

A Beautiful Mind

Reviewed by Lynne M. Butler

A Beautiful Mind

Movie directed by Ron Howard

John Nash's Life

West Virginian John Nash earned a Ph.D. in mathematics from Princeton for foundational work on the theory of noncooperative games, published in 1950. He accepted a position at MIT, where he met Alicia Larde, a student to whom he taught multi-variable calculus. They married and conceived a son before Nash was involuntarily committed to a psychiatric hospital. In the next few decades, Nash experienced both remission and relapse of his paranoid schizophrenia. Cared for by Alicia at their home near Princeton, he gradually rejoined the academic community and learned to reject paranoid thoughts. His genius is diminished, but he is valued by his family and honored by his colleagues. He was awarded the 1994 Nobel Prize in Economics for his early work in game theory.

The movie *A Beautiful Mind* incorporates these biographical details, but omits others to tell its story using invented characters and plot. In 1951 John Nash was hired at MIT as a Moore Instructor. In 1953 he was promoted to assistant professor for his work on the embedding problem

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for Riemannian manifolds. The mathematics faculty voted to grant him tenure just before his fifty-day hospitalization at McLean in 1959. In the next thirty-five years, he was involuntarily hospitalized three more times. In 1961 at Trenton State he was aggressively treated to achieve a remission, but he later relapsed and Alicia sued for divorce. In 1963 at the Carrier Clinic he responded quickly to Thorazine but was not released until well after his divorce was finalized. Although Alicia and John did not remarry until 2001, he has lived at her house near Princeton since 1970. Their son also suffers from schizophrenia.

John Nash was awarded the 1978 von Neumann Theory Prize for his foundational work on noncooperative games and a 1999 Steele Prize in recognition of his embedding theorem for Riemannian manifolds. See [1] for a discussion of his mathematical work.

Ron Howard's Movie

A Beautiful Mind is at heart a love story between John, played by Russell Crowe, and Alicia, played by Jennifer Connelly. Nash is reported in Sylvia Nasar's biography [2] as an arrogant and egotistical anomaly, admired for his brilliance and pitied for his illness. Crowe's character John is not anomaly but outsider. As we come to understand him, we see not arrogance but confidence, not egotism but self-awareness. Alicia hears not rudeness but honesty in his suggestion that they bypass platonic activities on the way to lovemaking, and she recognizes sincerity in his proposal to marry her if she can provide proof that their love will last.

The Noncooperative Game in *A Beautiful Mind*

The movie suggests that a motivating example for the discovery of Nash equilibria might have been the strategies of five suitors most attracted to the same woman in a group of five. As suggested by the movie's visuals, positive outcomes occur only when each woman is approached by one suitor. In the two-person version of this game, each of two suitors, say John and Martin, decides with what probability, say x and y respectively, he will approach the more attractive of two women. The expected payoff to John is $xa(1-y) + (1-x)by$, where $a > b > 0$ since John prefers the more attractive woman. Likewise the expected payoff to Martin is $(1-x)cy + xd(1-y)$, where $c > d > 0$. Two Nash equilibria for this game, as suggested in the movie, occur when $x = 1$ and $y = 0$ (with payoffs a and d) and when $x = 0$ and $y = 1$ (with payoffs b and c). The only other Nash equilibrium is when $x = c/(c+d)$ and $y = a/(a+b)$ (with payoffs $ba/(a+b) < b$ and $dc/(c+d) < d$). At a Nash equilibrium, neither player can improve his expected payoff by unilaterally changing his strategy. Visit <http://www.haverford.edu/math/1butler/maths-illustrated.html> for a complete explanation of a similar example and of the wit in John's courtship line "I believe in assigning value to things."

Alongside Alicia, we love him for his desire to make a valued contribution and sympathize with him as we realize how his mind betrays him and us. The love story connects John's two stories of personal accomplishment: Thought is fueled by emotion in the first; emotion is directed by thought in the second. To succeed in graduate school—to be recognized for one original idea—required a brilliant mind fueled for years by personal ambition; to survive schizophrenia—to work again in his "art form", to help care for his son, and to share intimacy with his wife—required a loving heart directed for decades by honest self-assessment.

This review looks beyond what some view as flaws in Akiva Goldsman's screenplay to gain an intelligent appreciation of a movie that transcends stereotypes of mathematical genius and mental illness. Those who have read Nasar's biography of Nash might fault the movie for inaccurately portraying his life: He did not participate in Cold War codebreaking efforts. Those who have studied a reference book like [3] will find the symptoms suffered by the movie's protagonist fantastic: Auditory, not visual, hallucinations are characteristic of this brain disease. Finally, those who have seen David Auburn's play *Proof* [4] know a story inspired by Nash's life that is suspenseful without a car chase or a homicide. However, to dismiss *A Beautiful Mind* based on any of these well-informed observations is to fail to appreciate the creative choices that enable this movie to tell the most compelling, truthful, and important story about mental illness staged or screened since President Kennedy championed deinstitutionalization in the 1960s.

A story is compelling if those told it feel they have shared the experience of its characters. Nash,

his colleagues, and his wife did not know he was going mad. They tried to understand his unusual perspective and strange behavior in light of his unique mathematical mind. It was thrilling, then agonizing, to recognize first his genius, then his madness. Is it thrilling to believe in a paranoid or grandiose delusion? Is it agonizing to realize that experiences are not real but delusional? Audiences of Howard's *A Beautiful Mind* feel the thrill of that belief and the agony of that realization because Goldsman invented delusions for John that the audience experiences as credible (though far-fetched) and exciting (though formulaic). The audience and Alicia share John's desperation to understand what is happening to him. We sympathize with his self-mutilation in the hospital, submit to the doctor who orders insulin coma therapy, laugh at the light-hearted joke he plays on an old friend who visits him at home, feel Alicia's loss of companionship and anxiety for her child, suffer with John when he chooses far-fetched and formulaic delusions over reality where he feels worthless, appreciate his reawakening as a personal accomplishment made possible by Alicia's understanding care, and are grateful for the appreciation offered him by mathematics students and colleagues at Princeton.

A story is truthful if it is based on understanding. *A Beautiful Mind* tells a truthful story about an academic subculture that values genius. In that subculture, creativity is used to solve hard problems, and competition is a way to negotiate friendships. At Princeton, John's refusal to attend classes frees him to search for a truly original idea, and his decision not to romance women saves him from those who can see only his physical appeal. His talent and true appeal lie in his ability to see mathematical beauty everywhere. He seeks the mathematical principles that govern everything from the movement of pigeons in a grounded flock to the selection of strategies in noncooperative games. His Ph.D. thesis on game theory wins him the instant celebrity he craves and the placement he wants most. At MIT, John notices a beautiful woman in his advanced calculus class, who boldly challenges the self-absorption of her handsome and celebrated professor. Their love grows from a shared appreciation of the beauty to be found in pattern and color. Together they appreciate the patterns high above made by the stars at night and the colors deep inside a glass prism that refracts light. Alicia's efforts to understand John's genius transform her admiration to love, and her efforts to understand his madness transform her fear and pity to sympathy. Their meeting of minds enables them together to solve the problem of surviving John's schizophrenia. The mathematics community is the extended family to which they turn for support.

A story is important if it sheds light on some aspect of human experience. The reality of

deinstitutionalization of the mentally ill in the United States is darkly oppressive; as explained in [3], it will lighten only when the experience of schizophrenics is understood by families, employers, and neighbors. *A Beautiful Mind* treats seriously and sensitively the issues they face, in sharp contrast to movies such as *Birdy* (1984) and *Benny and Joon* (1993). Unlike *Shine* (1996) and *Pi* (1998), this movie does not assume a questionable relationship between schizophrenia and either abuse in childhood or genius in adulthood. *A Beautiful Mind* shows us the reality of this brain disease: Its onset is not necessarily rapid or apparent and its causes are unknown, effective treatments can be torturous, side effects of antipsychotics include sexual dysfunction and tardive dyskinesia, delusional thinking can result in refusal of needed hospitalization or medication, and the stigma of the disease exacerbates suffering. Many schizophrenics are periodically imprisoned or homeless, and some resort to self-mutilation or suicide. The emotional impact of *A Beautiful Mind* breaks down the barrier of intimidation that blocks understanding of individuals endowed with genius or afflicted with schizophrenia. True appreciation and sympathy are impossible without understanding. This movie offers unobscured understanding to an audience much wider than that reached by Nasar's biography or Auburn's play.

Mathematicians and Moviemakers

The movie *A Beautiful Mind* is as concise and unexpected as an elegant proof. Its logic is tight and its acting is precise. Facial expressions and subtle movements reveal John's thoughts: Standing behind Alicia, he smiles to himself as she studies a painting; seated at his desk, he reaches for her but she has turned away to go alone to bed. I wonder at Crowe's visually informed intelligence. What inspired him in the fall of 2000 as he watched a Rademacher lecture at Penn alone at the back of the hall or as he studied photographs of the young John Nash supplied by Princeton consultant Harold Kuhn? Is asking how Crowe created his character like questioning what led Nash to the concept of equilibrium in noncooperative games? *A Beautiful Mind's* answer to the latter question is elaborated in the shaded box.

Moviemakers found Nash an incomprehensible expositor of his work. Howard's interview at <http://www.countingdown.com/beautifulmind/ronhoward.html> reads, "I tried to get Nash to lecture us and explain some of his important breakthroughs...it was pretty hopeless. But...we copied some of what he wrote on the board." So they hired a mathematics consultant more attuned to their needs, Dave Bayer of Barnard College. During filming Goldsman described him as "an academic who is also movie savvy" whom "we were and continue



First week of filming at Princeton: Nash (left) with Crowe (center) and Howard.

to be lucky to have around." In addition to designing visuals for the movie, like the blackboards on the Riemann hypothesis and de Rham cohomology, Bayer served as Crowe's hand double.

Nash watched from a distance while Bayer placed stones on a go board before each take, but his visits to the set did not go unnoticed. The red knit cap worn by Crowe late in the movie is like the one Nash wore to the set the first week of filming. The last week of March 2001 was still cold, so Crowe offered him a hot cup of tea. Nash responded with detailed mutterings about his palate subsequently used in the movie. The last week of June was uncomfortably hot, so my brother offered Crowe a cold bottle of beer after the rooftop scene shot on the last day of filming in Princeton. (For details, visit <http://www.murphsplace.com/crowe/mind/fanlast.html>.) Crowe responded with genuine friendliness rarely shown to strangers who appear mentally ill. My brother, who suffers the stigma of schizophrenia, told me he would remember the encounter for a long time.

References

- [1] *The Essential John Nash*, edited by Harold W. Kuhn and Sylvia Nasar, Princeton University Press, 2001.
- [2] *A Beautiful Mind: A Biography of John Forbes Nash Jr., Winner of the Nobel Prize in Economics 1994*, by Sylvia Nasar, Simon & Schuster, 1998. Reviewed by John Milnor in the *Notices* 45 (1998), pp. 1329–32.
- [3] *Surviving Schizophrenia: A Manual for Families, Consumers, and Providers*, by E. Fuller Torrey, Harper-Collins, 2001.
- [4] Reviews of the play *Proof*, Dave Bayer, *Notices* 47 (2000), pp. 1082–4; Mark Saul, *Notices* 48 (2001), pp. 596–7.