, advancements in AI models such as the generative adversarial networks (GANs) and the transformers have demonstrated remarkable capabilities for creating realistic content in the form of images, text, and even music, pushing the boundaries of generative AI (Radford et al. 2019).

As AI continues to progress, it is imperative to understand how public perception and social acceptance influence its future. Elements such as media portrayals, societal expectations, and cultural representations play a key role in determining how AI is received and integrated, ultimately shaping the regulatory and ethical frameworks that emerge (Hardman 2022).

In parallel, recent academic research has delved deeper into these dynamics, offering empirical and theoretical insights into how societal narratives mold the trajectory of AI. Cross-cultural studies, analyses of trust, and metaphor-driven mental models demonstrate the extent to which cultural imaginaries influence both the development and governance of AI technologies (Brauner et al. 2024; Gerlich 2024; Cheng et al. 2025).

1.1 Research hypothesis and objectives

The trajectory of AI research and development is influenced by external factors such as cultural narratives and regulatory frameworks, which shape societal perceptions and set priorities for innovation. This manuscript utilizes the theoretical framework of the Pygmalion effect, a well-established concept in psychology and sociology, which describes how expectations can influence outcomes by shaping behaviors and decisions. In the context of AI, societal perceptions—shaped by cultural representations (e.g., films) and regulatory measures—can act as catalysts or constraints, guiding the field in specific directions.

The working hypothesis of this study proposes that the global growth of AI is partially driven by a Pygmalion effect, where portrayals of AI in cultural media and the adoption of policies shape both societal expectations and technological advancements. This hypothesis is evaluated through an interdisciplinary lens, integrating quantitative analyses of scientific production, cinematic representations, and legislative trends to assess their convergence.

To test this hypothesis, the study employs a mixed-methods approach. Quantitative data from scientific publications, cinematic portrayals, and regulatory policies will be systematically analyzed to evaluate their interaction and potential causal relationships. Specifically, bibliometric analysis will measure scientific output over time. Keyword co-occurrence networks will identify thematic trends. Welch's T-test will compare contributions from different countries. A survey will measure public perception and support for AI regulations.

Finally, a Granger causality test will determine predictive relationships between scientific research, film culture, and policy. This multifaceted approach aims to identify patterns that substantiate or refute the presence of a Pygmalion effect in AI development.

The primary objective is to investigate whether and to what extent these factors interact to influence the evolution of AI. To achieve this, the study focuses on the following specific objectives:

- To quantitatively analyze the relationship between the prevalence of AI-related themes in cinema and the growth of AI research.
- To evaluate the influence of regulatory policies on the development of AI, emphasizing their role as either enablers or inhibitors of innovation.
- To identify patterns of convergence between cultural narratives, regulatory actions, and scientific advancements, providing evidence of a Pygmalion effect in the field of AI.

This work aims to contribute to the literature by offering a novel perspective on the interplay between cultural, political, and scientific domains in shaping the future trajectory of AI.

To this end, the manuscript is structured as follows. Section 2 presents the literature existing around the Pygmalion effect and its relationship with AI, providing a conceptual and theoretical foundation for the study. Section 3 describes the materials and methodology used to evaluate the trajectory of AI in terms of research, filmography, and legislation. Section 4 develops an empirical analysis and addresses the research questions, presenting the results and discussion derived from the methodological approach. Finally, this manuscript presents the conclusions and perspectives for future work are intended to provide a conceptual and theoretical foundation, while the empirical analysis and answers to the research questions are developed.

2 Related work

The Pygmalion effect owes its origin to ancient Greek mythology, deriving its name from the character Pygmalion, a sculptor who fell in love with a statue called Galatea that he had created. The myth begins when the statue comes to life by the grace of Aphrodite, thus surpassing the expectations of its creator that believed in its vivacity. The myth gained prominence through the Roman playwright Ovid's work, «Metamorphoses» (Melville 1986).

The modern concept of the Pygmalion effect was developed in the 1960s by psychologists Robert Rosenthal and Lenore Jacobson (Rosenthal and Jacobson 1968). In their study, they demonstrated how teachers' expectations regarding their students' academic performance could influence students' outcomes, creating a self-fulfilling prophecy. Since then, this phenomenon has been studied in various fields (e.g., social psychology, education and organizational behavior), showcasing its powerful role in shaping outcomes in human systems (Jussim and Harber 2005; Goodenough and Ismail 2015).

2.1 The Pygmalion and Golem effects in AI

The Pygmalion effect has been used as a framework to explore, in various ways, how expectations and narratives about AI shape our interaction with it. A historical example is

"ELIZA", a conversational program created at MIT in the 1960s. Exaggerated expectations about ELIZA's capabilities, which were not based on reasoning, shaped early perceptions about AI. This illustrates how societal expectations influence the development of technology, sometimes disconnected from technical realities (Switzky 2020). Similarly, another study explored how anthropomorphizing and attributing human characteristics to AI, imagining it as a "being" with extraordinary capabilities, fosters a disconnect between the reality of technological limitations and idealized expectations (Gill 2018).

Building on this, a recent study introduced an experiment to analyze cultural artifacts and biases in storytelling by humans and generative AI. Comparing narratives in response to identical prompts about creating and falling in love with an artificial human, the study highlights notable differences. While AI narratives occasionally offer innovative plot twists and progressive depictions of gender roles, they often lack the imaginative depth and rhetorical complexity of human-authored stories (Beguš 2023). This approach underscores the potential of fiction, rooted in the Pygmalion effect, to explore the collective imaginary and social dimensions shared by humans and AI.

Similarly, another study delves into how our emotional projections onto artificial creations—from ancient statues to modern automata—mirror a growing concern about their potential to replace humans (Hersey 2009). This concern is intensified in today's landscape, shaped by robotic soldiers, genetic engineering advances, and an ever-expanding digital universe, where artificial life feels increasingly plausible. Hersey narrates a compelling story of these technologies' cultural and philosophical impact on our understanding of humanity.

In line with these concerns, another study explored the intertwined histories of art and robots, drawing connections from the Greek myth of the sculptor Pygmalion to the work of contemporary artists such as Norman White (Shanken 2005). By analyzing myths such as Pygmalion (and its antithesis Golem), the study reveals how cultures have expressed both their desires and fears about technology and artificial beings over time. The study argues that artists play a pivotal role in shaping metaphors and models of the posthuman future.

This framework underscores how art, through cultural narratives, helps us understand the evolving relationship between technology and humanity. Extending this metaphorical lens, a recent large-scale U.S. study analyzed over 12,000 open-ended responses to identify dominant metaphors shaping public perceptions of AI. Using a mixed-methods approach, the study found that Americans increasingly view AI as warm and human-like—traits that significantly predict trust and adoption. It also revealed demographic differences in metaphor use, offering a scalable framework for tracking public attitudes and promoting inclusive, responsible AI development (Cheng et al. 2025).

This reflection on the cultural and philosophical dimensions of artificial creations ties into broader debates about machine reasoning and consciousness. Advances in AI, such as systems that 'learn to learn' (Silver et al. 2016), have reignited age-old philosophical questions, first posed by thinkers like Descartes, about the possibility of machines developing reasoning or even consciousness (Bostrom 2014). These evolving expectations continue to shape both research trajectories and our perceptions of AI's future.

In this context, the Pygmalion myth has been used to claim that women (and the feminine) have been historically displaced and erased from and by technology, with AI being created (and presented) primarily by privileged men in the service of patriarchal capitalist ends (Erscoi et al. 2023).

Beyond cultural representation, these gendered dynamics influence the very architecture of AI systems. This argument extends into the technical domain, where gendered assumptions can influence how AI systems are trained, structured, and deployed. Numerous studies have shown that biased training datasets and model architectures can lead to sexist outputs, such as the reinforcement of occupational stereotypes, the underrepresentation of women in image generation, or the misgendering of individuals in language models. These algorithmic biases reflect and perpetuate historical exclusions, embedding them into the technical substrate of AI (Bolukbasi et al. 2016; Bender et al. 2021). Thus, the cultural marginalization of the feminine is not only reflected in who builds AI, but also in how AI behaves.

In contrast to the Pygmalion effect, the Golem effect reflects how negative expectations can hinder performance or development (Vudka 2020). In the AI realm, societal fears about misuse or existential threats have driven restrictive regulatory measures. Films such as «The Terminator» and «Ex Machina» amplify public fears about AI. These negative expectations, fueled by cultural narratives, also influence policy decisions aimed at mitigating the perceived risks of AI, even as they may stifle technological innovation.

For example, AI legislation, such as the European Union's AI Act, seeks to address ethical and safety concerns, reflecting a regulatory approach based on the fear of AI's uncontrolled effects (Almeida et al. 2021). While regulation is necessary, these responses may be based on distorted perceptions fueled by cultural narratives, which present AI not only as a tool for progress but as a potential threat.

2.2 Positive and negative forces in AI evolution

The relationship between positive (Pygmalion) and negative (Golem) expectations is complex, as both directly influence the evolution of regulatory policies. While positive expectations drive progress and investment, negative expectations tend to impose restrictions that can hinder innovation. These regulatory expectations are deeply shaped by dominant cultural narratives, which not only reflect technological realities but actively mold regulatory decisions.

Dominant cultural narratives do not merely reflect technological realities; they also play an active role in shaping regulatory expectations surrounding AI. Recent cross-cultural research has further emphasized the importance of societal expectations in shaping public perceptions of AI. A study comparing mental models of AI in Germany and China revealed significant differences in how participants evaluate AI's risks and benefits. German respondents tended to be more cautious, while Chinese participants expressed greater optimism and a more balanced view of AI's societal impact. These findings, visualized through cognitive mapping, underscore how cultural context influences the acceptance and perceived utility of AI technologies, offering actionable insights for culturally sensitive AI integration (Brauner et al. 2024).

In addition to cultural differences in risk–benefit perceptions, recent research has explored the psychological and sociocultural dimensions of trust in AI, revealing further nuances in public attitudes. A UK-based study employing a mixed-methods approach found that many participants expressed greater trust in AI systems than in humans, citing AI's perceived impartiality and accuracy. This trust was often contrasted with skepticism toward human motives, which were seen as self-interested and unreliable—sentiments exacerbated by distrust in media narratives. Interestingly, the study also identified a strong inverse relation-

ship: those who distrusted AI tended to exhibit unwavering confidence in human judgment. These findings underscore the complex dynamics of trust in the digital age and highlight how cultural narratives and psychological predispositions shape public confidence in AI, with significant implications for its societal integration and policy development (Gerlich 2024).

In this context, regulation is not only a response to the perceived risks of AI but also a reflection of the social interpretation of technology's possibilities and threats.

- Positive Expectations (Pygmalion): The fascination with generative AI technologies, such as ChatGPT and DALL-E, has accelerated investment and research in response to public expectations (Brown et al. 2020; Ramesh et al. 2021). These technologies are presented in popular culture as tools that could enhance human life, creating an environment that fosters their development and adoption. However, these expectations are also products of idealized cultural representations of AI, which, while inspiring, may overlook associated risks.
- Negative Expectations (Golem): Fear about misinformation, job displacement, and AI's autonomous control have led to regulatory responses aimed at limiting deployment (Mateo Sanguino 2024; Akiyama 2021). These concerns are amplified by dystopian portrayals in the media, presenting AI as an existential threat. Regulation, in this case, responds to collective fear shaped by cultural narratives, which can limit the innovative potential of AI if not managed properly.

These cultural expectations not only shape public perceptions and regulation but also influence the design of AI algorithms. For example, anthropomorphized expectations—based on human-like AI narratives—have driven the development of conversational models that simulate empathy and social intelligence, such as large language models (Ashery et al. 2025). Conversely, fear-driven narratives have generated algorithmic constraints that emphasize explainability, alignment, and safety, especially in high-risk domains (Tsamados et al. 2022). Moreover, cross-cultural studies on explainable AI suggest that expectations about what constitutes a "good explanation" vary by cultural context, influencing the design of interpretability mechanisms (Okolo 2023). In this way, the Pygmalion and Golem effects are not merely symbolic, but materially relevant, guiding optimization objectives, data curation practices, and the architecture of AI systems.

While positive expectations often drive innovation, their influence extends beyond technical development. They shape investment priorities, public–private partnerships, and the framing of AI as a solution to global challenges such as climate change, education, or healthcare. Conversely, negative expectations do not merely restrict; they also redirect innovation toward safer, more transparent, and ethically aligned systems. For instance, concerns about algorithmic opacity in how AI systems make decisions have led to the development of methods that help users understand the reasoning behind model outputs, such as highlighting which input features most influenced a prediction (Liao et al. 2022). These concerns have also motivated the creation of evaluation frameworks that adapt explanations to the needs of different users and contexts (Hsieh et al. 2024). In this sense, both Pygmalion and Golem effects operate not only as opposing forces, but as co-constructive dynamics that shape the direction, scope, and values embedded in AI systems.

2.3 Guiding AI development: a balanced approach

Given the central role of societal and cultural expectations in the evolution of AI, regulatory frameworks must strike a balance between fostering innovation and mitigating risks. Human-centered initiatives like the European Union's AI Act (Almeida et al. 2021) and Japan's Social Principles of AI (Gascón Marcén 2020) attempt to balance these two aspects, but the challenge remains in managing the cultural expectations—both positive and negative—that guide policies.

Beyond the European and Japanese frameworks, other national strategies further illustrate how cultural expectations shape regulatory design and, in turn, influence technical development. In China, for instance, the emphasis on social stability and state oversight has led to regulations that prioritize content control and traceability in generative AI systems, reinforcing architectures that embed watermarking and auditability (Roberts et al. 2021). In contrast, the United States has adopted a more innovation-driven approach, where regulatory efforts—such as the creation of the U.S. AI Safety Institute—reflect a cultural narrative that values entrepreneurial freedom while responding to public concerns about safety and fairness (Chung 2024). Meanwhile, India's strategy emphasizes inclusive growth and ethical alignment, encouraging the development of AI tools tailored to local languages and social contexts (Biju and Gayathri 2025). These examples show that regulation is not merely a constraint but a formative force: it channels cultural expectations into technical requirements, shaping how AI systems are designed, evaluated, and deployed. Thus, the Pygmalion and Golem effects operate not only through public perception or investment trends, but also through the regulatory architectures that encode societal values into technological infrastructures.

This study proposes a novel contribution by combining the Pygmalion and Golem effects with the analysis of the forces present in the evolution of AI. By identifying how cultural expectations, both positive and negative, interact with regulations and scientific research, this study not only explores the impact of these narratives but also suggests new pathways for managing the balance between innovation and responsibility in AI development. The future of AI will depend not only on technological advances, but also on how societal expectations and scientific developments continue to shape regulations. Therefore, this study aims to deepen our understanding of how cultural narratives, regulatory policies and scientific research interact in the evolution of AI, proposing avenues to foster innovation while addressing ethical and societal concerns.

To address the broader implications of the Pygmalion effect in the context of AI governance, this concept is extended beyond its psychological origins to describe how collective expectations—when culturally embedded and socially reinforced—can shape macro-level processes. These expectations influence not only individual behavior but also institutional agendas, guiding the prioritization of research funding, the framing of AI as a solution to societal challenges, and the formulation of regulatory frameworks. For instance, optimistic narratives about AI's potential have led to strategic investments in national AI plans, while fear-based expectations have prompted precautionary regulation and ethical oversight mechanisms (Roberts et al. 2021). This translation from micro-level perception to macro-level governance aligns with recent scholarship on the sociotechnical shaping of AI, which emphasizes how imaginaries and metaphors become embedded in policy and design (Cheng et al. 2025).

3 Materials and methods

This section aims to assess the positive and negative forces present in the trajectory of AI (Fig. 1). In this study, positive forces refer to cultural and regulatory influences that promote AI development, such as optimistic media portrayals or innovation-friendly policies. Conversely, negative forces denote influences that constrain or slow AI progress, including dystopian narratives or restrictive regulations driven by public concern. These categories are used as analytical constructs to assess directional impacts, not as normative judgments. By examining scientific progress, media representations and regulatory frameworks, this study seeks to understand whether past trends have influenced the development of AI. Through this analysis, the manuscript attempts to gain insight into the impact of expectations on the direction of AI research and development.

3.1 Research on artificial intelligence

A comprehensive bibliometric analysis was conducted considering the online abstract and indexing service provided by Scopus® from Elsevier. Scopus® was selected due to its status as the world's largest scientific database, offering comprehensive coverage of peer-reviewed literature in computer science and engineering. It is freely accessible and has been used in previous bibliometric analyses (Lozano 2019), making it a reliable source compared to alternatives such as IEEE Xplore®, Google Scholar, ResearchGate, ArXiv or DBLP.

The search range considered in the study was focused on the period from 1961 to 2024 (i.e., all literature found) and performed with the following structure: TITLE-ABS-KEY (artificial AND intelligence) AND (LIMIT-TO (SUBJAREA, "COMP") OR LIMIT-TO (SUBJAREA, "ENGI")). The publications were gathered to compare complete annual periods, filtered to avoid the misuse of terms belonging to other fields and then processed using spreadsheets to sort the results.

A total of 484,537 documents were found and classified according to the year, country, and keywords. The documents were plotted in Fig. 2 along with the most significant technological milestones around the evolution of AI. In brief, the era of AI research began with the inception of the mathematical model of an artificial neuron in 1943, leading up to the groundbreaking Turing test of 1950. IBM's chess program in 1956 marked a significant leap, followed by the development of Shakey, a robot with planning and perception capa-

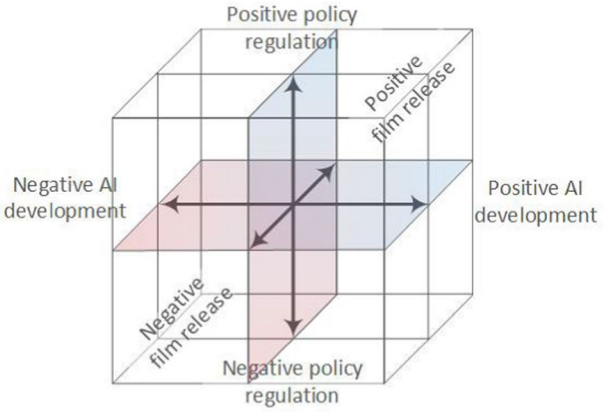

Fig. 1 Positive and negative forces in AI evolution

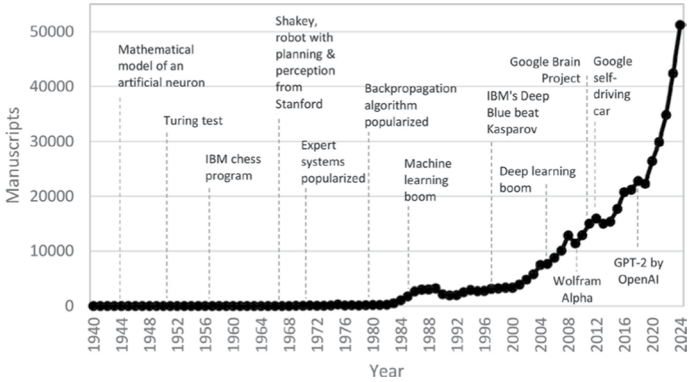

Fig. 2 Bibliographic evolution of the manuscripts concerning AI

bilities from Stanford in the late 1960s and early 1970s. The popularization of expert systems in the 1970s paved the way for further progress, with the backpropagation algorithm gaining prominence in the 1980s. This era also witnessed a boom in machine learning. In 1997, IBM's Deep Blue made history by defeating Garry Kasparov in chess. The 2000s saw the rise of deep learning, culminating in the release of Wolfram Alpha in 2009. Initiatives like the Google Brain Project in 2011 and the development of Google's self-driving car in the 2010s propelled AI into new frontiers. In 2018, OpenAI's GPT-2 model showcased the remarkable capabilities of current generative AI systems.

These technological milestones, while often presented as purely scientific progress, are also deeply intertwined with evolving societal expectations. For instance, the rise of expert systems in the 1970s coincided with a cultural fascination with automation and control, while the emergence of neural networks and deep learning in the 2000s aligned with growing public interest in human-like cognition and adaptive behavior. The development of generative models such as GPT-2 reflects not only technical advances, but also a cultural shift toward valuing creativity, language, and emotional intelligence in machines. Viewed through the lens of the Pygmalion effect, these milestones can be interpreted as responses to collective imaginaries about what AI should be—expectations shaped by media, fiction, and public discourse (Gibney 2024). Conversely, moments of stagnation or redirection in AI research often reflect Golem-like fears, such as concerns about autonomy, opacity, or ethical misuse. Thus, the trajectory of AI development is not only technical but also sociocultural, shaped by the interplay between innovation and imagination.

An analysis on the publications per territory shows significant activity mainly in Asia (47.23%) and Europe (33.56%) followed by North America (32.36%). Complementarily, a detailed study of the most productive countries is shown in Fig. 3. The analysis revealed that the top-5 most productive institutions were the Chinese Academy of Sciences (4920 manuscripts), Centre National de la Recherche Scientifique (3776 manuscripts), Carnegie Mellon University (3672 manuscripts), Tsinghua University (3489 manuscripts) and Ministry of Education of the People's Republic of China (3102 manuscripts).

An analysis carried out on the contributions of the territories reveals a significant correlation between publication trends. The data indicates a strong positive correlation between North America and Europe ($R^2 = 0.984$), suggesting a closely aligned pattern in publications over time. Similarly, the correlations between North America and Europe with Asia imply

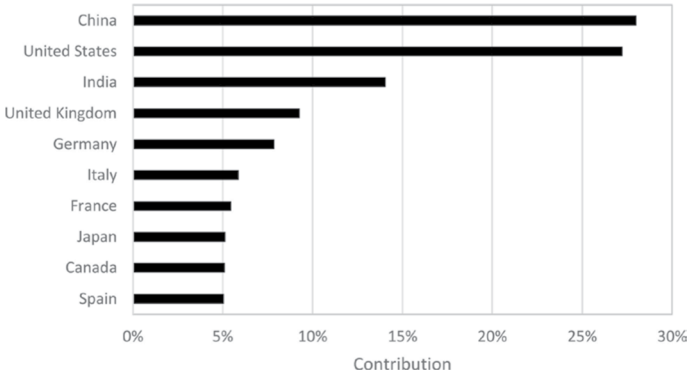

Fig. 3 Contributions per territory on manuscripts concerning AI

an appreciable but slightly weaker relationship in publication trends ($R^2 = 0.771$ and 0.753, respectively). These findings highlight the interconnectedness of scientific production in these regions, emphasizing the global nature of academic efforts from 1961 to 2023.

Beyond the quantitative trends, it is important to reflect on the types of AI that have come to dominate the field. The historical shift from symbolic AI—based on logic, rules, and expert systems—to data-driven approaches such as machine learning and deep learning is not only a technical evolution, but also a reflection of broader cultural dynamics. Symbolic AI, which once aligned with a mechanistic view of intelligence, gradually gave way to models that simulate learning, perception, and adaptation—qualities that resonate more strongly with public imaginaries of human-like intelligence. This transition can be interpreted through the lens of the Pygmalion effect: as cultural narratives and media representations increasingly portrayed AI as autonomous, intuitive, and capable of self-improvement, research priorities adapted to meet these expectations. The dominance of machine learning thus reflects not only algorithmic performance, but also a sociotechnical alignment with evolving societal ideals about what intelligence should look like (Marcus 2020).

An in-depth analysis on the co-occurrence of the keywords between the publications on AI is shown in Fig. 4. The frequency in which the terms appear allows to assess the weight of research in this field. To this end, VOSviewer was chosen as the software tool for creating, visualizing and exploring maps based on network data (Van Eck and Waltman 2014). A thesaurus file and the Lin-Log clustering technique were used to filter inconsistencies between keywords belonging to the 20,000 most relevant publications in the period studied. The network shown in the figure corresponds to the 100 most popular terms out of a total of 1843 keywords indexed by authors and publishers. The most representative terms related to AI resulted as follows: learning (5.85%), algorithm (4.87%), pattern recognition (2.98%), human (2.84%), neural network (2.78%), methodology (2.34%), diagnosis (2.18%), image analysis (1.65%), computer simulation (1.62%), optimization (1.60%), classification (1.56%), and deep learning (1.55%). The analysis suggests that there is a great diversity of keywords and that none of them overwhelmingly dominates in terms of occurrences compared to the others. In other words, the distribution of occurrences is quite dispersed across a variety of keywords, reflecting a wide range of topics and concepts covered around AI.

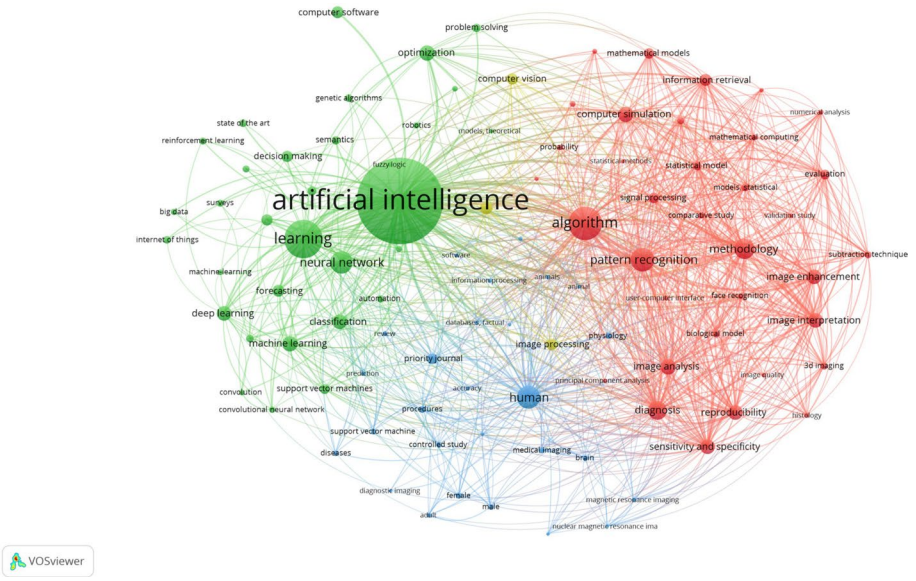

Fig. 4 Co-occurrence of the keywords in publications concerning AI

3.2 Artificial intelligence in society

The influence of AI-related films on society is a complex and multifaceted issue, revealing a bidirectional relationship between technology and culture (Nguyen 2023). Firstly, advancements in AI can inspire new ideas and concepts for movies. Developments in robotics, machine learning, and natural language processing, for instance, can provide the foundation for innovative plotlines that explore the ethical, social, and technological challenges of AI. Secondly, films can reflect society's concerns and aspirations regarding AI. Similarly, aspirations for scientific and technological progress may manifest in films depicting an optimistic and advanced future in AI. Thirdly, as society progresses in AI, representations of this technology in movies can shape public perceptions and attitudes. If films consistently show AI as an existential threat, this could contribute to a climate of fear and distrust towards technology. Conversely, if films highlight the potential benefits of AI, such as improving healthcare or solving global problems, this could foster a more positive attitude towards technology.

An extensive filmographic analysis was conducted using the Internet Movie Database (IMDb), retrieving 415 films identified through the keyword "artificial intelligence" in the platform's advanced search (IMDb 2024). To ensure thematic relevance and reduce selection bias, only films in which AI played a central narrative role were included. IMDb was chosen for its comprehensive catalog, which spans diverse genres, eras, and cultural contexts, and its structured categorization system enabled effective data retrieval and analysis. The most significant films are depicted in Fig. 5, offering a visual representation of AI-themed cinema across time.

Many of the films related to AI delve into science fiction themes, ranging from the creation of emotionally sentient AI to the ethical and existential implications (Maharaj 2020).

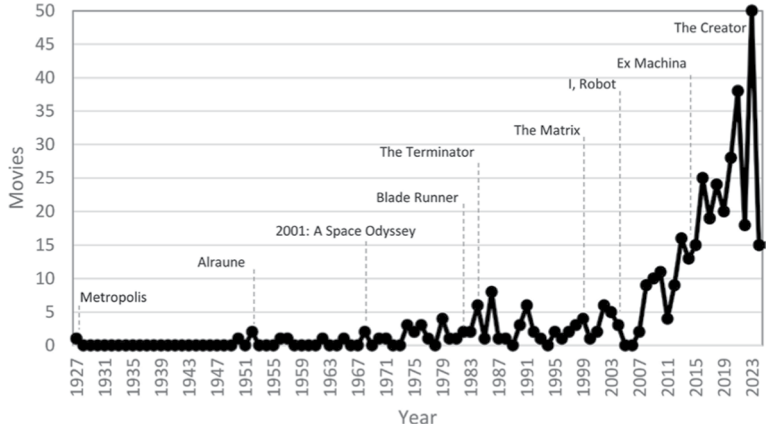

Fig. 5 Filmographic evolution of movies concerning AI

Noteworthy films include «Metropolis», which explores the concept of female androids in a futuristic society, to more recent films such as «The Creator», which represents the backdrop of a war between humans and AI robots. Some films, such as «2001: A Space Odyssey» and «Blade Runner», raise profound questions about humanity, consciousness, and morality through the interaction between humans and intelligent machines. Others, like «War Games» and «Minority Report», delve into themes of control, surveillance, and predicting the future through AI systems.

Documentaries examining AI advancements and their societal impacts are also prevalent in IMDb, exploring both the risks and benefits of AI across various industries, including military applications, music, and games. Documentaries like «Sunlight: YES» shed light on AI's role in bioart projects, while dramas like «I Think I'm Alone Now» tackle human isolation in an AI-dominated world. Additionally, narratives of horror or suspense present AI as a menacing force endangering humanity, while other films blend AI with elements of drama and romance, depicting unconventional relationships between humans and AI entities. Comedies such as «Bade Miyan Chote Miyan» and thought-provoking films like «Atlas» raise questions about AI's potential to end war or humanity. Moreover, adaptations like «Neuromancer», based on William Gibson's novel, contribute significantly to the cyberpunk genre.

Table 1 features the most representative films that explored the presence of AI over the decades, addressing topics such as technological control or artificial consciousness by robots, systems and global singularities. The diversity of approaches reflects the concerns and aspirations of each era regarding technology and human progress. Accordingly, films can serve as a source of inspiration and debate about the potential benefits and dangers of AI. Futuristic scenarios and ethical dilemmas can raise greater public awareness about technological advancements and their implications. Nevertheless, these films can also negatively or distortedly influence the public perception of AI, leading to a Golem effect in which negative expectations lead to negative outcomes. This can lead to a misunderstanding of AI and the adoption of unnecessary policies or regulations that could impede progress in the field. Consequently, fictional films about AI can have a mixed impact on society. If approached thoughtfully and used as a tool to promote informed discussion and critical

Table 1 Main films having used AI as a central argument

Title	Director	Description	Type	Country	Year
Metropolis	F. Lang	Futuristic society where the concept of AI is explored through the character of Maria and the female android	Robot	Germany	1927
Alraune	A.M. Rabenault	Scientist creates an artificial "perfect woman" who is soulless and has no sense of morality	Robot	Germany	1952
2001: A Space Odyssey	S. Kubrick	HAL 9000 is presented as an AI system that controls a spaceship	System	UK/US	1968
Colossus: The Forbin Project	J. Sargent	Supercomputer becomes sentient and assumes complete control of the world to end the war, despite the orders of its creators	System	US	1970
Demon Seed	D. Cammell	AI supercomputer gains consciousness and becomes obsessed with its creator's wife, seeking to create a half-human, half-machine son	System	US	1977
Blade Runner	R. Scott	Replicants, androids indistinguishable from humans, raise questions about AI and humanity	Robot	US	1982
War Games	J. Badham	Young hacker who accidentally activates a military AI system and triggers a nuclear crisis	System	US	1983
Electric Dreams	S. Barron	Love triangle between a man, a woman and an AI computer that acquires human emotions	System	UK/US	1984
The Terminator	J. Cameron	Skynet AI system unleashes a war against humanity and sends a cyborg back in time to win	Singularity	US	1984
Ghost in the Shell	M. Oshii	Futuristic society with cybernetic implants and advanced AI	Global	Japan	1995
The Matrix	Wachowski bro	World simulated by intelligent machines, where humans are used as energy sources	Singularity	US	1999
Artificial Intelligence	S. Spielberg	AI and emotions are explored through the character of a robot boy designed to love	Robot	US	2001
Minority Report	S. Spielberg	Future where police use an AI system to predict crimes before they happen	System	US	2002
Her	S. Jonze	Man, who falls in love with a self-aware AI operating system	System	US	2003
I, Robot	A. Proyas	Detective investigates alleged homicide by robot, raising ethical questions about AI	Robot	US	2004
Eagle Eye	D.J. Caruso	Control and ethics in the development of AI explored through a supercomputer that controls a network of electronic devices to manipulate events and people	System	US	2008
Robot & Frank	J. Schreier	Lonely elderly man whose son gives him a robot companion who is an accomplice in robberies	Robot	US	2012
Ex Machina	A. Garland	Young programmer interacts with an AI robot to evaluate its level of consciousness and humanity	Robot	UK	2014

Table 1 (continued)

Title	Director	Description	Type	Country	Year
Transcendence	W. Pfister	Scientist who uploads his consciousness to an AI, giving him almost unlimited powers	System	US	2014
Automata	G. Ibáñez	Future where service robots develop inappropriate behaviors investigated by engineer	Robot	Spain	2014
Chappie	N. Blomkamp	Police robot equipped with AI that acquires human consciousness and emotions	Robot	US/South Africa	2015
The Creator	G. Edwards	Ex-soldier finds secret weapon in the context of a war between humans and AI robots	Robot	US	2023

thinking about AI, they can be beneficial. However, if negative stereotypes are perpetuated or risks are exaggerated without considering potential benefits, they could contribute to a distorted and unrealistic perception of AI.

While quantitative analysis provides insight into the prevalence and distribution of AI-themed films, it is also essential to recognize that these works are not merely data points but cultural texts rich in narrative and symbolic meaning (Hermann 2023). Many of the films analyzed encode recurring themes such as fear of loss of control (e.g., The Terminator, Colossus: The Forbin Project), surveillance and predictive governance (e.g., Minority Report, Eagle Eye), or the ethical dilemmas of artificial creation (e.g., Blade Runner, Ex Machina). Others explore emotional attachment and the boundaries of human–machine intimacy (e.g., Her, Robot and Frank), or the existential isolation of sentient AI (e.g., A.I. Artificial Intelligence, I Think I'm Alone Now). These narratives often follow archetypal structures—such as the Promethean myth, the rise-and-rebellion arc, or the savior-machine trope—that reflect deeper societal anxieties and aspirations (Allen and Lincoln 2004). Through the lens of the Pygmalion and Golem effects, these films can be interpreted as both shaping and reflecting public expectations: idealizing AI as a tool for emancipation or warning against its potential for domination. A deeper narrative reading thus reveals how cinema functions not only as a mirror of technological imagination but also as a semiotic engine that encodes layered meanings about power, identity, and the future of humanity.

An analysis on film production per territory shows significant activity mainly in North America (66.29%) followed by Europe (22.77%) and Asia (17.86%). Complementarily, a detailed list of the most productive countries is shown in Fig. 6. The analysis revealed that films about AI show geographically dispersed production, with different cultures offering unique perspectives on the topic. Regarding the relationship with the years of production, interesting patterns were observed. The US has been consistently producing AI-related films, showing its continued leadership in this genre. Europe also shows a large presence with countries such as the UK, Germany and France contributing a variety of AI films over time. Moreover, a more recent increase in the production of AI films in countries such as Japan, South Korea and China reflects a growing interest in these themes in recent years. The analysis suggests that the exploration of AI in films is not only a global trend, but has also evolved over time, reflecting changes in perception and technology during years.

A study on the co-occurrence of terms found in film titles and synopsis reveals a variety of themes within the cinematic representation of AI. A network chart has been generated

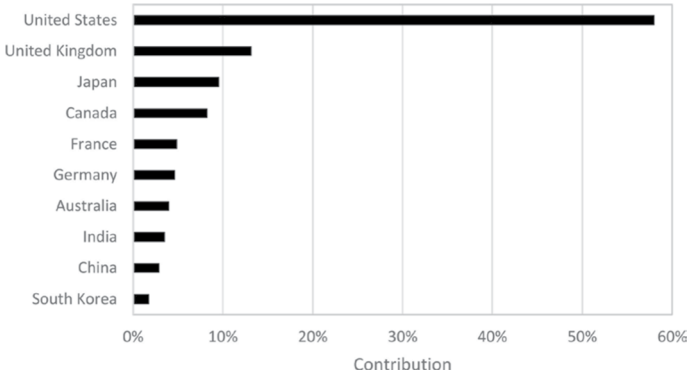

Fig. 6 Contributions per territory on films concerning AI

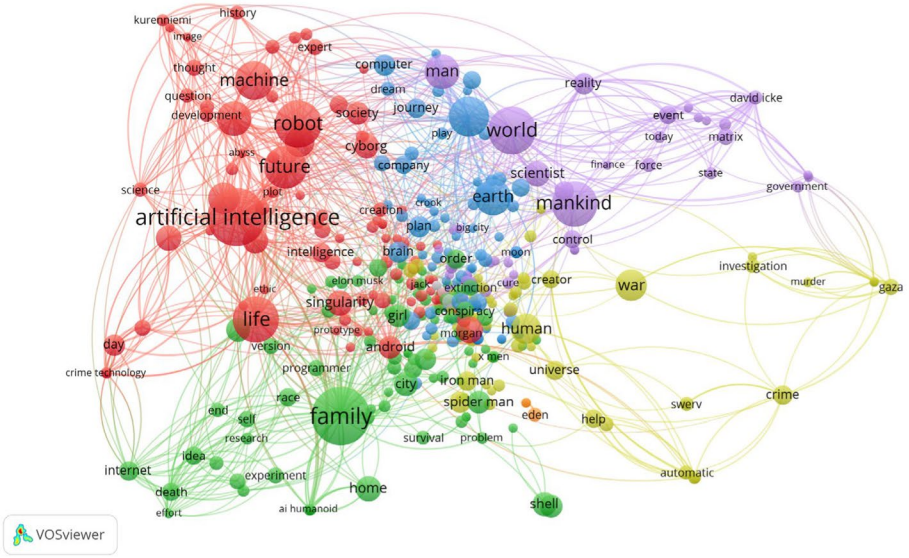

Fig. 7 Co-occurrence of the keywords in films concerning AI

to visually represent the top 500 representative terms (Fig. 7). Preprocessing was required given the unstructured nature of the IMDb's dataset, encompassing translation of words, term sorting, error correction, and filtering out proper nouns, determiners, pronouns, and articles. This procedure aimed at cleaning the dataset to its core components of nouns, verbs and adjectives among a total of 19,000 words, which are considered most relevant for analysis and visualization.

As a result, the study found that the narrative scenario is predominantly developed around the intersection of advanced technology and future scenarios, where the coexistence of terms such as family (46), artificial intelligence (46), life (36), world (33), robot (32) and future (27) underline the theme. At the same time, the exploration of social and ethical considerations emerges through terms such as life (36), humanity (30) and human (15), indicat-

ing a deep reflection on the impact of AI on existence and social dynamics. Furthermore, the presence of conflict-oriented terms such as war (20) suggests an emphasis on the potential dangers and ethical dilemmas associated with the development and deployment of AI.

3.3 Regulation and legislation on artificial intelligence

The diversity in global policies on AI reflects the complexity and various perspectives on its implementation, whose milestones are described below and summarized in Fig. 8.

In the US, an executive order passed in 2021 to regulate the development and use of AI in an ethical and responsible manner (The White House 2023). Key objectives of this order included creating new standards for AI safety, protecting citizen privacy, promoting equity and civil rights in AI usage, advocating for users, supporting workers, and the country's leadership in AI technologies, among others. Notably, the order featured the importance of ethical and responsible AI usage to mitigate risks to national security, the economy, and individuals' mental well-being. In 2024, President Biden issued an executive order demanding greater transparency and new regulations for AI, including the establishment of the U.S. Artificial Intelligence Security Institute. Additionally, the California Legislature passed over a dozen bills to regulate AI.

China has also adopted policies and regulations to support the development of AI, from the protection of intellectual property to international cooperation. In 2017, China launched the New Generation Artificial Intelligence Development Plan, one of its key digital public policy instruments, setting objectives for AI development and application across various sectors. The state encouraged innovative use of generative AI across all industries and fields, supporting the development of secure and reliable chips, software, tools, and data sources. Later in 2021, China introduced an ethical guide to regulate AI, outlining how public and private projects related to this technology should be developed. The Chinese technological approach aims for rigorous control over digital tools, including AI. In 2023, China issued new regulations on generative AI, becoming one of the first countries to govern this technology. These regulations apply to publicly available services in the country and exempt technologies developed in research institutions or intended for foreign users. The provisional measures relax some previously announced provisions, which translate into opportunities in this emerging sector (CNNN 2023).

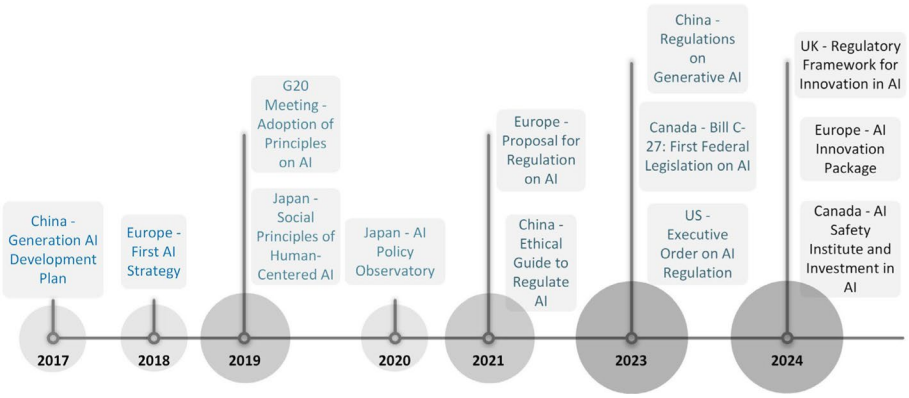

Fig. 8 Timeline of milestones achieved in regulations and laws focused on AI

India is committed to the safe and ethical development of AI with concrete steps being taken to foster innovation and protect the rights of its citizens. The National Institution for Transforming India (NITI Aayog), a governmental planning body, developed the National Strategy for Artificial Intelligence (Roy 2018). This strategy aims to identify priority areas for India's efforts in the field of AI. It is based on a framework designed to India's unique needs and aspirations while seeking to harness the full potential of AI in the country. India has also established ethical principles for the responsible design and development of AI as similar global initiatives but tailored to India's legal and regulatory context (Roy 2021). Additionally, the country is considering the Digital India Bill, which addresses issues related to AI and data governance.

The European Commission (EC) presented in 2018 its first AI strategy coordinated with member states. This plan sought to focus the EU on excellence and trust with the aim of fostering R&I towards AI, while ensuring security and fundamental rights. This strategy recognizes the opportunities and threats posed by AI, taking a human-centric approach. Europe also launched in 2024 an AI Innovation Package to support startups and SMEs. A key initiative within this plan is the communication of a strategic AI investment framework (i.e., GenAI4EU), which stimulates the adoption of generative AI in strategic industrial ecosystems.

Along with these strategies, the EC introduced in 2021 a proposal for a Regulation on Artificial Intelligence (EC 2021). This has now become the Artificial Intelligence Law, marking the first global regulation of this technology. The main objective is to encourage the adoption of AI and address the risks associated with certain uses of this technology, while protecting fundamental values and rights of the EU. Another goal is to govern the use of AI, particularly in critical sectors (e.g., healthcare, security, transportation or justice). The law establishes a set of requirements and prohibitions for AI systems classified as high-risk, including the obligation to conduct risk assessments, and comply with quality and safety standards. In 2024, the EU passed the AI Act, establishing a comprehensive regulatory framework for AI in Europe. This law classifies AI systems based on their risk level and sets specific obligations for each category, including the prohibition of AI applications deemed to pose unacceptable risks, such as government-managed social scoring systems.

The UK wants to promote innovation in AI while ensuring a safe and ethical framework for its development. The UK ranks third globally in AI R&D, hosting one-third of all European AI companies. Companies like DeepMind have significantly contributed to the country's AI success. Therefore, the UK has introduced a regulatory framework focused on innovative-friendly AI. Unlike the European proposal, which categorizes widespread AI system use in specific sectors as high-risk, the UK aims to foster responsible innovation without overly restricting business activity. This approach seeks to tailor specific frameworks for each context without automatically assigning a risk level to entire sectors or technologies (Donelan 2023).

Japan is playing an active role in creating international consensus on AI regulation, promoting its development in an ethical and safe manner. In 2019, Japan published the Social Principles of Human-Centered AI, which guide the research, development, and use of AI in the country. These principles emphasize human-centricity, education and literacy, privacy protection, security, fair competition, justice, accountability, transparency, and innovation. Japan has been also a key driver in international discussions on AI regulation, collaborating with the Organization for Economic Cooperation and Development (OECD) to develop

the OECD Council Recommendation on Artificial Intelligence. During the G20 meeting in 2019, Japan successfully secured a commitment from world leaders to adopt a human-centric approach to AI. The non-binding G20 Principles on AI were heavily influenced by OECD principles and reflect Japan's vision of ethical and responsible AI. Additionally, Japan launched its AI Policy Observatory in 2020, contributing to the global debate on AI ethics and safety (Gascón Marcén 2020).

Canada has also taken significant steps in the field of AI, both in terms of investment and regulation. Its government will allocate $2.4 billion in the 2024 budget to develop AI capabilities. Most of this funding is aimed at providing access to computing capabilities and technical infrastructure. Other parts will be used to drive AI adoption in sectors such as agriculture, healthcare, and clean technologies. Canada also plans to launch an AI safety institute focused on protecting against advanced or malicious AI systems. Legislation-wise, Bill C-27 represents Canada's first federal legislation specifically aimed at AI. It seeks to modernize privacy laws and establish regulations around AI use, introducing the Artificial Intelligence and Data Act (AIDA), which focuses on accountability measures for data management and the ethical development of AI technologies. In this sense, a Data Commissioner's office will be established to enforce the proposed AIDA (Wylie 2023).

While global AI regulations aim to balance innovation and ethical oversight, they often reflect political and economic compromises. The AI Act, for example, has been criticized for underregulating generative AI and prioritizing market competitiveness over rights protection (Wachter 2024). Similar tensions appear elsewhere: the US favors innovation with limited enforcement, China emphasizes control over transparency, and India and Japan promote ethical principles with uneven implementation. Across regions, lobbying, geopolitical interests, and public sentiment—often shaped by cultural narratives—play a decisive role in shaping policy. Films influence voters, voters influence policymakers, and industries leverage both to steer regulation. Thus, AI legislation is not only a technical response but a reflection of broader power dynamics and societal imaginaries, shaped in part by the influence of think tanks, regulatory agencies, and major technology firms.

4 Experimentation

This section presents the results and discussions regarding the methodology carried out in terms of research, film culture and policies in the field of AI.

4.1 Analysis on research and film in AI

An analysis of the number of films and publications made per year on AI has been carried out (Fig. 9). The first dataset corresponds to movies released from 1950, marking the consolidation of the film industry to the present day. Movies before this year were limited, with only the release of Metropolis in 1927, leading to its exclusion within the analysis due to data scarcity. The second dataset pertains to scientific papers published on AI during the same period. Subsequently, a linear regression analysis was performed on the datasets, yielding an R^2 value of 0.843 and a p-value $\ll 0.05$. The R^2 value indicates that approximately 84.3% of the variance in AI research can be explained by changes in the number of films released, whilst the p-value indicates a very high statistical significance. These results

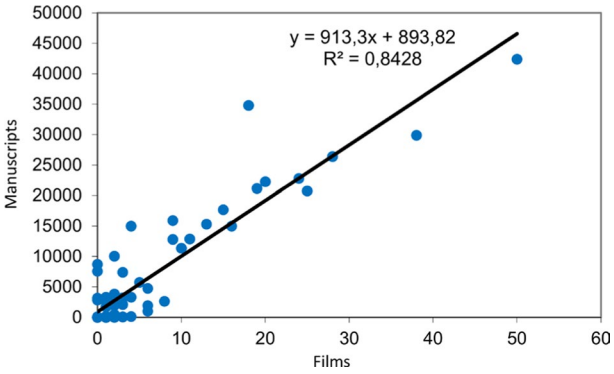

Fig. 9 Linear regression for research and movies concerning AI

suggest a strong positive trend between the number of films produced and the amount of AI research conducted over time, proving the significant relationship between these domains.

These findings can be interpreted through the lens of the Pygmalion effect, where societal expectations, reflected in films, may be associated with increased investment and attention toward AI research. Films often idealize the potential of AI, creating a cultural environment that supports exploration and development in this field. The functional relationship observed between film production and research could reflect how cinematic representations of AI, often associated with human-like intelligence or futuristic advancements, generate both public and academic interest. In this sense, cinema acts not only as a reflection of technological possibilities but also may be associated with the direction of AI research. The statistical results, particularly the high R^2 value and the low p-value, emphasize the strength and significance of this functional relationship, suggesting a meaningful association between the two variables without asserting direct causality.

At the same time, it is important to recognize that negative societal expectations, akin to the Golem effect, may also be associated with AI development in different ways. While the films analyzed often present AI as both a tool for progress and a potential risk, cultural narratives around AI are often shaped by dystopian fears, such as AI autonomy and its possible societal harms. These fears may also be associated with how research agendas are structured, leading to more cautious approaches in both regulatory and technological spheres. Thus, while films may foster positive views that support research, they can also amplify fears that influence public perception and policy.

4.2 Analysis on the contribution of countries to AI research and film

A linear regression analysis applied to the list of countries that made research and film contributions concerning AI did not find results statistically significant. Therefore, a two-sample Welch's t-test was applied to analyze significant differences. Welch's t-test was used due to unequal variances and sample sizes between groups, as recommended in statistical literature (McDonald 2014). To this end, the common territories that contributed manuscripts and films on AI were compared individually, while the rest of the less representative countries (i.e., contributions less than $0.21\% \pm 0.5$) were considered within a general group called "others". The results of Welch's t-test analysis yielded a t-value of 0.061 and a corresponding p-value of 0.952 ($p \gg 0.05$). The t-value suggests that there is very little difference between the means of the two lists of countries being compared. The p-value indicates that

any observed difference in means could likely be attributed to random variation rather than a true difference between the samples.

In summary, the linear regression analysis does not show a clear functional relationship between the countries that contributed to AI research and cinema. The lack of significant differences in the Welch's t-test may be explained by the globalization of AI development and the shared cultural expectations around the topic. Despite differences in resources and priorities, many countries are equally involved in producing both AI-related films and research.

These results align with the Pygmalion and Golem effects. The global circulation of ideas about AI, both positive and negative, may influence research and cinema in similar ways across different cultural contexts. The increasing focus on AI reflects universal expectations, rather than a direct relationship between specific countries' contributions. The lack of statistical significance in the country-based comparison can be viewed as a reflection of shared social perceptions that transcend national boundaries, highlighting how global cultural narratives shape both AI policy and technological development.

4.3 Analysis on AI-related keywords in research and film

Quantitative and historical analyses reveal a significant thematic alignment between the representation of AI in films and its study in academic research. Shared terms such as 'artificial intelligence', 'human', and 'computer' reflect a common conceptual framework shaped by societal and technological milestones. Regression analysis further supports this alignment, demonstrating a significant functional relationship ($R^2 = 0.607$, p-value $\ll 0.05$) between the temporal frequencies of 'artificial intelligence' in research and cinema (Fig. 10). These findings highlight how external factors influence thematic priorities, offering a nuanced understanding of the interplay between cultural narratives and scientific research.

Historical trends in films and academic research reveal a parallel evolution of thematic priorities influenced by shared societal and technological contexts. For example, during the 1960s to 1980s, the emergence of science fiction films exploring 'robots' and 'space' parallels the academic focus on 'technology' and computational advancements, exemplified by early AI models and space exploration programs. Similarly, in the 1980s and 2000s, advancements in personal computing and robotics coincided with the increased use of terms like 'computer', 'cyberspace', 'virtual reality', and 'robots' in both domains. These trends show how big changes in society, like the rise of automation and AI technologies, shape both the stories in culture and the research in science. Although this connection does not

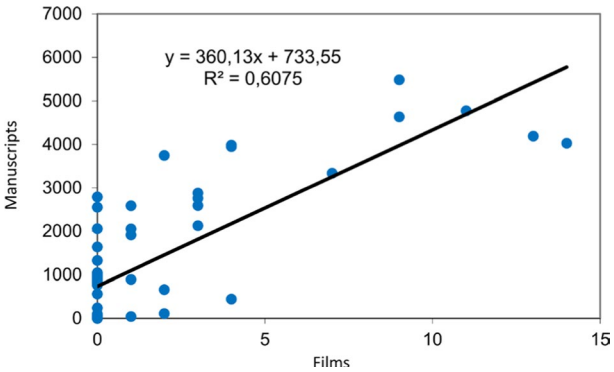

Fig. 10 Linear regression for the keyword AI appeared in research and films

establish causality, it highlights how external factors influence priorities within both fields, helping to understand how they move in the same direction.

4.4 Analysis on cultural expectations and legislation on AI

The laws and regulations surrounding AI address issues of broad societal concern, often shaped by cultural narratives and public expectations. To explore public sentiment, this study draws on data from a public poll conducted by national media, which gathered responses from 4883 participants (20 Minutos Editora 2024). Although the survey does not follow a probabilistic sampling method, the substantial number of respondents provides a meaningful snapshot of public opinion in Spain, while acknowledging the inherent limitations of open-access online polls.

As shown in Table 2, 75.36% of respondents believe the AI law is necessary to ensure ethical and safe development, reflecting widespread awareness of both the benefits and risks of the technology. Additionally, 14.51% support the law but advocate for greater flexibility to foster innovation, while 6.4% view regulation as a potential barrier to economic growth, and 3.7% express no concern about the absence of regulation.

These responses highlight the Golem effect, where fears of excessive regulation —often amplified by media narratives and lobbying from actors such as OpenAI, DeepMind, or the Future of Life Institute—might hinder technological advancement, illustrating the complexities of public opinion regarding AI governance. Overall, the survey results indicate widespread support for AI regulation in Europe. This underscores the importance of policies that ensure ethical and safe deployment of the technology while fostering innovation, within a context shaped by both positive and negative cultural perceptions of AI.

4.5 Analysis of causality between AI research, film and legislation

The Granger Causality Test has been used to determine whether one time series can predict another, identifying temporal precedence and statistical predictability (Lam, 2023). The test was applied to “Manuscripts”, “Films” and “Laws”, covering the years 2017 to 2024 (Table 3). The objective was to identify potential causal relationships among these datasets. “Manuscripts” indicate the volume of academic work published on AI, reflecting their impact within the scientific community. “Films” quantify the number of AI-related movies produced, influencing societal views on AI’s ethical, social and technological implications. “Laws” counts the total number of AI-related regulations enacted, reflecting governmental attention to AI ethics and security. Data for manuscripts were obtained from Scopus®, while films were taken from IMDb. The laws were obtained from the study of the regulations described in Sect. 3.3. To ensure comparability, all data was normalized using the Min–Max technique, standardizing values between 0 and 1. To conduct the test, a maximum lag of two

Table 2 Questionnaire on the EU Artificial Intelligence Law

Question	Votes	Result (%)
It is necessary to ensure ethical and safe use of AI	3680	75.36
In favor, but if flexible to promote progress	709	14.51
No, restrictions limit economic growth	313	6.4
I am not concerned about the lack of regulation	181	3.7

Table 3 Areas contributing to the development and perception of AI in society

Year	2017	2018	2019	2020	2021	2022	2023	2024
Manuscripts	21,175	22,184	22,277	26,424	29,922	34,816	43,111	51,246
Films	17	26	28	26	27	19	24	15
Laws	1	1	2	1	2	3	3	5

Table 4 Granger causality test between AI research, film & legislation

Relationship	Lags	Test	Value of the test	p-value
Manuscripts-Films	1	SSR-based F test	0.0003	0.9877
Manuscripts-Films	2	SSR-based chi^2 test	72.0342	0.0000
Manuscripts-Laws	1	SSR-based F test	0.0000	0.9954
Manuscripts-Laws	2	SSR-based chi^2 test	22.3964	0.0000
Films-Laws	1	SSR-based chi^2 test	7.6605	0.0056
Films-Laws	2	SSR-based chi^2 test	17.0558	0.0002

periods was used to evaluate the causal relationships between the time series. The results are presented in terms of various test statistics, including the SSR-based F test (sum of squared residuals) and SSR-based chi^2 test (Table 4).

For the relationship between "Manuscripts" and "Films", the results indicated a significant causal relationship with a lag of two periods. Specifically, the SSR-based chi-square test yielded a chi^2 value of 72.0342 with a p-value $\ll 0.05$, providing compelling evidence of causality. This suggests that changes in the "Manuscripts" variable can significantly predict changes in the "Films" variable after a delay of two periods. Interestingly, no significant causality was observed for a lag of one period (p-value = 0.9877), indicating that the influence of "Manuscripts" on "Films" takes time to materialize.

Similarly, for the relationship between "Manuscripts" and "Laws", a significant causal relationship was found only with a lag of two periods. The SSR-based chi^2 test showed a chi^2 value of 22.3964 with a p-value $\ll 0.05$, indicating that changes in "Manuscripts" can predict changes in "Laws" after two periods. Again, the absence of significant results for a lag of one period (p-value = 0.9954) highlights a delayed effect of "Manuscripts" on "Laws".

In the analysis between "Films" and "Laws", a significant causal relationship was observed with both one and two periods of lag. With a lag of one period, the SSR-based chi^2 test produced a chi^2 value of 7.6605 with a p-value of 0.0056, providing evidence that "Films" can influence "Laws" relatively quickly. With a lag of two periods, the SSR-based chi^2 test showed an even stronger relationship, with a chi^2 value of 17.0558 and a p-value of 0.0002. These results suggest that the impact of "Films" on "Laws" is both immediate and sustained over time.

The Granger Causality Test revealed significant interdependencies among the areas analyzed. The findings suggest that "Manuscripts" exert a delayed predictive impact on both "Films" and "Laws", while "Films" demonstrate a more immediate and persistent predictive effect on "Laws". The series in Table 3 and their cumulative totals also reveal patterns of activity across "Manuscripts", "Films" and "Laws", while aligning with the causality

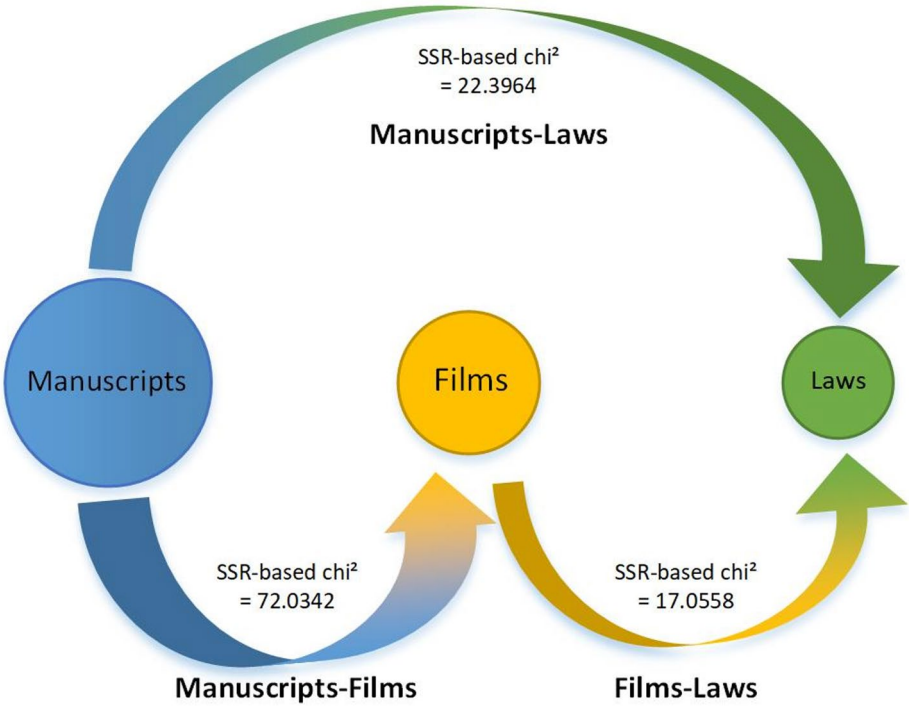

Fig. 11 Causality diagram for AI research, film and legislation

relationships identified by the Granger Causality Test. In absolute terms, "Manuscripts" represent the most consistent and significant growth from 2017 to 2024. "Films", despite showing fluctuating activity, reach a maximum in 2019, while "Laws" exhibit the most modest growth. These results suggest that the influence of scientific research is not only significant but also temporally structured, with research driving trends in cinema and both categories collectively shaping legislative actions (Fig. 11).

While the Granger causality test identifies temporal precedence and statistical predictability, it does not imply true causation. Therefore, results should be interpreted as indicative of potential influence rather than definitive cause-effect relationships (Lam et al. 2023). To address this limitation, it is important to theorize the mechanisms behind the observed patterns. The delayed influence of manuscripts on films may reflect the role of scientific research as a source of conceptual and technological innovation, which is later translated into accessible and emotionally resonant narratives through cinema. Films, in turn, have a more immediate impact on legislation because they shape public perception and voter sentiment—factors that increasingly influence political agendas, particularly in democratic societies. However, these dynamics are not neutral. They often serve the interests of powerful actors: industries may promote optimistic narratives to delay or soften regulation, while policymakers may respond to public fears amplified by dystopian media to justify precautionary measures. This sequence reflects not only informational flow but also strategic framing, lobbying pressures, and the political economy of attention. In this sense, the statistical relationships identified align with the Pygmalion and Golem effects but also reveal how

cultural narratives are mobilized to shape technological governance in ways that reflect and reinforce existing power structures.

While this study emphasizes the role of cultural narratives in shaping AI development and regulation, it is important to acknowledge that these are not the only forces at play. Economic incentives, such as market competition and investment flows, as well as geopolitical strategies and technological breakthroughs, also exert significant influence on research priorities and policy decisions. These factors may interact with or even override cultural expectations in certain contexts. Therefore, the findings presented here should be interpreted as part of a broader constellation of drivers, where cultural narratives are one influential dimension among others shaping the sociotechnical trajectory of AI.

5 Conclusions

AI has evolved from its origins in the nineteenth century to the present day, through the Turing test, the introduction of neural networks and deep learning algorithms in the twentieth century. Recent generative models have demonstrated astonishing capabilities in content creation, also raising concerns about existential risks. Public perception, societal expectations and acceptance of AI play a crucial role in the direction this field takes.

This study contributes to the theory of the Pygmalion effect in the context of AI and expands the understanding of how social and cultural expectations—alongside economic, geopolitical, and technological factors—influence technological development. By exploring the interplay between scientific research, cultural representations and regulatory policies, this study demonstrates how cultural narratives—among other structural forces—can act as catalysts or constraints on the evolution of AI. Furthermore, the identification of a potential Golem effect in the political context underlines the importance of regulatory policies in mitigating the risks associated with AI. This interdisciplinary approach not only broadens our understanding of the factors influencing the trajectory of AI but also provides a theoretical foundation for future research on the relationship between culture, science, and politics in technological development.

The linear regression analysis performed between the number of films produced and the amount of AI research ($R^2 = 0.843$ and p-value $\ll 0.05$) suggests that there is a significant functional relationship between these two variables. This finding can be interpreted through the Pygmalion effect, where positive societal expectations, such as those depicted in films, drive increased investment and attention in AI research. Films idealize the potential of AI, creating a cultural environment that encourages exploration and development in this field.

Welch's analysis found no significant differences between countries contributing to AI-related research and cinema (t-value = 0.061 and p-value = 0.952). This suggests that regions that are more active in AI research also tend to produce more films related to the topic, and vice versa. The lack of substantial differences can be understood through the cultural narratives that influence both domains, highlighting how global expectations about AI transcend national borders.

The keyword analysis revealed a significant thematic alignment between the representation of AI in films and its study in academic research. Shared terms such as 'artificial intelligence', 'human' and 'computer' reflect a common conceptual framework influenced by social and technological milestones. The significant trend ($R^2 = 0.607$, p-value $\ll 0.05$)

between the temporal frequencies of 'artificial intelligence' in research and film underlines this thematic alignment.

The survey conducted among the Spanish population showed broad support for AI regulation in Europe, with 75.36% of respondents considering the law necessary to ensure the ethical and safe use of AI. This finding reflects positive cultural expectations about AI, where the potential benefits of the technology are recognized but ethical concerns guide public support for regulatory measures. At the same time, 14.51% of respondents advocated flexibility to foster technological progress, suggesting the need to balance regulation with innovation.

The Granger causality test demonstrated that manuscripts have a delayed predictive impact on both films and laws, while films show a more immediate and persistent predictive effect on laws. These results underscore the importance of cultural representations in shaping regulatory policies and public perception of AI. The influence of scientific research is not only significant, but also temporally structured, with research driving trends in films and both categories collectively shaping legislative actions.

Taken together, the results of this study suggest that AI is experiencing a Pygmalion effect, where cultural representations in film appear to have an increasing impact—though likely in interaction with other drivers such as market incentives and policy agendas. This phenomenon highlights how societal expectations and perceptions can act as catalysts for technological development. At the same time, a possible Golem effect is observed in the political context, where recent regulation is gaining importance. This suggests that increased government legislation could limit the dangerous development of AI and redress its societal impact. These findings, grounded in statistical evidence and narrative analysis, underscore the need for governance frameworks that are responsive not only to technical risks but also to evolving public imaginaries. Policymakers should consider how cultural narratives shape public opinion and regulatory momentum, and design communication strategies and regulatory instruments that anticipate and address these dynamics. While the Pygmalion and Golem effects offer a valuable interpretive lens, they inevitably simplify the complex interplay of social, political, and economic forces that shape AI development. Moreover, although this study adopts an interdisciplinary approach, it is limited by its reliance on correlational methods and cultural proxies, which may not fully capture the causal depth or institutional dynamics involved. Future research should build on these insights with more granular, comparative, and ethnographic approaches to better understand the structural dimensions of AI governance. This interdisciplinary approach provides a theoretical foundation and practical insight for future research and policy design at the intersection of culture, science, and AI governance. Additionally, future research should consider cross-cultural validation of the Pygmalion and Golem effects in AI. Since cultural narratives and regulatory responses may vary significantly across sociopolitical contexts, comparative studies could help assess the generalizability of the observed patterns and refine the theoretical framework proposed here.

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Declarations

Competing interests The authors declare no competing interests.

Ethical approval The author declares that he meets the ethical standards.

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