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And the Winner Is: Inviting Hollywood into the Neuroscience Classroom

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Both short excerpts from, and full-length presentation of feature films have been used with success in undergraduate instruction. Studies of such use of films has revealed that incorporation of film viewing within courses can promote both content mastery and the development of critical thinking skills. This article discusses and provides examples of successful use of two methods that may be used to incorporate a variety of full-length feature films into neuroscience instruction. One, the "neuro-cinema" pairs the presentation of a film featuring extensive neuroscience content with primary literature reading assignments, group discussion and writing exercises. The second, a neuroscience film series, features group discussion of movies of perhaps more limited relevance to neuroscience.

An additional goal of this article is provide the reader with initial resources for the selection of potential film titles for use in neuroscience education. Three extensive tables are included to provide a wide range of title suggestions appropriate for use in activities such as the neuro-cinema, the neuroscience film series, or for more limited use as short "clips" in classroom instruction.

Key Words: teaching methods; neuroscience education; Motion Pictures; films; movies.

It is no secret that instructors across disciplines have long made use of feature films and short "clips" from movies in conjunction with classroom instruction. Examples of such use in instruction include the use of film to provide conceptual illustrations (Fleming et al., 1990; Boyatzis 1994; Conner 1996; Kelly, 1998); allow examination of social relationships and interpersonal communication (for example, Paddock et al., 2001); to permit the observation of specific methodological techniques (Toman and Rak, 2000; see also Wedding and Boyd, 1999) and to introduce students to content that may be beyond their personal experience, such as psychological trauma (for example, Alexander and Waxman, 2000). In studies of such course related uses, movies have been shown to augment the understanding of course material (Kinney, 1975; Fleming et al., 1990; Boyatzis 1994; Conner 1996; Paddock et al., 2001), improve critical thinking skills (Fleming et al., 1990; Conner 1996; Paddock et al., 2001), broaden student awareness of important social issues (Hyler, 1996; Alexander and Waxman, 2000; Davis, 2000), and aid in the application of concepts from their coursework to real life situations (Fleming et al., 1990; Hyler and Moore, 1996; Davis, 2000; Toman and Rak, 2000).

The purposes to which movies have been put across disciplines may also be of benefit in the study of neuroscience. While not a substitute for classroom instruction and readings, movies can serve to promote the understanding and retention of specific content areas under discussion within a course. A critical examination of films depicting (for example) neuroscience methodology in use, pharmacological effects on behavior, or the impact of illness or injury on the nervous system can provide students with valuable opportunities for the evaluation of their own educational progress. Further, movies featuring neuroscience content may effectively expose students to unfamiliar, but important subject matter, or provide needed context-- stimulating interest in and enthusiasm not only for specific topics, but for the interdisciplinary field of neuroscience. Indeed, the use of movies in undergraduate neuroscience education may also help students to recognize the many intellectual and vocational possibilities that such study has opened for them (for a discussion of the use of neuroscience-related feature films in middle school/secondary education, see Stewart and Chudler, 2002).

This article discusses some ways in which to incorporate movies into the undergraduate neuroscience curriculum. It provides extensive title suggestions, along with examples of the sorts of assignments and film choices that have been effective in recent years in my own course offerings. The movie titles included here are intended to provide suggestions for use across a wide range of topics, genres and Motion Picture Association of America (MPAA) ratings, from the earliest days of film making to today. It is by no means exhaustive-- or intended to exclude the reader's personal favorites.

ASSIGNMENT/EXERCISE 1: NEURO-CINEMA

This assignment includes the viewing of an entire film by the class as a group, within a single multi-hour laboratory period. The design allows the class to become involved in the story and remain so for an immediate post-viewing discussion. (This sort of exercise is not unique to neuroscience instruction; for example Fleming et al. (1990) describe a somewhat similar exercise used each week in a film-based psychology course.)

Ideally, films chosen by the instructor for use in this exercise should meet two criteria: 1) Feature a neuroscience concept, used as a central plot mechanism; and 2) Employ a neuroscience concept associated with a strong primary literature base. Considering the rate at which feature films are currently produced worldwide, along with the incredible number already in existence, the limited number and type of movies that meet the above criteria for use is surprisingly large.

Table 1 contains a selection of movie titles that meet the criteria suggested above. One week prior to the

Title	Year	Released By	Running Time	Directed By	Featuring	Specific Content	Genre/ Rating
A Beautiful Mind	2001	Universal Studios and Dreamworks LLC	2 hrs., 16 mins.	Ron Howard	Russell Crowe, Ed Harris, Jennifer Connelly	Schizophrenia, attention	Drama PG-13
A.I.: Artificial Intelligence	2001	Dreamworks LLC and Warner Brothers	2 hrs., 25 mins.	Steven Spielberg	Haley Joel Osment, Jude Law	Artificial intelligence, ethics	Drama/ Action PG-13
Afraid of Dark	1991	New Line Productions	1 hr., 31 mins.	Mark Peploe	James Fox	Vision, perception, neurodegenerative disease	Drama/ Thriller R Violence
As Good As It Gets	1997	Tristar Pictures	2 hrs., 19 mins.	James L. Brooks	Jack Nicholson, Helen Hunt, Greg Kinnear, Cuba Gooding, Jr.	Obsessive-Compulsive Disorder, phobias	Drama PG-13
At First Sight	1996	Metro Goldwyn Mayer	2 hrs., 8 mins.	Irwin Winkler	Val Kilmer, Mira Sorvino	Visual perception, surgery, methods	Drama PG-13
Awakenings	1990	Columbia Pictures	2 hrs., 1 min.	Penny Marshall	Robert DeNiro, Robin Williams, Julie Kavner	Encephalitis, Parkinsonism, L-Dopa, dyskinesia, treatment of the mentally ill, ethics	Drama PG-13
Blind Date (AKA Deadly Seduction)	1984	New Line Cinema	1 hr., 35 mins.	Nico Mastorakis	Joseph Bottoms, Kirstie Alley	Vision, nervous system/technology interface	Suspense/ Horror R Violence Gore Sexual Content
Clean Slate	1994	Metro Goldwyn Mayer	1 hr., 47 mins.	Mick Jackson	Dana Carvey, James Earl Jones, Valeria Golino, Vyto Ruginis	Korsakoff's Syndrome, memory, brain injury	Comedy PG-13
Dark Victory	1939	First National Pictures Inc./Warner Brothers	1 hr., 44 mins.	Edmund Goulding	Bette Davis, George Brent, Humphrey Bogart, Ronald Reagan	Brain Tumor, terminal illness, vision	Drama NR
Darkman	1990	Universal Studios	1 hr., 36 mins.	Sam Raimi	Liam Neeson, Frances McDormand	Brain/spinal surgery, pain, methods	Action/ Horror R Violence, Gore, Language
Deep Blue Sea	1999	Warner Brothers	1 hr., 45 mins.	Renny Harlin	Samuel L. Jackson, LL Cool J, Saffrom Burrows, Michael Rapaport	Methods, Alzheimer's Disease, genetic manipulation, neuropharmacology	Suspense/ Thriller R Violence, Gore, Language
Fight Club	1999	Twentieth Century Fox	2 hrs., 19 mins.	David Fincher	Brad Pitt, Edward Norton Meat Loaf	Dissociation, pain, delusional thought	Drama/ Action R Violence, Language, Sexual Content
I Come in Peace	1990	Anchor Bay Entertain-ment	1 hr., 31 mins.	Craig R. Baxley	Dolph Lundgren, Brian Benben	Abuse potential of Endogenous opioids, psychopharmacology	Action/ Thriller R Violence, Gore, Language

Title	Year	Released By	Running Time	Directed By	Featuring	Specific Content	Genre/ Rating
Jacob's Ladder (AKA Dante's Inferno)	1990	Carolco Pictures	1 hr., 55 mins.	Adrian Lyne	Tim Robbins, Danny Aiello, Ving Rhames, Jason Alexander	Death and the nervous system, environment and learning, psychopharmacology	Suspense/ Horror R Violence, Language, Sexual Content
Lorenzo's Oil	1992	Universal Studios	2 hrs., 9 mins.	George Miller	Nick Nolte, Susan Sarandon	Nervous system disease, adrenoleukodystrophy, science and society, ethics	Drama PG-13
Man's Best Friend	1994	New Line Productions	1 hr., 27 mins.	John Lafia	Ally Sheedy	Genetically-enhanced nervous system, neuropharmacology, ethics	Thriller/ Horror R Violence, Gore, Language
The Matrix	1999	Warner Brothers	2 hrs., 16 mins.	Larry and Andy Wachowski	Keanu Reeves, Laurence Fishburne	virtual reality, nervous system/technology interface, sensation and perception	Action/ Thriller R Violence, Language
Metropolis	1926	Universum Film A.G., Paramount Pictures	1 hr., 55 mins. (DVD Release)	Fritz Lang	Brigitte Helm	science and society, artificial intelligence, robotics, cybernetics, memory	Drama SILENT NR
One Flew Over the Cuckoo's Nest	1975	The Saul Zaentz Co.	2 hrs., 14 mins.	Milos Forman	Jack Nicholson	Psychopathology, electroconvulsive treatment of mental illness, ethics	Drama R Violence Sexual Content Language
Quills	2000	Twentieth Century Fox	2 hrs., 4 mins.	Philip Kaufman	Geoffrey Rush, Kate Winslet, Michael Caine, Joaquin Phoenix	Treatment of mental illness-historic (18th century); defining insanity, sadism	Drama R Strong sexual content; violence
Regarding Henry	1991	Paramount Pictures	1 hr., 48 mins.	Mike Nichols	Harrison Ford, Annette Bening	Brain Injury, Recovery of Function	Drama PG-13
The Secret of NIMH	1982	Metro Goldwyn Mayer and United Artists	1 hr., 22 mins.	Don Bluth	Various Voices	Science and society, animal rights, neuroscience methods	Drama ANIMATED G
The Serpent and the Rainbow	1988	Universal Pictures	1 hr., 38 mins.	Wes Craven	Bill Pullman, Paul Winfield	neuropharmacology, cultural beliefs, learning	Horror R Sexual Content
Star Trek VII: Generations	1994	Paramount Pictures	1 hr., 58 mins.	David Carson	William Shatner, Patrick Stewart	Artificial Intelligence, Emotion	Drama/ Action PG
The Terminal Man	1974	Warner Brothers	1 hr., 47 mins.	Mike Hodges	George Segal	Brain surgery, implantation, neural stimulation, seizures	Drama/ Thriller PG
The Wild Child (L'Enfant Sauvage)	1969	Les Films du Carrosse and United Artists	1 hr., 26 mins.	François Truffaut	François Truffaut, Jean-Pierre Cargol	Nature versus nurture debate, language, learning, concept of self/soul	Drama French; dubbed english (DVD) G

Table 1. Selected titles, including year of release, cast and production information, for feature films that meet the criteria for use in the neuro-cinema exercise. Also included are brief descriptions of the content relevant to neuroscience instruction (Specific Content), story genre and MPAA rating (Genre/Rating). These films are also suitable for use in a neuroscience film series, and contain material appropriate for use as short “clips” within classroom sessions.

laboratory session in which the film will be shown, two to three readings related to the film chosen are assigned to the students. Typically, the readings chosen are a combination of one or more empirical research papers and a single review article. Students are assigned to prepare a one- to two-page summary for each of the readings, which are collected prior to the film presentation. The film presentation is followed by a group discussion of the movie in relationship to the assigned readings and relevant course content; a one- to two-page "reaction" paper is due at a subsequent next class meeting.

Example 1. Lorenzo's Oil (1992)

Consider the dramatic motion picture that is marketed as a serious treatment of neuroscience subject matter. Depending on the particular course and area of neuroscience, a number of possibilities might exist and coordinate well with the instructor's interests (see Table 1). One such choice that this author has used with success is the 1992 movie, Lorenzo's Oil (Miller and Mitchell, 1992). Lorenzo's Oil provides a wealth of material that illustrates the roles of science and medicine in society. Further, Lorenzo's Oil demonstrates the value of a liberal arts education; showing how an understanding of the nervous system, in combination with other well-developed academic skills and life experiences, may collectively enable the motivated individual to pursue even those goals that to others around them seem unattainable.

The reader may recall that Lorenzo's Oil is ostensibly the story of how two parents, Augusto and Michaela Odone, worked to provide a therapeutic intervention for their son Lorenzo, stricken with the rare disease adrenoleukodystrophy (ALD). Indeed, the efforts of the Odones and the foundation they established, the Myelin Project, have stimulated substantial research activity on ALD and related disease processes where there once was very little (the instructor considering the use of the film Lorenzo's Oil in a course may be interested in visiting the foundations' promotional/informational website; it can be found at http://www.myelin.org). A literature search using the film title as the key word reveals a substantial collection of empirical reports, clinical case studies, journal editorials and research reviews, many suitable for use as reading assignments focusing on various aspects of the film's content and ALD (for example, see Rizzo, 1993; Aubourg et al., 1993; Hudson, 2000).

Completion of the reading assignment and viewing of the film reveals a complex story. To frame the post-viewing discussion, I ask the class to consider a number of issues, such as:

1. This film begins with a plea from the film's stars, Nick Nolte and Susan Sarandon, to support the Odones' work and the Myelin Project. What was your reaction to this segment, experienced by the student, both in the moment and after the film's completion?

2. Several scenes in the movie are devoted to instruction (of characters depicted in the film) on the topic of long-chain fatty acids. To what extent did you find this content of educational value? Did you view this portion of the film as potentially educational?

3. The movie end credits feature testimonials from seeming dozens of boys positively affected by the Odones' work. Having read the literature, what is your reaction to these testimonials?

4. Consider the depictions of clinical researchers and basic scientists in the film, and their interactions with the Odones (as well as the other parents, patients, and Lorenzo). Are these two groups treated similarly in the film?

Example 2. Clean Slate (1994)

Films have also employed neuroscience content as central plot mechanisms for comedic, rather than dramatic effect (See Table 1). One example of the appropriation of such content to amuse is the use of Korsakoff's Disease in the movie Clean Slate (Zanuck et. al., 1994). Korsakoff's Syndrome is a familiar topic in both neuroscience and neuropsychology textbooks used in undergraduate neuroscience instruction, and the available literature from which readings may be selected is robust. As in the previous example, summary papers for each of the readings are collected from each student prior to the film presentation. The film presentation is followed by group discussion, with a one- to two-page reaction paper due at the next class meeting.

Clean Slate is the story of Pogue, a private detective who, in the midst of a "case" receives a brain injury. As a result, he is unable to form new long-term memories, and amnesic for the events in the years just prior to the accident-- a constellation of effects the movie identifies as Korsakoff's Syndrome. As luck would have it, the plot requires that Pogue continue his investigation, allowing each scene to mine the comedic potential of memory loss. An additional comedic "element" relevant to neuroscience can be found in Pogue's dog, which is blind in one eye and perceptually challenged at every turn.

As in the previous example, following the conclusion of the film, several issues are raised in the form of questions, both to stimulate and frame discussion. Potential questions here might include:

1. How does this movie's depiction of memory loss compare to known forms of memory impairment?

2. How does the depiction of Korsakoff's Syndrome compare to what you know? Describe your expectations for a movie scene dealing with Korsakoff's Syndrome.

3. Is the use of Korsakoff's syndrome justifiable as a plot mechanism? What are examples of justifiable use? What effects might this use have on the viewing public? On science?

4. Given your knowledge of the disease, how enjoyable was the film?

5. Would your emotional response be different if the film made dramatic, rather than comedic use of Korsakoff's syndrome?

6. What effect did the depiction of Pogue's dog have?

The neuro-cinema exercise can be a dynamic part of a neuroscience class, but requires significant allotments of

time; not only in viewing the movie, but for students in completing the preparatory readings and the two writing assignments; and for the instructor in preparation of readings and discussion questions. However, while the persistent and intrepid instructor may develop reading assignments to accompany many more movies beyond those featured in Table 1, not all movies that contain desirable neuroscience plot elements focus on well-defined topics that allow the instructor to easily assign readings drawn from a single primary literature. Moreover, at some institutions laboratory periods may not be of sufficient duration to allow for completion of the film presentation and group discussion. Indeed, while the restrictions for film suitability and requirements placed on students and instructor promote the educational value of the neuro-cinema, in many courses time constraints and competing educational goals may limit an extensive use of laboratory sessions for such experiences. One alternative to the neuro-cinema exercise is a less restrictive neuroscience film "festival" or series, conducted outside regular class or laboratory hours, for which participation may be limited to those enrolled in a specific course or opened to a larger student audience.

ASSIGNMENT/EXERCISE 2: A NEUROSCIENCE FILM SERIES

An evening or weekend film series can also augment content and provide important context for the study of neuroscience, without the use of laboratory periods or class time. However, mounting a film series to accompany a course does require real effort on the part of the sponsoring faculty, not only to select appropriate titles and participate in the viewing and post-presentation discussion, but also to stimulate and maintain student interest in the events. One potential approach to stimulate student involvement is to reduce the obstacles to participation in the film presentation and post-viewing discussion by the elimination of the students' preparatory readings and initial writing assignment employed in the neuro-cinema exercise. Here, instead of readings, a few minutes of introductory remarks by the instructor prior to the movie presentation set the stage for the presentation and foreshadow the post-viewing discussion. In my use of the film series exercise, I do require that students complete a short reaction paper reflecting on the film and group discussion, to be handed in at a subsequent class meeting. While an individual instructor may or may not choose to include a written assignment component, a film series otherwise structured in this way allows a greater range of films to be suitable for such use, in comparison to the neuro-cinema exercise.

Table 2 includes feature films that make use of neuroscience content, without the explicit satisfaction of the criteria described above for the neuro-cinema exercise. Films in this category can provide valuable lessons in neuroscience, but may not derive their central themes from such content, or focus on a single subject matter. Given the emphasis of the neuroscience film series exercise on the post-presentation discussion, some of the best films for use in this assignment may well be those that provide neuroscience content of a more implicit than explicit nature. Indeed, some instructors are even able to effectively employ the discussion of films of irrelevant content by "forcing" the generation of analogies to the course content (see Dengler, 1974 for a discussion of this possibility). Examining films with less explicit neuroscience content may promote a more critical analysis from discussion participants. Further, such films provide the instructor with additional opportunities for teaching moments within the post-presentation discussion, helping students to grasp important concepts of neuroscience; develop an appreciation for the connections between the various sub-areas of neuroscience; and to link principles to application. In choosing from feature film titles that satisfy the criteria imposed on the suggested titles in either Tables 1 or 2, a neuroscience film series attached to a course can promote a variety of goals for neuroscience instruction, not the least of which may be to convey the excitement and scope of the interdisciplinary field of neuroscience.

Example: White Zombie (1932)

While White Zombie (Halperin and Halperin, 1932) was extremely successful at the time of its release, it is a film very few students (if any) might have seen. Most will recognize the star, Bela Lugosi, from his signature portrayal of Dracula (see Browning and Laemmle, 1931). In producing White Zombie, many of the sets from the classic movies Dracula (Browning and Laemmle, 1931) and Frankenstein (Laemmle and Whale, 1931) were re-used (Rhodes, 1995), a combination that, in a darkened lecture hall, can result in a memorable night time group viewing experience.

The movie is the story of a young couple's trip to Haiti, where their wedding is to take place. But, this is no vision of Haiti as an idyllic Caribbean island; almost immediately after arriving on the island, the couple encounter groups of "zombies" populating patches of ground fog as the gloom of dusk becomes the dark of night. As the story unfolds, it soon becomes evident that Lugosi's character (named Murder Legendre) is responsible for the presence of these zombies, delivering a powdery substance into drinks that transform the unwitting consumer into the walking dead, most of whom become slave labor for his plantation and sugar mill. Legendre becomes infatuated with the young bride to be, and pre-empts the wedding by turning the young woman into a zombie. In a classic good versus evil finale, the young groom must free his fiancée from the grips of Legendre's pharmacology.

Following the conclusion of the movie, students are first asked about their reactions to the story. Several questions are then posed to draw the students into discussion, such as:

1. What kind of agents might produce the effects seen in the walking dead, as well as the young bride to be?
2. To what extent does culture play a role in the effects of the zombie "powder"?
3. Some aspects of White Zombie were based on a popular travelogue about Haiti in the 1920s, The Magic Island (Seabrook, 1929). Discussion of the Haitian penal code in the movie, for example, is drawn from that book

Title	Year	Released By	Running Time	Directed By	Featuring	Specific Content	Genre/ Rating
12 Monkeys	1995	Universal Studios	2 hrs., 10 mins.	Terry Gilliam	Bruce Willis, Brad Pitt, Madeleine Stowe	Delusional thought, treatment of mental illness	Suspense/ Drama R Violence, Language, Gore
2001: A Space Odyssey	1968	Metro Goldwyn Mayer	2 hrs., 28 mins.	Stanley Kubrick	Keir Dullea, Gary Lockwood	Artificial intelligence, the human ecological niche, concept of self/soul	Drama G
The 6th Day	2000	Columbia Pictures	2 hrs., 4 mins.	Roger Spottiswoode	Arnold Schwarzenegger	Memory, cloning, ethics	Action/ Suspense PG-13
A Bird in the Head	1946	Columbia Pictures	16 mins.	Edward Bernds	Moe Howard, Larry Fine, Curly Howard	Brain transplantation across species, brain anatomy	Comedy NR
A Clockwork Orange	1971	Warner Brothers	2 hrs., 17 mins.	Stanley Kubrick	Malcolm McDowell	Learning, aversion therapy, perception, ethics	Drama R Violence, Sexual Content, Language
Abbott and Costello Meet Frankenstein	1948	Universal Pictures Co. Inc.	1 hr., 23 mins.	Charles T. Barton	Bud Abbott, Lou Costello, Bela Lugosi, Lon Chaney, Jr.	Brain transplantation, ethics	Comedy NR
Benny and Joon	1993	Metro Goldwyn Mayer	1 hr., 38 mins.	Jeremiah Chechik	Johnny Depp, Mary Stuart Masterson, Aidan Quinn	Mental illness, pyromania	Comedy PG
Black Friday (AKA Friday the Thirteenth)	1940	Universal Pictures Co. Inc.	1 hr., 10 mins.	Arthur Lubin	Boris Karloff, Bela Lugosi	Brain Surgery, neural tissue transplantation, motivation, personality	Horror NR
The Black Sleep (AKA Dr. Cadman's Secret)	1956	United Artists	1 hr., 22 mins.	Reginald LeBorg	Basil Rathbone, Lon Chaney, Jr., Bela Lugosi	Brain tumor, brain surgery, pharmacology	Horror NR
Blade Runner: The Director's Cut	1982	The Blade Runner Partnership	1 hr., 57 mins.	Ridley Scott	Harrison Ford, Sean Young	Artificial intelligence, ethics	Suspense/ Action R Violence, Language, Gore
Brain Damage	1988	Palisades Partners	1 hr., 26 mins. (uncut version)	Frank Henenlotter	Rick Hearst, Gordon MacDonald	Disembodied brain, addiction, neuropharmacology	Horror/ Comedy Unrated; Violence, Gore, Language
The Brain From Planet Arous	1957	Howco International Pictures	1 hr., 10 mins.	Nathan Juran	John Agar, Joyce Meadows	Giant disembodied brain (alien), invasion of nervous system	Horror NR
Brain of Blood (AKA Brain Damage; The Brain)	1972	Independent International Pictures	1 hr., 27 mins.	Al Adamson	Kent Taylor, John Bloom	Brain transplantation	Horror PG
Brain Waves (AKA Mind Games)	1982	CinAmerica	1 hr., 17 mins.	Ulli Lommel	Keir Dullea, Vera Miles, Tony Curtis	Neurostimulation, memory, memory transfer, coma	Suspense/ Thriller PG

Title	Year	Released By	Running Time	Directed By	Featuring	Specific Content	Genre/ Rating
Brainscan	1994	Coral Productions	1 hr., 36 mins.	John Flynn	Edward Furlong, Frank Langella	Memory, hypnosis, virtual reality	Horror/ Thriller R Violence, Language
Brainstorm	1983	Metro Goldwyn Mayer	1 hr., 46 mins.	Douglas Trumbull	Christopher Walken, Natalie Wood	Memory, memory transfer, nervous system/technology interface, perception, imaging, ethics	Suspense/ Thriller PG
Charly	1968	Selmur Productions and Cinerama	I hr., 43 mins.	Ralph Nelson	Cliff Robertson. Claire Bloom	Mental retardation, experimental brain surgery, science and society	Drama PG
Coming Home	1978	Jayne Productions, United Artists	2 hrs., 6 mins.	Hal Ashby	Jane Fonda, John Voight	Spinal injury, recovery of function	Drama R Violence, Sexual Content, Language
The Computer Wore Tennis Shoes	1969	Walt Disney Pictures	1 hr., 31 mins.	Robert Butler	Kurt Russell, Cesar Romero	Nervous system/technology interface, artificial intelligence	Comedy G
De Luxe Annie	1918	Select Pictures Corp./Norma Talmadge Film Corp.	1 hr., 12 mins.	Roland West	Norma Talmadge	Amnesia, dissociative fugue	Drama SILENT NR
Edward Scissorhands	1990	Twentieth Century Fox	1 hr., 40 mins.	Tim Burton	Johnny Depp, Winona Ryder, Vincent Price	artificial intelligence, prosthetics, science and society, immortality, ethics	Comedy/ Horror PG-13
Eve, The Wild Woman (AKA King of Kong Island)	1968	Three Star Films	1 hr., 32 mins.	Roberto Mauri (AKA Robert Morris)	Esmeralda Barros	Brain implantation, nervous system/technology interface, ethics	Action/ Horror Italian; dubbed english NR
eXistenZ	1999	Alliance Atlantis Communi-cations	1 hr., 37 mins.	David Cronenberg	Jennifer Jason Leigh, Jude Law, Willem Dafoe	Virtual reality, implantation, gaming, perception, nervous system/technology interface	Suspense/ Action R Violence, Gore. Language
Fearless	1993	Warner Brothers	2 hrs., 2 mins.	Peter Weir	Jeff Bridges, Isabella Rossellini, Rosie Perez	Learning, emotion, traumatic stress	Drama R Violence, Language
The Fisher King	1991	Tristar Pictures inc.	2 hrs., 17 mins.	Terry Gilliam	Robin Williams, Jeff Bridges	Schizophrenia, treatment, ethics	Comedy R Language
Flatliners	1990	Columbia Pictures	1 hr., 51 mins.	Joel Schumacher	Julia Roberts, Kevin Bacon, Kiefer Sutherland	Death, clinical experimentation, ethics	Suspense/ Horror R Violence, Language
Frankenstein	1931	Universal Pictures Co. Inc.	1 hr., 11 mins.	James Whale	Boris Karloff, Colin Clive	Re-animation, brain transplantation Immortality, ethics	Drama/ Horror NR
Freejack	1992	Morgan Creek Productions, Inc.	1 hr., 50 mins.	Geoff Murphy	Emilio Estevez, Mick Jagger, Renee Russo, Anthony Hopkins	Mind transfer, nature of self/soul	Suspense/ Action R Violence. Language

Title	Year	Released By	Running Time	Directed By	Featuring	Specific Content	Genre/ Rating
Hydrotherapie Fantastique	1910	Méliès	13 mins. (approx.)	Georges Méliès	Georges Méliès	Re-animation, historic neuroscience/methods	Drama SILENT NR
The Island of Dr. Moreau	1996	New Line Cinema	1 hr., 36 mins.	John Frankenheimer	Marlon Brando, Val Kilmer, Fairuza Balk	Genetic manipulation across species, ethics	Horror/ Drama PG-13
Johnny Mnemonic	1995	Tristar Pictures Inc.	1 hr., 38 mins.	Robert Longo	Keanu Reeves, Ice-T	Memory, neural implantation, imaging techniques	Drama/ Action R Sexual Content. Violence, Gore, Language
Jurassic Park	1993	Universal Studios	2 hrs., 7 mins.	Steven Spielberg	Sam Neill, Laura Dern, Jeff Goldblum	Genetic manipulation, learning, memory, sensation and perception	Action/ Thriller PG-13
K-Pax	2001	Universal Studios	2 hrs., 1 min.	Iain Softley	Kevin Spacey, Jeff Bridges, Alfre Woodard	Treatment of mental illness, proximity effect, learning, ethics	Drama PG-13
La Femme Nikita	1991	Samuel Goldwyn Co.	1 hr., 57 mins.	Luc Besson	Anne Parillaud	Brainwashing, drug use	Drama/ Thriller French; dubbed english R Violence, Sexual Content
Lawnmower Man	1993	New Line Cinema	2 hrs., 20 mins.	Brett Leonard	Pierce Brosnan, Jeff Fahey	Virtual reality, artificial intelligence, nervous system/technology interface	Action/ Horror R Violence, Language
The Long Kiss Goodnight	1996	New Line Productions	2 hrs.	Renny Harlin	Geena Davis, Samuel L. Jackson	Amnesia, Memory	Suspense/ Action R Sexual Content, Violence, Language
Love Potion #9	1992	Twentieth Century Fox	1 hr., 32 mins.	Dale Launer	Tate Donovan, Sandra Bullock	Psychopharmacology, limbic system	Comedy PG-13
The Man With Two Brains	1983	Warner Brothers	1 hr., 30 mins.	Carl Reiner	Steve Martin, Kathleen Turner	Brain surgery/transplantation, disembodied brains	Comedy R Gore, Language, Sexual Content
The Manchurian Candidate	1962	United Artists	2 hrs., 6 mins.	John Frankenheimer	Frank Sinatra, Janet Leigh, Angela Lansbury	Brainwashing, hypnosis	Drama/ Thriller PG-13
Marathon Man	1976	Paramount Pictures	2 hrs., 5 mins.	John Schlesinger	Dustin Hoffman, Lawrence Olivier, Roy Scheider	Torture, pain	Drama/ Thriller R Violence, Language
Marnie	1964	Universal Studios	2 hrs., 10 mins.	Alfred Hitchcock	Sean Connery, Tippi Hedrin	Dissociation, psychogenic fugue	Drama/ Suspense PG

Title	Year	Released By	Running Time	Directed By	Featuring	Specific Content	Genre/ Rating
Mary Shelley's Frankenstein	1994	Tristar Pictures	2 hrs., 3 mins.	Kenneth Branagh	Robert DeNiro, Kenneth Branagh	transplantation, re-animation, science and society, ethics	Drama/ Horror R Sexual Content, Violence, Gore
Memento	2000	I Remember Productions LLC	1 hr., 53 mins.	Christopher Nolan	Guy Pierce	Memory, anterograde amnesia	Suspense/ Thriller R Violence, Language, Gore
Novocaine	2001	Artisan Entertain-ment	1 hr., 35 mins.	David Atkins	Steve Martin, Helena Bonham Carter Laura Dern	Pain, drug abuse, imaging technique	Comedy/ Suspense R Violence, Language, Sexual Content
Osamu Tezuka's Metropolis	2001	Tezuka Productions/ Metropolis Project	1 hr., 49 mins.	Rintaro	Various Artists	Artificial intelligence, science and society	Drama/ Action ANIME PG-13
Outbreak	1995	Warner Brothers	2 hrs., 8 mins.	Wolfgang Peterson	Dustin Hoffman, Morgan Freeman, Renee Russo	Neurodegenerative disease, science and society, ethics	Thriller R Language
Psycho	1960	Universal Studios	1 hr, 49 mins.	Alfred Hitchcock	Anthony Perkins, Janet Leigh	Multiple personalities	Suspense/ Horror R Violence, Gore
Rain Man	1988	United Artists	2 hrs., 13 mins.	Barry Levinson	Dustin Hoffman, Tom Cruise	Autistic savant, ethics	Drama R Language, Sexual Content
Re-Animator	1985	Re-Animator Productions Inc, Empire Pictures	1 hr., 26 mins (rated version)	Stuart Gordon	Jeffrey Combs	neuropharmacology, re-animation, science and society, ethics	Horror/ Comedy R Violence, Gore, Language
Resident Evil	2002	Columbia TriStar	1 hr., 44 mins.	Paul W. S. Anderson	Milla Jovovich, Michelle Rodriguez	Artificial intelligence, amnesia, genetic manipulation, re-animation, ethics	Horror/ Action R Violence, Language, Gore
The Road to Wellville	1994	Columbia Pictures	2 hrs.	Alan Parker	Matthew Broderick, Anthony Hopkins, Bridget Fonda, John Cusack	Neural stimulation, historic neuroscience/methods, ethics	Comedy R Sexual Content
Robocop	1987	Orion Pictures Corp.	1 hr., 43 mins.	Paul Verhoeven	Peter Weller, Nancy Allen	Artificial intelligence, robotics, cybernetics, nervous system/technology interface, ethics	Action R Violence, Sexual Content, Language, Gore

Title	Year	Released By	Running Time	Directed By	Featuring	Specific Content	Genre/ Rating
Scared to Death	1946	Golden Gate Pictures	1 hr., 7 mins.	Christy Cabanne	Bela Lugosi	Psychopharmacology, hypnotism, sensation and perception	Drama/ Horror NR
Scent of a Woman	1992	Universal Studios	2 hrs., 37 mins.	Martin Brest	Al Pacino	Non-visual sensation and perception	Drama R Language
Sleeper	1973	United Artists	1 hr., 29 mins.	Woody Allen	Woody Allen, Diane Keaton	Cryogenics, cloning, virtual reality	Comedy PG
Sleepy Hollow	1999	Paramount Pictures	1 hr., 45 mins.	Tim Burton	Johnny Depp, Christina Ricci	historic neuroscience/methods	Horror R Violence, Gore
Strange Days	1995	Twentieth Century Fox	2 hrs., 25 mins.	Kathryn Bigelow	Ralph Fiennes, Angela Bassett, Juliette Lewis	Memory, memory transfer, nervous system/technology interface, perception, imaging, virtual reality, ethics	Suspense/ Thriller R Disturbing Sexual Content and Violence, Language
The Terminator	1984	Cinema '84 - A Greenberg Brothers Partnership	1 hr., 47 mins.	James Cameron	Arnold Schwarzenegger, Linda Hamilton	Cybernetics, artificial intelligence, robotics, science and society, ethics	Action/ Horror R Violence, Language, Gore, Sexual Content
Terminator 2: Judgement Day	1991	Canal+ D.A.	2 hrs., 36 mins.	James Cameron	Arnold Schwarzenegger, Linda Hamilton, Edward Furlong	Cybernetics, artificial intelligence, robotics, learning, science and society, ethics	Action/ Thriller R Violence, Language, Gore
Total Recall	1990	Carolco Pictures	1 hr., 53 mins.	Paul Verhoeven	Arnold Schwarzenegger, Sharon Stone	Memory, nervous system/technology interface, artificial intelligence	Action/ Thriller R Violence Sexual Content Language
Traffic	2000	USA Films LLC	2 hrs., 27 mins.	Steven Soderbergh	Michael Douglas, Benicio Del Toro, Catherine Zeta-Jones, Dennis Quaid	Addiction, drugs of abuse, science and society, ethics	Drama R Strong sexual Content Violence Language
Tron	1980	Walt Disney Pictures	1 hr., 36 mins.	Steven Lisberger	Jeff Bridges	Artificial intelligence, neural networks, memory, concept of self/soul	Action/ Thriller PG
Universal Soldier	1992	Carolco Pictures	1 hr., 42 mins.	Roland Emmerich	Jean-Claude Van Damme	Genetic Manipulation, memory	Action R Violence, Language
Vanilla Sky	2001	Paramount Pictures	2 hrs., 15 mins.	Cameron Crowe	Tom Cruise	Virtual reality, memory, cryogenics	Drama/ Suspense R Sexual Content, Language

Title	Year	Released By	Running Time	Directed By	Featuring	Specific Content	Genre/ Rating
Virtuosity	1995	Paramount Pictures	1 hr., 45 mins.	Brett Leonard	Denzel Washington, Russell Crowe	Artificial intelligence, virtual reality, nervous system/technology interface	Drama/ Thriller R Violence, Language
White Zombie	1932	Halperin Productions	1 hr., 8 mins.	Victor Halperin	Bela Lugosi, Madge Bellamy	Neuropharmacology, re-animation, power of cultural beliefs	Horror NR
Young Frankenstein	1974	Twentieth Century Fox	1 hr., 48 mins.	Mel Brooks	Gene Wilder, Peter Boyle, Madeline Kahn	Brain transplantation, re-animation, science and society, ethics	Comedy PG
Zaat	1972	Barton Films, Aquarius Releasing Inc.	1 hr., 40 mins.	Don Barton and Arnold Stevens	Marshall Grauer	Genetic manipulation across species, science and society, mad scientist	Horror R Violence

Table 2. Selected titles, including year of release, cast and production information, for feature films that meet the criteria for use in a neuroscience film series. Also included are brief descriptions of the content relevant to neuroscience instruction (Specific Content), story genre and MPAA rating (Genre/Rating). These films also contain material appropriate for use as short "clips" within classroom sessions.

(Rhodes, 1995). Why might someone want to create zombies?

Discussion of any of the questions above may lead to a far-reaching conversation on neuroscience. For example, Question 1 might lead to discussion of neurotransmitter systems and pharmacological antagonism; the physiology of the neuromuscular junction; diseases such as myasthenia gravis; perception and attentional processes; arousal and neuromodulatory circuits, or the ethical concerns of pharmacological treatments, to name just a few potential topics.

Exercise 3: Film Clips in Lectures

The use of full-length feature films as described in the neuro-cinema and film series exercises above can be a great adjunct to neuroscience education, but to incorporate film use within standard class periods it is generally more practical to use short excerpts. The distinct advantage of the use of "clips" is that they may be inserted into the course without taking significant amounts of time away from other classroom activities. Yet another advantage of using short excerpts is that an even larger selection of films becomes appropriate for use in neuroscience education.

While any of the movies included in Tables 1 or 2 above are suitable for such use, Table 3 presents further title suggestions, including films with entirely implicit, tangential or momentary content relevant to neuroscience education.

Presenting just those few moments of a particular film that relate to a class topic may accomplish a number of goals. Short film clips can provide a purposeful transition from other course content; needed context for discussion to follow; or vivid illustration of a hard-to-grasp concept. Recent research in psychology instruction (Roskos-Ewoldsen and Roskos-Ewoldsen, 2001) suggests that the use of film clips can be an enjoyable part of class time, and similar to full-length film presentations, can aid in the understanding of lectures and overall subject mastery. Furthermore, as student interest may wax and wane across a class period, the judicious inclusion of a interesting short film clip may serve to maintain student engagement in the subject at hand. The instructor considering the occasional use of film clips for this purpose may find it useful to employ a variety of film titles and genres popular with the students' age demographic, as what engages students might not be what is interesting or even tasteful to the instructor, however relevant to the course a particular clip may be (see Brumbaugh, 1940, for an interesting early study and discussion along these lines). One example from my own in-class use of film clips is the use of scenes depicting dental procedures from the movies Marathon Man (1976) and The Little Shop of Horrors (1960) in the discussion of pain mechanisms and modulation with my behavioral neuroscience class. In the scene from "Marathon Man", a young Dustin Hoffman is put through agony at the hands of an aged former-Nazi torture specialist played by Lawrence Olivier. However, in the scene from The Little Shop of Horrors, a young Jack Nicholson is positively joyful to receive a similar experience at the hands of Semour-- the flower shop clerk, pretending to be a dentist. Both clips serve to focus attention on the subject of pain, and provide vividly contrasting examples of how the meaning of the situation and the experience of the individual interact in the interpretation and perception of pain.

Many instructors have integrated the use of film clips into their classroom instruction beyond the illustrative and occasion-setting uses employed by this author. For further examination of the use of film clips in instruction, the reader may be interested in recent articles by Alexander and Waxman (2000), which discusse such use in a medical school setting, and Paddock et al. (2001), which describes the use of film clips within an undergraduate psychology course.

Title	Year	Released By	Running Time	Directed By	Featuring	Specific Content	Genre/ Rating
Andy Warhol Presents Frankenstein (AKA Flesh For Frankenstein)	1974	Triboro Entertain-ment Group	1 hr., 36 mins.	Paul Morrissey	Udo Kier, Monique Van Vooren	transplantation, re-animation, science and society, ethics	Horror/ Comedy R Sexual Content, Violence, Gore, Language
Charlie Chan in Honolulu	1938	Twentieth Century Fox	1 hr., 7 mins.	H. Bruce Humberstone	Sidney Toler, George Zucco	Disembodied brain	Suspense/ Comedy NR
Color of Night	1994	Cinergi Productions	2 hrs., 1 min. (2 hrs., 20 mins. director's cut)	Richard Rush	Bruce Willis, Jane March	Psychogenic achromatopsia, mental illness	Suspense R Violence, Sexual Content, Language
The Dark Half	1993	Metro Goldwyn Mayer	2 hrs., 2 mins.	George A. Romero	Timothy Hutton, Amy Madigan	Brain Surgery, undeveloped conjoined twin	Suspense/ Horror R Violence
Death Race 2000	1975	Roger Corman Classics, Concorde-New Horizons Corp.	1 hr., 18 mins.	Paul Bartel	David Carradine, Sylvester Stallone	Cybernetics, prosthetics	Action R Violence, Sexual Content, Gore
The Empire Strikes Back	1980	Lucasfilm Ltd.	2 hrs., 4 mins.	Irvin Kershner	Mark Hamill, Harrison Ford, Carrie Fisher, Billy Dee Williams	Prosthetics/cybernetics, learning, artificial intelligence	Action/ Thriller PG
Encino Man	1992	Hollywood Pictures Co.	1 hr., 38 mins.	Les Mayfield	Brendan Fraser, Pauly Shore	Cryogenics, Recovery of function, learning	Comedy PG
Escape from L.A.	1996	Paramount Pictures	1 hr., 41 mins.	John Carpenter	Kurt Russell. Bruce Campbell	Nervous system injury, ethics	Action/ Thriller R Violence, Language
Face/Off	1997	Paramount Pictures	2 hrs., 20 mins.	John Woo	John Travolta, Nicolas Cage	Cranial Nerves, Facial innervation, tissue rejection	Thriller R Violence, Language, Gore
Forrest Gump	1994	Paramount Pictures	2 hrs., 22 mins.	Robert Zemeckis	Tom Hanks Sally Field Gary Sinise Robin Wright	Prosthetics, nervous system injury and disease, recovery of function, perception	Drama PG-13
Grandma's Reading Glass	1900	George Albert Smith	6 mins. (approx.)	George Albert Smith	uncredited	Perception, examination of the eye (external)	Document-ary SILENT NR
The Green Mile	1999	Warner Brothers	3 hrs., 8 mins.	Frank Darabont	Tom Hanks	Brain tumor, positive symptoms	Drama/ Suspense/ Horror R Violence, Language
Half Baked	1998	MCA/ Universal Studios	1 hr., 22 mins.	Tamra Davis	Dave Chappelle, Jim Breuer	Psychopharmacology, drugs and society, pharmaceutical research	Comedy R Drug content, Language

Title	Year	Released By	Running Time	Directed By	Featuring	Specific Content	Genre/ Rating
Inspector Gadget	1999	Walt Disney Pictures	1 hr, 18 mins.	David Kellogg	Matthew Broderick, Rupert Everett, Michael Hagerty, Andy Dick	Cybernetics, nervous system/technology interface	Comedy/ Action PG
John Q	2002	New Line Productions	1 hr., 52 mins.	Nick Cassavetes	Denzel Washington	Transplantation, ethics	Drama PG-13
The Little Shop of Horrors	1960	The Filmgroup	1 hr., 10 mins.	Roger Corman	Jonathan Haze, Jack Nicholson	Pain and context	Comedy/ Horror UNRATED
Mars Attacks!	1996	Warner Brothers	1 hr., 46 mins.	Tim Burton	Jack Nicholson, Annette Bening, Pierce Brosnan, Danny DeVito	Transplantation across species, disembodied heads	Comedy PG-13
Men In Black	1997	Columbia Pictures	1 hr., 38 mins.	Barry Sonnenfeld	Will Smith, Tommy Lee Jones	Memory, amnesia, sensation	Comedy/ Thriller PG-13
Never Say Never Again	1983	NSNA Co.	2 hrs., 13 mins.	Irvin Kershner	Sean Connery, Kim Basinger	Vision, eye anatomy	Action/ Thriller/ Suspense PG
Office Space	1999	Twentieth Century Fox	1 hr., 30 mins.	Mike Judge	Ron Livingston, Stephen Root, Jennifer Aniston	Hypnosis, personality, emotion	Comedy R Language, Sexual Content
Our Man Flint	1965	Twentieth Century Fox	1 hr., 48 mins.	Daniel Mann	James Colbern, Lee J. Cobb	Brainwashing, hypnosis	Comedy NR
Peeping Tom (AKA Face of Fear)	1960	Anglo-Amalgam-ated Productions	1 hr., 41 mins. (uncut version)	Michael Powell	Carl Boehm	Fear and the nervous system, scopophilia	Drama/ Horror NR
Planet of the Apes (2001)	2001	Twentieth Century Fox	2 hrs., 4 mins.	Tim Burton	Mark Wahlberg, Tim Roth, Helena Bonham Carter	Science and society, evolution, learning, ethics	Thriller PG-13
Star Trek III: The Search for Spock	1984	Paramount Pictures	1 hr., 45 mins.	Leonard Nimoy	William Shatner, Leonard Nimoy	Memory, memory transfer	Drama/ Action PG
Vertigo	1958	Paramount Pictures; 1996 by Universal Pictures	2 hrs., 8 mins.	Alfred Hitchcock	James Stewart, Kim Novak	acrophobia	Drama/ Suspense PG
What's Eating Gilbert Grape	1994	Paramount Pictures	1 hr., 58 mins.	Lasse Hallstrom	Johnny Depp, Juliette Lewis, Leonardo DiCaprio	autism	Drama PG-13
What hypnotism can do	1899	American Mutoscope and Biograph	6 mins. (approx.)	Frederick S. Armitage (also cinemato-graphy)	uncredited	Hypnotism, perception, science and society	Document-ary w/fantasy content SILENT NR
The World is Not Enough	1999	Danjaq.,LLC and United Artists	2 hrs., 8 mins.	Michael Apted	Pierce Brosnan	Imaging techniques, brain injury, emotion	Action/ Thriller/ Suspense PG-13
X-Men	2000	Twentieth Century Fox	1 hr., 44 mins.	Bryan Singer	Patrick Stewart, Halle Berry, Hugh Jackman	Genetics, mutation, sensation and perception, nervous system/technology interface	Action/ Thriller PG-13

Title	Year	Released By	Running Time	Directed By	Featuring	Specific Content	Genre/ Rating
The X-Ray Mirror	1899	American Mutoscope and Biograph	6 mins. (approx.)	Wallace McCutcheon (also cinemato-graphy)	uncredited	x-ray concept, science and society	Comedy w/fantasy content SILENT NR

Table 3. Selected titles, including year of release, cast and production information, for feature films containing material appropriate for use as short "clips" within classroom sessions, that meet the criteria for use in the neuro-cinema exercise. Also included are brief descriptions of the content relevant to neuroscience instruction (Specific Content), story genre, and MPAA rating (Genre/Rating).

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The reader may enjoy visiting The Internet Movie Database website (us.imdb.com) which was employed in the verification of some cast and crew information, and invaluable in the preparation of this article.

Instructors interested in mounting a film series not connected to course offerings should investigate United States Title 17 copyright law for limitations concerning presentations of films. For an excellent example of such a film series, visit the National Institutes of Health Office of Science ongoing "Science in the Cinema" summer program, online at science.education.nih.gov/cinema.

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