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How Neuroscience Changes, Complicates, and Complements Contemporary
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Introduction:

During the past decade, there has been a growing interest in how cognitive neuroscience will influence not only film studies, but also the field of humanities as a whole. As a result of recent research discoveries and technological advancements within neuroscience, interest in the brain and its functions permeates not only the cognitive film studies paradigm, but also other fields such as philosophy, psychology and social behavioral science. In this sense, the interest in neuroscience has yet again highlighted the problematic relationship between the natural sciences and the humanities. The aim of this essay is to explore and review how contemporary film studies relates to the increasing influence of cognitive neuroscience. By analyzing a body of articles and books reflecting on this influence, emphasizing various aspects, I will attempt to assess the current influence and highlight how neuroscience complicates, changes and possibly complements the current film studies discourse. Hence, a comparative method is adopted where recent academic discussions within both the humanities and within neuroscience will constitute the primary research material. In doing so, I will address the question why neuroscience is becoming increasingly influential within film studies, and what the impacts could be for the future of film studies.

Within film studies, the influence of cognitive film theory gained ground throughout the past decade, especially in relation to the social constructionist paradigm emphasizing psychoanalytical and cultural analytical models. In *Narration in the Fiction Film* from 1985, David Bordwell questioned how one could explain the cinematic experience and its narrative structure. By studying different structures and strategies central to film, he found that most of these strategies emphasize our basic cognitive capacities (5). As Thomas Elsaesser and Malte Hagener note in *Film Theory - An Introduction through the Senses*: "[cognitivists] would hold that all sense perception and physical sensations are processed by the brain, including in the cinema. Therefore it is neither "the body" nor "the senses" but the brain that decides whether something is pleasant or painful, hot or cold, wet or dry" (166). In 1996, David Bordwell and Noël Carroll edited the anthology *Post-theory: Reconstructing Film Studies*. In this volume, both authors attacked the ruling paradigm within film studies, questioning the advocates for social constructionist Grand Theories. Additionally, both authors ended their articles by pleading for a new approach as well

as a new methodology within film studies. While the cognitivist turn within film studies led to a paradigm focusing to a greater extent on the human brain and its cognitive processes, the influence of Bordwell and Carroll's appeal by no means indicates a rapid or all-inclusive paradigm shift. Instead, I would argue that the cognitivist turn attests to the growing influence of natural science within the field of film studies. At the same time, it would not be controversial to argue this aforementioned tendency paved the way for the current influence of neuroscience.

In order to examine how neuroscience influences film studies, I will limit the study to three central areas of investigation, namely: (1) how does neuroscience change contemporary film studies?; (2) how does neuroscience complicate contemporary film studies?, and (3) how does neuroscience complement contemporary film studies? In doing so, I will first discuss how neuroscience influences film scholars with different starting points. Secondly, given recent technological advancements, I will not only discuss the possible changes to film studies' methodology, but also to the production companies as such. Lastly, I will not only examine how neuroscience complements film studies, but also how film studies can complement neuroscientific investigations into film. But first, I will briefly address the preconditions for the growing influence of neuroscience.

The Growing Influence of Neuroscience

In a pragmatic sense, two major research findings—along with technological advancements—constitute the primary influence within the field of film studies: the discovery of mirror neurons, and Antonio Damasio's research on emotions. When researchers at the University of Parma discovered mirror neurons, they found that macaque monkeys' mirror neurons are not only triggered when they perform an action, but also when they perceive, smell or hear something associated with this action, such as a hand grasping for a peanut.¹ These mirror neurons are also present in the human brain, and are activated when we perceive others performing goal-oriented activities as well as when we perform the activities ourselves. Subsequent research into mirror neurons has shown how muscle groups triggered by neural events respond to movement of other agents (Fadiga and Rizzolatti 1995: 2608). This, in turn, might

¹ For further reading on the mirror neuron system, see for example Vittorio Gallese and Alvin Goldman. "Mirror neurons and the simulation theory of mind-reading." *Trends in Cognitive Sciences*. Dec. 1998: 493-501.

provide insight into how emotions are simulated and how this affects our feelings of empathy (Jabbi, Swart and Keysers 2007). In this sense, the discovery of mirror neurons could, prospectively, have a particular influence within the field of film studies because of cinema's dependence on audiovisual stimuli. In other words, if research into mirror neurons offers a feasible explanation of how gestures, postures and facial expressions evoke emotions, cinema would emerge as an ideal medium for this practice of communication. Hence, drawing on studies into what the mirror neuron system can and cannot tell us, a growing body of film scholars is beginning to highlight how moods, gestures and facial expressions influence our emotional experience of cinema.²

Meanwhile, neuroscientist Antonio Damasio is cited heavily for his explorations of the human emotional system. In his research, Damasio stresses the crucial roles of emotions in our cognition, proving a link between our minds and our nerve cells.³ In this sense, Damasio highlights the embodied mind and the error of the Cartesian divide between body and mind. In Damasio's view, "the emotion-feeling cycle begins in the brain with the perception and appraisal of a stimulus potentially capable of causing an emotion and the subsequent triggering of an emotion. The process then spreads elsewhere in the brain and in the body proper, building up the emotional state" (110). When considering this link between Damasio and film studies, it is interesting to note the connection between cinema and emotions from an etymological point-of-view. As Noël Carroll notes in *The Philosophy of Motion Pictures*, many descriptions of film genres are commonly associated with emotional states—for instance, "tearjerkers", suspense and horror (148). According to the cognitivist film scholars Carl Plantinga and Greg M. Smith, emotions research is a common starting point for film scholars because "the cinema is a place to feel something" (2). Additionally, Noël Carroll argues that emotions are particularly salient in the cinema because of the filmmakers desire to criterially prefocus the action and thus communicating, and manipulating, the audiences' emotional response (149). Given the movie houses' link to emotions, Damasio has become influential within this field. Moreover, as a result of the growing emphasis on the human brain, Damasio has

² See for instance Amy Coplan, "Catching Characters' Emotions: Emotional Contagion Responses to Narrative Fiction Film", *Film Studies*, University of Manchester, 2006 or Patrick J. Cook, *Cinematic Hamlet: the films of Olivier, Zeffirelli, Branagh, and Almereyda*. Athens: Ohio University Press, 2011.

³ See for instance, Antonio Damasio. *Self Comes to Mind: Constructing the Conscious Brain*. New York: Pantheon Books, 2010.

emerged as a common denominator for philosophers, psychologists and social behaviorists in their quest to understand the human mind, indicating how neuroscience can cross paradigms.

Changing Film Studies: Crossing Paradigms

As mentioned, contemporary film studies does not deal with neuroscience from a joint perspective; but rather, theorists with different starting points stress diverse areas where neuroscience might prove valuable. Simply put, neuroscience influences theorists with significantly diverse backgrounds and research interests. For instance, in “Mathematics, Madness and Metaphysics: Two Poles of the Neuro-Image in *Pi* and *The Fountain*”, Patricia Pisters argues that today’s popular fascination with our minds within cinema highlights not only how Hollywood films have developed a ‘neuroaesthetic’ style, but also that the French philosopher Gilles Deleuze’s thoughts on neurobiology, as articulated in *The Time-Image* and *The Movement-Image*, have influenced contemporary film theory to a great extent (1). Despite the fact that Deleuze was fascinated with the brain during the latter part of his academic career—in his view neurobiology offered more to cinema than both linguistics and psychoanalysis—he was not primarily interested in examining cognitive processes. Instead, Deleuze utilized neuroscience as a methodology for understanding “the exposition of ontology” (Elliott 1). While scientists today have the ability to assess the effect of films on spectators’ brain activity through so-called fMRI scanners, the technological advancements had not progressed sufficiently when Deleuze discussed neurobiology in his famous interview with *Cahiers du Cinéma* entitled “The Brain is the Screen”, following the publication of *The Movement-Image* in 1986. In this sense, Deleuze’s thoughts on the neuro-image are considered visionary, and this aspect of Deleuze’s work is now often the focal point of attention for film scholars such as the aforementioned Patricia Pisters and other prolific film scholars such as Anne Friedberg.⁴ In this sense, the increasing interest for Deleuze’s thoughts on neurobiology constitutes a trend within film philosophy.

Meanwhile, in a more recent line of discourse, both philosophers and psychologists have been increasingly interested in recent research into what the mirror neuron system can and cannot tell us. In her essay “Catching Characters’ Emotions:

⁴ For a recent text assessing Gilles Deleuze’s influence, see for instance Paul Elliott. “The Eye, the Brain, the Screen: What Neuroscience Can Teach Film Theory.” *Excursions* vol. 1, June (2010): 1-16.

Emotional Contagion Responses to Narrative Fiction Film”, film scholar and philosopher Amy Coplan suggests that cinema highlights affective-responses such as moods and mimicry in a particularly striking manner contrasting our experience of literary narratives. In this sense, she argues that affective responses are “unique to our experience of audiovisual narratives” due to their dependence on “direct sensory engagement and ... automatic processes” (26). According to Coplan, automatic and affective processes might induce emotional contagion when we observe others’ emotions (26). Even though contemporary scholars researching emotional contagion draw heavily upon the research on mirror neurons, the notion of emotional contagion is not novel but rather has long traditions within the field of psychology.⁵ While emotions are expressed through multiple modes such as position, voice, touch, posture and so on, Paul Ekman and other researchers has shown how facial expressions are particularly “reliable markers of emotion” (Matsumoto et al 225).⁶ Drawing on both Ekman’s findings as well as recent findings within neuroscience, film scholars such as Amy Coplan and Naomi Rokoitz connect the notion of emotional contagion with the way mimicry communicates through the mirror neuron system.⁷ In this sense, classical filmic techniques such as the close-up, in their view, rely heavily upon these mechanisms in order to communicate emotions. In contrast, these film scholars utilize neuroscience in a completely different manner than Gilles Deleuze. While Deleuze discussed neuroscience as a tool to understand human ontology, these scholars emphasize innate neurobiological processes.

While film scholars drawing on both philosophy and psychology are showing a growing interest in neuroscience and research findings such as the mirror neuron system, film scholars inspired by different cognitive stances are also inspired by the upsurge of neuroscience. Torben Grodal’s recent book *Embodied Visions: Evolution, Emotion, Culture and Film* draw concretely on neuroscientist Antonio Damasio’s theory of mind. In Grodal’s view, the bodily experiences felt when watching film are linked to our emotional reactions, which in turn are essential to memory, cognition

⁵ See for example Elaine Hatfield, John T. Cacioppo, and Richard L. Rapson. *Emotional Contagion*. Cambridge: Cambridge University Press, 1994.

⁶ For more on facial expressions and emotions, see David Matsumoto, Dacher Keltner, Michelle N. Shiota, Maureen O’Sullivan and Mark Frank. “Facial Expression of Emotion”, eds. Michael Lewis and Jeanette M. Haviland-Jones. *Handbook of Emotions*. New York, Guilford Press, 2000. 211–234.

⁷ See Naomi, Rokoitz. "Too far gone in disgust": Mirror Neurons and the Manipulation of Embodied Responses in *The Libertine*." *Configurations*. Vol 16, Fall (2008): 399-426. Print.

and consciousness (4). Furthermore, Grodal elaborates on this notion and suggests that the cinematic experience is embodied. In his view, “the senses are designed to pick up information which may in turn prompt actions that implement the preferences of agents, as expressed in their emotions” (146). This argument relies heavily upon research into mirror neurons, emphasizing the way the mirror neuron system in the premotor cortex elicits action and “mirror the actions and the intentions of the characters” (150). In other words, when we perceive a gesture in a film, the mirror neurons simulate a similar movement in our brains. But Torben Grodal is far from the only cognitive film scholar who is inspired by neuroscience. As noted, cognitive film scholars such as David Bordwell and Noël Carroll made the first explorations into how cognitive and natural science might improve our understanding of films and storytelling. Similarly, by utilizing contemporary neuroscientific research and concrete empirical studies as his main sources, Grodal provides a new approach to film studies that is to a greater extent intertwined with the natural sciences.

As these diverse sources of inspiration show, neuroscience is emerging as a common denominator for different practices of film scholarship; moreover, the natural sciences are beginning to take a stronger position within the field of humanities as a whole. Obviously, the difference between film scholars inspired by philosophical, psychological and cognitive approaches differ both in terms of focus and in terms of methodology. Nevertheless, emphasis is consistently put on the importance of the human brain, and thus, in a sense, I would argue that neuroscientific influence bridges paradigms.

Complicating Film Studies: New Technology

As mentioned, both the discovery of mirror neurons and the research of Antonio Damasio have influenced film studies a great deal, but it is important not to neglect importance of the evolving technology within neuroscience. In fact, I believe that this technological aspect of neuroscience might constitute the primary influence that complicates contemporary film studies. When considering how neuroscientific influence might affect film studies, recent experiments using Functional Magnetic Resonance Imaging scanners—measuring the neural activity in the brain—have highlighted how our understanding of film might change drastically with growing technological efficiency. The developments of refined scanners have provided

neuroscience with technical assistance, proving valuable in the investigation of both the “function and dysfunction of the human brain” (Hasson 2). In order to measure brain activity, a series of images are taken from the scanner while, for instance, a task is presented to an agent (Cabeza 353). In relation to film studies, fMRI scans can provide insight into the neural activity in different regions of the brain and thus discover certain patterns with regard to the spectator’s experience of narrative fictional film. But how does this technique affect film studies, and does this technology have any implication for the film industry?

At the annual meeting with The Society for Cognitive Studies of the Moving Image in Budapest June 2011, Talma Hendler delivered the keynote speech on how neuroscience now can show—through fMRI scans of the brain—when and where dramatic events affect spectators. According to Hendler, film clips are often utilized as stimuli within experimental psychology, but remain largely understudied within the field of neuroscience.⁸ Moreover, Kristin Thompson—one of the co-authors of the influential book *Film Art: An Introduction*—reported that the speech raised a stir within the cognitive media community.⁹ The reactions to Hendler’s speech, as well as the reactions to similar studies such as Uri Hasson’s study at New York University in 2008, signifies a quest for empirical evidence within film studies. Even though experimental testing within film studies exists—for instance tests utilizing systematic analysis of texts, questionnaires and reaction-speed methodologies—little emphasis on empirical data within film studies from a historical point-of-view; in this sense, there is a lack of strong evidence with regard to the “cognitive processes involved in film comprehension” (Spanne 1). Meanwhile, one must notice that the issue of a transforming methodology within film studies did not first occur with neuroscience, but the lack of empirical data has resulted in efforts to combine film studies with cognitive science in the past as well. Drawing on this quest for empirical evidence, researchers aiming to track the impact of our cognitive processing of narrative films—emphasizing quantitative methods to film studies—have focused to a great extent on so-called perception studies (1). This research methodology aims to track how and where our eyes move when viewing fictional film in an effort to understand our underlying cognitive processes; these data are then combined with other resources

⁸ For a brief elaboration on Talma Hendler’s study, see http://film.elte.hu/scsmi2011/SCSMI_abstracts.pdf

⁹ www.davidbordwell.net

such as questionnaires in order to provide greater insight into the agent's thoughts and emotions. In a metatheoretical evaluation of this method within film studies, Björklund and Jansson scrutinize how experiments based on eye-movements consistently utilize—like many other psychological tests—the aforementioned questionnaires in order to validate the given effect of the film in question. In *The Handbook of Psychological Testing*, Paul Kline argues that this aspect of psychological tests might be criticized for “poor reliability” because of the individual's limited range of alternatives (248). These methods, in consequence, have gained limited influence within film studies at large, even though the quest for empirical data remains a hot issue.

According to the the psychology professor Uri Hasson from Princeton University, studying eye-movements might be illuminating, but this kind of study is not “sufficient by itself to determine the amount of control a movie has on viewers' emotional and cognitive responses” (13). In a recent article entitled “Neurocinematics: The Neuroscience of Film”, Uri Hasson and his co-workers coin the term ‘neurocinematics’ after having studied spectators' relation to narrative fiction film utilizing fMRI scanners recording both eye-movements and neural activity. In the study published in *Projections: The Journal for Movies and Mind*, Uri Hasson et al propose a new method for assessing the effect of a given film on viewers' brain activity. In their experiment, the researchers analyze the data which indicates how much brain activity the films muster during the viewing of such separate audiovisual phenomena as *Alfred Hitchcock Presents* (1955-1962), Sergio Leone's *The Good, The Bad, The Ugly* (1966) and *Curb Your Enthusiasm* (2000--). In this experiment, focus is put on measuring the inter-subjective correlation during film viewing. In doing so, the experiment covers a number of different brain regions, ranging from “the visual areas in the occipital and temporal lobes of the brain, auditory areas ... regions near the lateral sulcus known to be critical to language, brain regions that have been implicated in emotions” and so on (4). The researchers, in turn, assess not only the response time in the brain regions when the agents are presented with audiovisual stimuli, but also the “average gaze map” of the spectators (6). Moreover, the study indicates where the spectator looks while watching films, thus indicating the filmmakers control over the gaze. In this sense, this technology has the potential to reveal whether the audience' looks at the ‘intended’ object, for instance a clue in a

thriller, but also whether the audiences' emotional response is largely congruent or scattered across groups.

According to the study, the Alfred Hitchcock Presents episode "Bang! You're Dead" was able to evoke a similar response through all viewers "in over 65 percent of the cortex ... indicating a high level of control of this particular episode on viewers' minds" (14). Similarly, *The Good, the Bad and the Ugly* mustered high inter-subject correlation of brain activity, evoking 45 percent of the cortex. In contrast, *Curb Your Enthusiasm* only evoked 18 percent, while an unstructured clip from a video filmed in Washington Square Park only managed to evoke 5 percent. When discussing the findings of the study, Hasson suggests "the fact that Hitchcock was able to orchestrate the responses of so many different brain regions, turning them on and off at the same time across all viewers, may provide neuroscientific evidence for his notoriously famous ability to master and manipulate viewers' minds" (16). In the particular case of Alfred Hitchcock, Hasson says, neuroscience could provide quantitative data and empirical evidence to back film scholars' analysis of, for instance, the acclaimed director's aesthetic and narrative style. In relation to the lack of satisfactory quantitative and empirical methods within film studies in the past, this type of neuroscientific testing engages because it can both confirm and disprove text-analytical analyses, which in turn highlights prospective complications regarding film studies' methodology.

At the same time as the research method described in Hasson's study highlights certain advancements in our understanding of the human brain's reaction to audiovisual stimuli, the method can be criticized on the ground that the spectatorial context does not adequately replicate our regular cinematic experience. As Hasson describes in his article, the subjects are positioned in an fMRI machine lying on their backs; after that, digital video and sound is supplied by an LCD projector placed behind the subjects head, which then is viewed via a mirror that is "mounted over their eyes" (3). By positioning the subject in an isolated machine viewing a mirror, the viewing experience differs significantly from a traditional movie house; not only in terms of the aspect ratio and depth of field, but also because of the lacking group dynamics that might materialize at the cinema. As a consequence of these, in my view, valid critiques, mainstream neuroscience-marketing companies such as Neurofocus, EmSense and MindSign, are attempting to produce alternative devices to

be worn on the subject's head in an effort to recreate a more natural spectatorial environment (Randall 2).

But why is the film industry interested in this technology? In a radio interview entitled "The Amygdala goes to Hollywood" with *On the Media*, produced by WNYC, New York's Public Radio station, the head of the neuromarketing company MindSign Philip Carlsen says that the growing interest from the major production companies stems from the desire to know, for instance, what aspects of a film is pleasurable and emotionally engaging, as well as how spectators feel about different characters.¹⁰ Similarly, the economic analyst Robert Marich, and the author of *Marketing to Moviegoers: A Handbook of Strategies and Tactics*, notes that production companies are to an increasing degree trying to assess the spectators' responses through focus groups, positioning studies and test screenings a priori to release (26). But what would the impact be if accessible, and less expensive, fMRI scanners indeed were to be introduced in the foreseeable future?

As mentioned, the prospective impacts of neuroscience within the field of film studies are immense, but likewise, the film industry might change drastically if these technologies were to gain influence. In an interview with the online journal *Fast Company*, Scott Susco, the writer of the financially successful horror-film *The Grudge* (2004), argues that neurocinematics might be the "natural evolution" for the major production companies. In this sense, Susco says that the creative field might become more scientific in the development of both "script and storytelling process". In other words, the major incentives for the production companies to develop neuroscientific testing would, presumably, be economic ones. According to the aforementioned business analyst Robert Marich, the dominant motivating force behind the production companies' strife for a greater insight into the audiences' mind is 'guaranteed' financial return (26). While this paper mainly has focused on the theorists and producers who have embraced neuroscience, one must note that this technology is met by both astonishment and concern. In a panel discussion at the Deutsche Guggenheim in Berlin, December 2010, organized by the Association for Neuroaesthetics, the famous Israeli filmmaker Amos Gitai displayed skepticism toward Hasson's notion of neurocinematics. In Gitai's view, the artistic aspect of filmmaking might get lost if neurotechnology became easily accessible for production

¹⁰ To access the interview, see <http://www.onthemediamedia.org/2009/oct/02/the-amygdala-goes-hollywood/>

companies around the world.¹¹ In this sense, critics fear that the instinctive, creative aspect of filmmaking might be under threat.

As I have shown, film studies, as well the film industry, strive for quantitative data and hard empirical evidence for each of their respective means. While Hitchcock has been notoriously famous for his ability to manipulate the spectators' minds, there has yet never been any actual way of visualizing the neurological and physical reaction to these films. In this sense, neuroscientific techniques could, prospectively, provide film studies with a methodological synthesis of the natural and the social sciences. Moreover, neuromarketing companies are attempting to cater to the film industries demands for a more natural spectatorial environment. At the same time as neuromarketing is beginning to influence the major production companies, critics are becoming increasingly weary about the prospective implications for both film as an art form and film as a trade. Because of the prospective impacts of neuroscientific techniques, I would argue that neuroscience, in a sense, complicates contemporary film studies.

Complementing Film Studies: Providing Hypotheses

As I have shown, the prospective impacts of neuroscience are believed to be vast. Despite this, the prospective impact remains largely under-theorized. By analyzing neuroscience's effect on film studies and the film industry, I believe that a greater knowledge of neuroscience's relation to film studies is gained. Moreover, by assessing how critics, marketers and researchers are discussing the hypothetical future, this paper highlights in what manner neuroscience is emerging as a field of discourse. I believe that both Hasson's effort to combine neuroscience and cinema, as well as the neuroscience-marketing companies strive to gain influence within the film industry, pinpoint one important aspect which film studies necessarily needs to address: film studies needs to actively complement neuroscience and offer thought-provoking hypotheses, supported by systematic pattern-oriented research, utilizing film studies unique knowledge and expertise. Accordingly, film studies needs to cooperate with neuroscientists in order to test these different hypotheses, while at the same time offering a consideration of the ethical and cultural impacts of the results.

¹¹ For a presentation of the panel, see <http://aoneuroesthetics.squarespace.com/archive/amos-gitai-uri-hasson-umlwhen-cinema-meets.html>

The crucial, overarching question then becomes in what specific manner film studies could complement neuroscience, and vice versa?

As mentioned, one of the ways in which film studies can complement neuroscience is through the formulation of thought-provoking hypotheses for testing through, for instance, fMRI technology. Given the wide array of influences that permeates film studies, the formulation of hypotheses depends to a high level on the research interest of the individual scholar. From my own point-of-view, I believe neuroscience could prove valuable in the investigation of the multimodal aspects of film as a tool of communication. The combination of different modalities—such as moving images, sound, music and language—forms the film medium as such a tool. The question which vexes scholars within this field of discourse is how these different modes affect each other, but also more centrally how the different modes affect the communication of different meanings. According to the research group “Adventures in Multimodality” at the University of Amsterdam, studies into multimodality highlights research that can be “(dis)confirmed, refined, improved on and, where appropriate, experimentally tested”.¹² In my view, the neuroscientific approach fits well with this line of discourse because of its emphasis on systematic analysis and experimental testing. But how, concretely, could a neuroscientific methodology be employed in order to aid our understanding of film as a multimodal tool of communication?

An intriguing sample hypothesis central to multimodal discourse, I would suggest, could be whether film music influences how strongly one engages with specific characters. The relation between the different modes sound and moving pictures long remained an understudied field but has gained increasing interest during the past decades; for instance, film theorist Rick Altman has published extensively on the subject.¹³ In “Film Music Influences How Viewers Relate to Movie Characters”, an article describing a recent study from 2011 at the University of Chicago, Berthold Hoechner et al examine the aesthetic and narrative power of music within film. In the test, a number of participants were shown film clips showcasing characters’ “neutral or ambiguous reaction” (146). Subsequently, the participants detailed the likeability of the characters. This, in turn, was revised when sound such as ‘thriller music’, ‘melodrama music’ and ‘no music’. While this study indeed offers a result which can

¹² For further reading on Adventures in Multimodality, see <http://muldisc.wordpress.com/>

¹³ See for instance, Rick, Altman. *Sound Theory, Sound Practice*. New York: Routledge, 1992.

be (dis)confirmed, refined and experimentally tested—showing that film music does affect character likeability—it simultaneously suffers from a lacking ability to pinpoint the participant’s immediate reactions. Instead, the study focuses on participants recalling their emotions and conducting so-called “emotional attribution” (148). While this test utilizes experimental testing and shows how musical schemas influence our understanding of characters, it is intriguing to consider how this experiment could have been conducted utilizing neuroscientific method.

To exemplify how such a method could be utilized, I will attempt to describe how this hypothesis could be tested. In accordance with the aforementioned experiment, the working hypothesis considers that sound mode, in the form of ‘thriller music’, ‘melodrama music’ and ‘no music’, contributes to the meaning the participants derive from certain film clips. While film scholars convincingly have studied the structures and patterns pertaining to the way music is used in film, little emphasis has been put on quantitative data and empirical evidence supporting these claims. By analyzing the neural activity and how different brain regions are stimulated with or without music, neuroscience might show how participants directly experience film as a tool of communication. By analyzing which exact brain regions are stimulated—from the amygdala to the premotor cortex—a neuroscientific method could add another layer of meaning to our understanding of how different modes affect the communication of meaning. In this sense, the hypothesis that a specific mode, such as sound, influences our understanding of another mode, moving pictures, could be validated or invalidated through neuroscientific testing.

Conclusion

In this paper, I have addressed the growing neuroscientific influence in an attempt to assess why neuroscience is becoming influential and what the impact could be for the future of film studies. As I have shown, neuroscientific research seems to influence film scholars with various different backgrounds. In this sense, the neuroscientific influence affects and changes the border of the different paradigms within the field of film studies. Meanwhile, neuroscience offers film studies a testing ground where quantitative data and empirical evidence might assist our understanding of the film medium. However, the technological advancements within neuroscience do not only impact film studies, but the greatest complication takes place within the film

production line where neuroscience marketing is becoming increasingly prominent. Today, production companies employ various innovative techniques in order to assess the audiences' response to fictional film—for instance through questionnaires, focus groups, and prescreenings. In this neuroscientific line of discourse, neuromarketers are in a direct sense offering insight into the minds of the consumers. In my view, these two aspects answer the question *why* film scholars are interested in neuroscience. But I have also addressed the prospective *impact* of neuroscientific influence for the field of film studies. In my view, the question whether a specific mode, such as sound, influences our understanding of another mode, moving pictures, constitutes one possible hypothesis that could be validated or invalidated through neuroscientific testing. At the same time, it is important to note that while this merely constitutes one hypothesis, there are of course numerous others; these hypotheses might concern crucial cinematic concepts such as narrative construction, aesthetic techniques and star actors' iconicity.

So where do we go from here? To discuss this sort of issue, I believe, naturally evokes more questions than it answers. In this sense, I have not been able to address all of the countless important issues pertaining to neuroscience's influence on film studies. At the same time, I believe that this paper succinctly offers an overview of the current debate regarding neuroscience and film studies, while critically considering some of the pitfalls that forthcoming scholars, producers and scientists might face. Seeing how this essay is limited in its scope, further work needs to be done in order to proficiently scrutinize neuroscientific methodologies, concepts and aims in relation to film studies.

To summarize, in this essay I have analyzed neuroscience's influence on contemporary film studies. In doing so, I have made a number of observations: firstly, neuroscience changes film studies by influencing scholars across paradigms; secondly, recent technological advancements within neuroscience complicates our notion of film studies and film production by offering quantitative data and empirical evidence of how the human mind responds to fiction film; thirdly, film studies could possibly complement neuroscience by offering hypotheses for validation or invalidation, thus utilizing film studies expertise and knowledge while simultaneously employing neuroscientific methods.

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