ŚWIAT I SŁOWO WORLD AND WORD
36|1|2021 ISSN 1731-3317
DOI: 10.5604/01.3001.0014.7964

Alicja Piotrowska

University of Warsaw
am.piotrowsk17@student.uw.edu.pl
ORCID: 0000-0003-3369-7580

Between Science and Pop Culture: The Role of Mathematics in Films

The general perception of scientific concepts in popular culture is gradually broadening without implying that one also needs to understand the related data. The humanities and social sciences have greater merits in this matter since it is easier to present cultural or social concepts to the general public in an accessible, and hence, simplistic way. Naturally, it does not mean that linguistics, sociology, or history have not developed their own hermetic scientific mechanisms or a scientific jargon, which the average recipient is not able to comprehend fully. However, the language of the exact sciences—numbers and related methodology—seems to be more difficult to portray in the form of a film than that related to the concepts derived from, e.g., historical or social sciences.

The assimilation of knowledge is closely associated with the difficulty of its presentation. It is much easier to use modern media to popularise knowledge concerning culture than the nature of the greatest mathematical discoveries. This claim does not imply, of course, that there have been no such attempts; nevertheless, they seem to have been insufficient. An example illustrating this thought may perhaps be the most famous physical formula, $E=mc^2$, which now has a symbolic dimension. This equation is widely used in the public sphere and in various marketing activities—on

posters or T-shirts.[1] However, such popularisation of the formula does not entail dissemination of the knowledge as to its very meaning. Neither does it provide an explanation why this discovery is considered a scientific breakthrough.

Striving to convey scientific truths to the widest possible audience is one element of presenting mathematical formulas in films, and using scientific facts as tools to indicate what the sender wants to communicate is another. As Arnold Reinhold demonstrates in his article, the educational value of mathematical problems presented in various films is undoubtedly substantial[2]; however, focusing only on the frequency and accuracy of the presentation of given formulas makes the recipient lose one of the basic elements for which popular culture uses scientific patterns—that it is transferring meaning. This is particularly evident in the use of mathematics in films. An average viewer cannot understand all the symbols appearing on screen, which is by no means the intention of the filmmakers, who often want to focus the viewer's attention on the general characteristics of the protagonist and not on the scientific problems studied by him. Mathematical formulas, equations and calculations belong to the diegetic world, so they affect primarily the characters, emphasise the nature of their work, and symbolise character development. The way in which mathematical concepts are presented helps the viewers to interpret the behaviour of characters associated with mathematics. In the present article, these issues are analysed on the basis of three films: *A Beautiful Mind, Good Will Hunting*—which use scientific formulas only as the basis for showing the stories of their protagonists—and *Pi*—which, despite its author's aspiration to show his philosophical perspective on mathematics in cinematography, also turns out to be a case of popcultural use of science. The choice of mathematics English-language films as *tertium comparationis* is a result of their considerable international recognition. Nevertheless, this selection is not intended to marginalise other film productions, but rather, due to the potential impact of American cinematography, contribute to the similar analyses of films made in other countries.

A Beautiful Mind is a film based on the story of John Nash, an American mathematician who received the Nobel Prize in economics for developing

[1] For example: "$E=mc^2$ T-shirt," *Amazon*, September 23, 2020, https://www.amazon.com/Science-Equation-E-MC2-T-shirt/dp/B07PGHQJMD.

[2] Arnold G. Reinhold, "Math in the Movies," *Math Horizons*, Vol. 4, No. 4 (1997), pp. 9–12.

the game theory concerning different strategies in a conflict situation in order to achieve the best result. The film presents this character from the point of his admission to Princeton University until the moment of receiving the award from the hands of the Swedish Academy. It portrays Nash as an outstanding scientist struggling with paranoid schizophrenia, which at some point prevents the hero from functioning in his scientific and family environment. Despite his illness, Nash continues to work as a mathematician, which ultimately leads him to the difficulty with differentiating between reality and fiction.[3]

John Nash in the film is portrayed as a figure that desires to achieve scientific success. This type of narrative based on goal achivement is considered to be one of the basic principles of storytelling in films.[4] For the protagonist, mathematical operations are the basis of life, and the idea of creating his own theory becomes an obsession that motivates the man to act and makes him see mathematical dependencies virtually everywhere. This is well presented in the scene in which Nash observes the movement of the flock of pigeons and, basing on those observations, tries to create an appropriate algorithm for their behaviour. The scientific failures of the character directly affect his behaviour which reflects the state of his mental health. The protagonist begins to suffer from paranoid schizophrenia, which manifests itself in talking to non-existent characters, feeling unjustified threats or even escaping from Harvard University during his own guest lecture, which could imply that scientific development cannot be reconciled with maintaining proper health. Nevertheless, the end of the film is a symbolic culmination of Nash's career, i.e. receiving the Nobel Prize, which also indicates the fundamental role of mathematics, or science in general, in the film.

Nash's mental illness should not be described as a simple delusional disorder. It is also, and perhaps above all, the problem of his interpenetration of the real and imaginary world, which often look identical to the protagonist. Initially, mathematics can be perceived by the viewer as a frame that allows the hero to capture what is certain and logical. It is not used to propose solutions of equations or graphs, it is rather a template used to stabilise elements of the presented world, and thus, to characterise the protagonist.

[3] Ron Howard, dir., *A Beautiful Mind* (DreamWorks Pictures, 2001).

[4] David Bordwell, Kristin Thompson, *Minding Movies: Observations on the Art, Craft, and Business of Filmmaking* (Chicago: University of Chicago Press, 2011), p. 114.

The scene of writing equations on window panes or the scene of a Go game are good examples of this idea—the character's attitude is more important than the precise presentation of scientific issues. Nevertheless, this view of mathematics soon changes as it becomes the basic tool of Nash's work for the secret service, which, as it turns out over time, is only a deceptive hallucination of the mathematician. His love of science makes him become gradually sicker and sicker, which he does not realise. Mathematics as an exact and certain field of study becomes a trap that pulls the man into the abyss of madness; work for the benefit of science and, for the security of the country, transforms into a destructive, completely unnecessary, and worthless task.

This duality of mathematics, as both developmental and destructive force which characterises that field of study as a prism through which we see the main character, emphasises the significant role of science in the film. The director of *A Beautiful Mind*, Ron Howard, also highlights the essence of mathematics in a different way. One of the more significant moments in the film is the Pentagon scene in which Nash is asked to break a potential Soviet code. By using the zoom-in and zoom-out techniques, and by showing a group of consecutively highlighted and darkened digits, the creators try to convey the way in which the protagonist analyses the complexity of the numerical sequences in his mind. The 360 dolly shot used in this scene adds tension, or even pathos, emphasising the importance of the moment for the character who is able to show his abilities to others.

The idea of writing mathematical equations on window panes in a room or a library is also worth mentioning. This way of presenting mathematics expresses not only the importance of this field of study in the eyes of the character, but it also influences the viewer. He or she does not have to decipher these records, but rather through them (literally and figuratively) might see Nash as the protagonist. The aforementioned Go game scene illustrates this clearly—the camera shows the course of the game only when it is necessary for the plot. Most of the scene is devoted to a dialogue between the players, therefore emphasis is put on accompanying emotions. The game is only a pretext to portray the personality of Nash and his relations with other students.

In the book *Math Goes to the Movies*, the authors present the commentary of David Bayer, a professor at Columbia University in New York and

a mathematics consultant in *A Beautiful Mind*, who discusses the types of mathematical problems used in the film and offers their solutions. Presented answers are undoubtedly significant; however, the full understanding of their meaning is optional from the perspective of the film interpretation. The reader can freely skip these examples which may seem too difficult, since they are not crucial to the perception of the whole film, in which the presentation of mathematics is based mainly on symbols and allegories.[5]

In addition to the symbolic approach to mathematics, *A Beautiful Mind* contains at least one scene that allows the viewer, if not to understand completely, then at least partially assimilate the technical information about the issue later called "the Nash equilibrium," which is an element of the mentioned game theory. The scene in the bar in which young Nash explains to his friends an outline of his new theory using parallels to the male-female relationships is entirely focused on the presentation of the mechanism that the protagonist wants to prove scientifically.[6] Due to suggestive visualisation and simple language, the viewer may quickly discover what the mechanism behind the theory of equilibrium is. In this case, mathematics ceases to be exclusively a way of characterising the protagonist and goes beyond the diegetic world, expressively presenting specific scientific content.

Mathematics plays a similar role in the film *Good Will Hunting*. Although there is no strictly educational scene in it, mathematics is a factor determining the character's behaviour. It is mathematics that allows the protagonist, Will Hunting, to begin a series of gradual life changes. *Good Will Hunting* is the story of a twenty-year-old resident of Boston who is highly intelligent, but, due to his difficult childhood, cannot use his intelligence to his benefit. Working as a janitor at MIT, he solves a task that no other student could solve. Moreover, he participates in a street fight, and his only chance to avoid expulsion is to study mathematics under the supervision of one of the professors and participate in therapeutic sessions.[7]

It is easy to notice that, due to his mathematical abilities, Will is able to start a slow process of changing his life. Mathematics is shown in this case as a driving force—which *per se* is not the most crucial, because its main role

[5] Burkard Polster, Marty Ross, *Math Goes to the Movies* (Baltimore: Johns Hopkins University Press, 2012), p. 21–39.

[6] Howard, dir., *A Beautiful Mind.*

[7] Gus Van Sant, dir., *Good Will Hunting* (Miramax Films, 1997).

in the film is to stimulate further action—ultimately going beyond the field of science. Will's undertaking the solution of the task can be interpreted as tantamount to his work on himself and further development.[8]

Mathematics can also be seen as a form of escape from reality. Undoubtedly, for the protagonist, the opportunity to study with a professor at MIT is a chance for a better life and the beginning of a change. Nevertheless, *Good Will Hunting* is predominantly a film about overcoming weaknesses and the courage of confronting the truth in the face of one's past and present. Science and mathematics are presented in a realistic and meticulous manner in the film but, ultimately, they are only tools enabling the transformation of the main character. Mathematics is not a life goal in this case, as in the case of *A Beautiful Mind*, but rather a temporary way of life. Will does not consider his study seriously, for him, this is only one of the activities of the day.

In *Math Goes to the Movies*, the authors present *Good Will Hunting* as "not really a movie about mathematics or mathematicians,"[9] which signals the problem that I try to highlight in my text. Mathematics in popular films is not a university discipline in the strict sense, but rather an element of reality that facilitates the viewer's understanding of the behaviour of characters. As in the film depicting the life of John Nash, the authors of *Good Will Hunting* try to present the symbolic meaning of mathematics, while emphasising its importance in the further course of action. This symbolism is visible, among others, in the class scene with professor Lambeau, in which all four blackboards are covered with mathematical equations, but the camera does not even show them to the viewer clearly. Symbolic meaning is mixed with elements of realism as Will solves the professor's puzzle in the university corridor. Viewers do not notice the content of the instruction, but they are able to see the graphic solution of the task.

Another film on which I would like to elaborate is *Pi*. It allows the viewer to look at the way mathematics is depicted in cinematography from a philosophical perspective. Contrary to Ron Howard's work—in which science is presented as a tool showing internal problems of the protagonist—and Gus van Sant's film—in which the hero struggles with himself and the outside world and uses mathematics as a tool—*Pi* presents

[8] Ibid.

[9] Ross, Polster, *Math Goes to the Movies*, p. 3.

mathematics as a bridge between reality and transcendence. That change of perspective does not mean that the film omits the issues such as mental instability or social anxiety disorders. However, the dominant motive in it concerns not only the behaviour of the main character, but also universal questions about the structure of the world and the limits of knowledge. The eponymous pi is a symbol which requires the recipient's interpretation. The viewer is introduced to the circle of numbers and calculations not so much to analyse them technically, but rather to understand better the main problem bothering the protagonist—is it really possible to understand nature through numbers or is it just a utopian aspiration which may result only in cluster headaches or even madness.

Max Cohen, the protagonist of the film, combines and extends the characteristic traits of John Nash and Will Hunting. Cohen tries to overcome his own limitations to understand fully the idea behind the 216-digit number which he sees on a computer screen, believing it would help him in understanding the surrounding. Mathematics is not only a scientific tool, but mainly a complex system which may allow him to discover some divine power. Nevertheless, science is here only a pretext for asking about the boundaries of human cognition, which, eventually, turns out to be as limited as other fields of study. The imperfection of mathematics can be seen through the prism of the protagonist's imperfection, and also interpreted in the context of the black and white colour tone of the film, which may symbolise our inability to look at the world from a wider, non-scientific perspective.

A Beautiful Mind, *Good Will Hunting* and *Pi* are merely three cinematic examples which relate to mathematical problems. The mathematical experts asked to cooperate with the directors of these films took care of the accuracy and probability of the solutions proposed. Their work undoubtedly deserves attention, but it is not the basic feature of any of these films. Mathematics in pop culture is only a means, a tool to show certain attitudes, and a simple element of stylisation designed to bring about specific effects on the recipient, e.g., a large number of equations should intensify the feeling of strangeness and create the impression of intelligence and often alienation as the domain of the main characters.[10] However, films concerning mathematical themes

[10] Heather Mendick, "A Mathematician Goes to the Movies," *Proceedings of the British Society for Research into Learning Mathematics,* Vol. 24, No. 1 (2004), p. 47.

have gained recognition in the world of cinematography, possibly because, as part of popular culture, they effectively capture our emotions or desires coded in the language of the exact sciences.[11] What is more, popular culture undoubtedly simplifies mathematical achievements. But, in that, it gives those achievements new meanings and analyses them in the context of the contemporary humanities, which extends its reach and opens up a new spectrum of perception of mathematics.

Alicja Piotrowska

Between Science and Pop Culture: A Role of Mathematics in Films

The present analysis is focused on the issue of interactions of individuals with mathematics in films and strives to show why the question of the accuracy of mathematical formulas is not crucial to films and, therefore, what their main functions in the creation of the diegetic and the outer world are. In order to achieve the set aim, I ground my reflection in the idea suggested in *Math Goes to the Movies*, i.e. that mathematics is not presented in films only as an abstract theory, but it also carries a creative potential. *Good Will Hunting* (1997), *A Beautiful Mind* (2001) and *Pi* (1998) are the films in which mathematics is a substantial driving force, influencing both the gradual development and consolidation of characters. In this work, the films serve as the research material.

Keywords: mathematics, films, scientific formula, *A Beautiful Mind*, *Good Will Hunting, Pi*
Słowa klucze: matematyka, filmy, formuła naukowa, *Piękny umysł*, *Buntownik z wyboru*, *Pi*

[11] Imre Szeman, Susie O'Brien, *Popular Culture: A User's Guide* (Hoboken, NJ: Wiley-Blackwell, 2017), p. 101.