Chapter 2

Narrative Empathy

2.0 Introduction – Defining a Narrative

Though ‘story’ and ‘narrative’ have been used interchangeably, a narrative is a structure of events while story is sequence of events. In Indian language the word ‘
Katha’ (Hindi and Sanskrit language) which translates to story is used synonymously for narrative too. A narrative format of presenting an event is not restricted to fictional works but to news article reporting real events to make it more engaging, though the reader/viewer takes cognizance of the factual information in the later. Fictional narratives are about characters derived from the imagination of the writer, with or without resemblance to real-world people and the reader’s/viewer’s interaction with the world created by the writer. Fictional narratives usually have an ending, while nonfiction narratives like news articles including economic, historical or political events do not necessarily have a closure.

Narratives play a role in every culture as an important form of communication of values, religious messages or purely as entertainment. Cultural narratives like folklore or religious texts influence reasoning as explicit and implicit messages (moral values, conflict reasoning, social interactions or philosophy of life) educed by the reader/listener seep into long term memories especially when exposed early in life. By far the largest poetic narrative or ‘katha’ in Indian culture has been the ‘Mahabharata’, which is a compilation of many stories with a common thread. This longest poem in the world is an epic narrative that has influenced the Hindu way of social and political life. Each katha in the narrative sets a time-space reference frame introducing characters, conditions and the causal relations between them. The complexity of powerful feelings and the subjectivisms as evoked by this epic story is an interesting research study.
Interestingly, the idea of emotions from literature comes from Indian poets, Anandavardhana (8th century) who wrote about ‘dhvani’ or the concept of being in resonance or same ‘wavelength’ with the poet to fully understand it. Another great poet and scholar of the 9th century who wrote on ‘rasa’ was Abhinavagupta. Both distinguished the everyday emotions called ‘bhavas’ and literary emotions called ‘rasas’, the latter said to be experienced with memories of past lives while it is not possible to decipher ‘bhavas’ as it could be clouded by ego. Detailed insights into the works of these two poets are provided by Ingalls et al., (1990).

In short, narratives are persuasive immersive experiences enabling role-taking, emotional transportation into the plot, sympathizing with the characters, bringing in external knowledge to analyze the events and importantly draw out emotions. Summarizing the theories on narratives and emotion published in the 21st century, Mar et al., (2011) suggests that selection of reading literature depends on the current emotional state of the reader and hence could also influence the emotional experience during and post reading. Five possible types of emotions reader experiences have been proposed (Oatley, 1994;2009; Mar et al., 2011), which are 1) emotions of sympathy, 2) emotions of identification, 3) emotions of empathy, 4) relived emotions (from past experiences) and 5) remembered emotions. Other studies have looked at emotion and action in narrative imagery (Sabatinelli et al., 2006), reading (Yarkoni et al., 2008) and stories in children (Brink et al., 2011). Bal and Veltkamp (2013), found the long-term effects on empathy from fiction reading on subjects with higher transportation (immersion ability into another world) experience. People who read fiction had higher scores in an empathy task compared to expressions of loneliness and negativity in non-fiction readers (Mar et al.,2009).
Keen (2007; 2013) defines narrative empathy as a spontaneous vicarious sharing of feeling and perspective-taking evoked by external sensory inputs or by purely imagining another’s situation. Green and Brock (2000;2004a,b) proposed the Transportation theory aimed for entertainment-education, in which the following processes are possible - an immersion that makes the readers/viewers forget the real-world concerns hence reduces their ability to formulate counter-arguments and second, the immersion simulates direct experiences. The more complex empathy response to narrative requires that the viewer follows the beliefs and thoughts of the characters and allows the experience to influence emotions comparable to that depicted by character or as appropriate to the context.

2.1 Empathy/emotion to Cinematic Narratives

Like the emotional experiences evoked from literature reading as described in the preceding section, cinematic narrative response is triggered by the bottom-up process from the multi-modal sensory inputs (visual, auditory) and the top-down process of individual viewer’s perceptions. While reading requires imagination to construct mental models of the described situations including that of facial /body expressions as described by the writer, in visual narratives explicit presentation of the events and characters translate to lower load on the ‘imagination’ process. That is, in cinematic narrative the viewer is expected to just follows the beliefs, thoughts and actions of the characters as created by the movie creator resulting in a ‘bonding’ between the viewer and the fictional character. The short duration relationship the viewer builds with the character(s) can be a state where he/she understands the feelings expressed by the actor and can extend to reciprocating the feelings, both evaluations considered to be basis for empathy (Decety and Jackson, 2004).

Though the movie is a time-bound task, watching a movie can be an extremely emotional experience with the potential to evoke long-lasting influence. The movie
plot takes one through a gamut of emotions from happiness, anger and anxiousness not just from the events depicted but also from correlation to real-life experiences. The influence of movies on viewers is acknowledged by movie-industry and hence scripts are designed carefully with high empathy quotient. The emotional appeal is created by context, depiction and narrative, which is the building block for movies with the emotional contagion drawn from the socio-cultural environment in which the story is set. For example, the actors in an Italian movie might show more overt facial expressions than actors in a Japanese movie. Similarly, Indian movies are rich in exploiting the ‘bhava’ or sentiment factor with an intention to create ‘rasa’ or emotion in the viewer (rasa is usually identified as the emotional response to the depicted or conveyed bhava). Further rasa does not exactly identify as empathy but is only said to be a one of the many types of empathic emotion (Hogan, 2008). The segmentation arises as viewer can distinguish those actions on the screen or stage does not require him/her to respond (self-other distinction) or have real-life consequences.

Hence the term empathy in the cognitive film theory refers to a range of phenomena - as a conscious endeavor for perspective-taking or in other words ‘putting oneself in another’s shoes’ to affective mimicry and emotional contagion where emotions are captured and mimicked involuntary (Smith, 2011). Smith (2011) elaborates that the process of imagining how the other thinks or feels does mean an empathic resonance and calls this ‘other-focused personal imagining’, which he says allows the viewer/reader to comprehend the emotional frame of mind of the other. It has been debated whether emotional contagion which is self-directed (‘experience the same feelings’) and typically considered non-cognitive can be empathy, but considering the broader definition of empathy as covered in Chapter 1, the affective process is critical to empathy in the holistic approach to this complex construct when applied to movie narratives given the said influence this medium has on social behavior.
Considering the complexity of relation with a fictional event or actor, the debate is on whether movies have the power to influence human behavior or whether movies just present an exaggerated version of human behavior and hence this medium is purely of entertainment value. This leads to a premise that viewer’s empathy responses are restricted to events shown on a screen and hence cannot be equated to real life social interactions and perception. While this could turn out to be true, it is not a stretch to suggest that movies have considerable influence on social perceptions. For example, a movie story inspired from a historical event, can by way of clever screen play and narrative skill teach us to empathize with the events that happened long ago while simultaneously effecting our outlook on current situations. A point of contention is reports of ‘viewers losing self-awareness and fusing their egos with that of the character” (D’Aloia, 2015; Raz and Hendler, 2014) and whether this could also be empathy. A parallel proposal (Hanich, 2010) from the phenomenological (‘a philosophical method of describing and reflecting on the experience of phenomena as they present themselves to consciousness’), theory of cinematic empathy includes sensation (replication involuntary of similar sensation as that experienced by the character on the screen), motor (muscular changes as per the action on the screen) and affective mimicry.

Keen (2013) extends the experience of cinematic narratives by suggesting that empathy is not only for characters and their actions but for inanimate objects in the film. Supporting this proposition, the phenomenological film theory adds that by manipulating the aesthetic style and the method of narration, empathy can be evoked not just for the characters but also non-living objects. Thus, from the definitions and the probable responses, it can be safely inferred that cinematic empathy can trigger both cognitive and affective empathy response mechanisms, even if the viewer is aware of the fictional nature of the events and characters. Hence, cinematic narratives are interesting stimuli to study, in terms of its
multimodality and the wide perceptive differences in viewers. Psychology or behavioral experimental research has exposed the complexity of such data and cognitive neuroscience is being applied to decipher the basis for the complexity.

2.2 Neuroscience of narrative empathy

From the definition for narrative and cinematic empathy, it is realized that empathy response is complex top-down and bottom-up processes including imagination, perspective taking (including past experiences), sub process of empathy (sympathy, personal distress, emotional contagion) and motor mimicry to name a few. Hence a cognitive empathy process that includes perspective-taking/ ToM, an emotional empathy process comprising of the sub-process of empathy like sympathy, emotional concern, personal distress and a motor empathy process from mimicry/mirroring of the affective state of the target should be examined as correlated responses. Considering this complexity, the neuroscience of narrative empathy is still in its nascent stages with more questions than answers. To form a more comprehensive picture of the brain responses to individual processes or the probable brain networks, findings from a few relevant studies are presented.

Initial studies using dynamic complex stimulus like movies have helped identify brain networks that process individual features embedded in a scene or of an entire event. Hasson, et al. (2004) report significant inter-subject correlation (ISC) in brain activity when viewing clips from the movie ‘Good, Bad & Ugly’ and found correlations in the temporal and fusiform area. Bartels, et al, (2004a,b) had participants view a 22 minute clip from a James Bond movie “Tomorrow Never Dies” and identified functionally specialized areas that process faces, language and color. Han et al. (2005) studied differences in brain activation to movie clips with cartoon human-like/non-human-like characters and real-actor movie clips. They report differences in motion perception for real-actor and human-like cartoon characters specific to the medial prefrontal cortex (mPFC) and cerebellum. A
study by Mar et al. (2007) comparing the ability to perceive intentions from movements as performed by a similar cartoon versus real human characters report higher responses in the areas associated with mentalizing – the mPFC, the superior temporal sulcus and the temporo-parietal junction – to be greater for the real actors compared to the computer-generated actor. Other studies which have used text or static cartoon narratives (Sabatinelli et al., 2006; Chow et al., 2015; Brink et al., 2011; Altman et al., 2012; Schnell et al., 2010) report activations in the emotional empathy networks with anterior insula and cognitive empathy networks of mPFC.

To understand the influence of past experience and knowledge about the world on understanding of a story, Chow et al, (2015), used 18 stories (written by the authors of the paper), three paragraphs long each confirming to the typical story format. Manipulations to include description of scenes – to set the perception condition and bodily actions – for action condition, emotional charged events (emotion condition) and factual description (control condition) were introduced in the paragraphs. Functional connectivity analysis was conducted to understand the interaction between the lower and higher-level visual and motor areas while comprehending a story rich with perceptual and motor details. The left anterior parietal area and left dorsal premotor area was significantly modulated by the participants’ experience with the narrated situation. The researchers of the study conclude that interactions between higher-lower level visual and motor processing systems are strongly modulated by personal experience and this in turn influences narrative comprehension.

Narrative imagery, that is, the ability to imagine themselves in situations is fundamental to any narrative engagement. To investigate this, Sabatinelli et al., 2006, provided subjects brief narrative scripts over headphones, and asked them to imagine themselves engaged in the described events. The scripts consisted of 12 exemplars of pleasant scene contents, 6 of neutral scene contents, and 12 of
unpleasant scene contents. The audio narratives of 12 seconds each was followed by 12 second duration where the subjects were instructed to ‘imagine’. The brain areas of interest for each condition were identified and comparative analysis conducted. During the listening phase, the auditory cortex, retrosplenium and the left medial frontal gyrus were significant. For the imagery phase the supplementary motor area, left inferior frontal gyrus and right lateral cerebellum were identified. They conclude that scripts with higher emotional contagion (negative or positive) show enhanced signal change relative to neutral scripts.

Using empathy rated cartoons and verbally presented stories, fMRI data was collected to examine developmental changes of preschool and school children by Brink et al (2011). They found that affective and cognitive empathy is associated with medial and bilateral orbitofrontal cortex activation. Older children showed higher affective empathy by increased activation in the medial orbito-frontal cortex, left inferior frontal gyrus and left dorso-lateral prefrontal cortex. The brain activations in these areas were also found to be greater for the non-verbal cartoon stimuli from which they conclude that it has greater empathy response.

Using a set of 80 short emotional and 40 neutral text narratives, Altman et al., (2012) investigated the change from cognitive to affective process in reading of the short emotional narratives. They were specifically interested in identifying the neural substrates active when participants liked negatively valanced narratives. Using a block design, as the stimuli duration was very short, they compared the brain activation for neutral versus unpleasant stories and the data revealed a stronger engagement of affective ToM-related brain areas with increasingly negative story valence. Unpleasant stories engaged the medial prefrontal cortex(mPFC), which the authors suggest might reflect the moral exploration of the story content. As mPFC becomes more engaged for the negatively valanced
stories, co-activation in brain areas related to affective ToM and empathy also increased.

Mentalizing and/or ToM is a critical mechanism involves the process of cognitive inferencing that one engages to decipher another person’s affective state (Frith and Frith, 2006). In an interesting experiment using 32 false-belief cartoons of 3 pictures, Schnell et al. (2010) conducted an fMRI study to explore the neural foundation of cognitive empathy and contrast with cognitive inference on non-affective (that is, no direct visual cues depicting explicitly the affective state) visuospatial representation of another person. The participants were asked to judge the affective or visuospatial changes with respect to their own perspective or that of the protagonists. Applying the General Linear Method (GLM), the contrast of the two perspectives were estimated. The evidence presented is the existence of a neural correlate of cognitive empathy disassociated from mentalizing of visuospatial content by the higher and simultaneous activation in the anterior mentalizing network comprising of the dorsomedial prefrontal cortex, anterior superior temporal sulcus, temporal pole and ventromedial prefrontal cortex and the limbic regions of amygdala and hippocampus. The important inference made by them is that cognitive empathy also involves references to internal affective states. Further their study showed that the higher mentalizing network for 1st person judgments about affective states compared to visuospatial content indicates that this system activates for social perception without taking the 3rd person perspective.

Pehrs et al. (2015), used 60 empathy evoking close-up shots of actors depicting sad or neutral expressions supported by information on the state via text and music. Their special focus was to investigate the role of temporal pole as semantic hub of complex social cues and from the results state that this area acts as an integrator of multi-sensory information to facilitate meaningful interpretations. In a recently
published study, Nguyen et al., (2016) investigated the brain areas relevant for interoception by having participants listen to an emotionally salient audio narrative. The fMRI data and the heart rate measured were found to be synchronized across the participants. The connectivity analysis revealed that anterior insula active for emotionally salient moments served as integration hub to the posterior insula where the interoceptive states were represented.

The neural base of amusement and sadness response using nine 2-minute movie clips or TV serials clips set in a block design was experimented by Goldin et al.(2005). Using contrast analysis of fMRI data from the sad/amusing presentations followed by subject-specific regression analysis with continuous rating for the clips, they found that for sad films activations in medial prefrontal cortex, inferior frontal gyrus, superior temporal gyrus, precuneus, lingual gyrus, amygdala, and thalamus were observed. Whereas for amusing films, the subject specific regression analysis demonstrated significant activations in medial-inferior frontal gyrus, dorso-lateral prefrontal gyrus, posterior cingulate, temporal lobes, hippocampus, thalamus and caudate.

Studies which have specifically examined empathy using naturalistic stimuli like movies (Nummenmaa et al., 2012) required the viewer to make inferences. Two research groups ( Nummenmaa et al., 2012 and Raz et al., 2012) focused on empathy specifically, Nummenmaa et al., (2012) conducted experiments using very short movie clips with emotional scenes with minimal narrative and do not explore explicitly the role of narrative or context on empathy response. Raz et al., (2012) used video excerpts of longer duration (~10 minutes) from commercial movies and explored the dynamics between the affective empathy and the top-down cognitive/ToM empathy. To look at the dynamic changes in the emotion specific brain areas as a function of the events in two long emotional movie clips (10 minutes from Sophie’s Choice and 8:27minute sequence from Stepmon, both
commercial Hollywood movies), Raz et al., (2012; 2014) analyzed EEG and fMRI data collected independently. Marking regions of interest, network based functional connectivity analysis was committed and regressed with the continuous rating collected from the participants. The data analysed from both the techniques revealed that the dynamics of the limbic network was associated with rated sadness intensity level. For the movies, significantly higher correlation between limbic-medial prefrontal cortex in the connectivity indicates that sadness involves regulated processes of mentalization and introspection. The correlation of the rating data with limbic lobe showed high cohesion for *Stepmom*, from which they suggest that different dynamics of emotional regulation could have been applied by the viewers. The concept of direct correlation between the behavioral data (rating) to neural activations is very challenging and only limited inferences can be drawn from the analysis.

Nummenmaa et al., (2012) explored the brain networks when explicitly sharing other’s emotional state to facilitate better understanding of intentions and actions. They used 13 segments of 30-132 seconds clips from Hollywood films (*When Harry Met Sally* and *The Godfather*), depicting the actors experiencing strong positive or negative emotions or when in neutral state. Major findings were, negative valence was associated with increased Inter-subject correlation in the emotion-processing network comprising the thalamus, ventral striatum, insula and also the default-mode network areas of precuneus, temporo-parietal junction, medial prefrontal cortex, posterior superior temporal sulcus. Seed-voxel correlation analysis confirmed that these sets of regions constitute dissociable functional networks.

To summarize, the neural correlates for empathy from the various studies and the meta-analysis can be classified as follows:

Emotional or affective empathy (incl motor empathy) : anterior/posterior insula , bilateral dorso-medial prefrontal cortex, supplementary motor area (SMA),
premotor areas (the mirror-neuron network noted by Rizzolatti et al., 2001, Gazzola et al., 2007), rostral anterior cingulated cortex (rACC), anterior midcingulate cortex, posterior cingulated cortex, anterior insula (AI), inferior frontal gyrus, midbrain, and temporo-parietal junction, as well as the left anterior thalamus further, the middle temporal gyrus, posterior superior temporal sulcus, posterior thalamus, hippocampus, and pallidum on the right. (meta-analysis: Fan et al. 2011, Bzdok et al., 2013).

Cognitive/ ToM: Mid-cingulate cortex, bilateral ventro-medial prefrontal cortex, dorso-medial prefrontal cortex, precuneus, temporo-parietal junction, middle temporal gyrus, posterior superior temporal sulcus, inferior frontal gyrus, as well as the right middle temporal/V5. (meta-analysis: Schurz et al., 2014, Fan et al., 2011, Bzdok et al., 2013).

2.3 Summary

Empathy related studies using pain as stimulus (reviewed in Chapter 1) and from studies using texts, cartoons, short video and one study with longer movie clips suggest the existence of three distinct empathy networks (cognitive and emotional), but overlapping activations as a function of the stimuli and task. The networks are:

a) cognitive empathy: which includes processes like mentalizing or the more abstract ‘theory of mind’, with sub-processes like perspective taking, appraisal and forming mental models from past experience,

b) emotional or affective empathy: where a number of sub-process like sympathy, emotional contagion, concern, personal distress, compassion are dissociable from the emotional resonance of the other’s affective state and

c) motor empathy is the motor mimicry of the actions or expressions as perceived from the actions of the other. At the neurophysiological level, the various studies have identified distinct networks and areas for each empathy mode, while also suggesting that the stimuli/context can trigger more than one of the networks simultaneously.
2.4 Motivation for the Proposed Experiments

Though cinema narratives are perceived to be ‘unreal’ by viewers, empathy response using cinema narratives could help understand other-oriented processes such as moral judgment and position taking leading to altruistic behavior in real-life, as the medium of cinema can project different scenarios and human response in each can be analyzed. In other words, understanding our brain in the cinema helps in figuring how we empathize with other’s emotions, actions and psychological states by observation. Notwithstanding the ‘paradox of fiction’, (Colin Radford, 1975) cinema can evoke cognitive perspective taking based on the visual/auditory sensory input and adequately supported by imagination while affective state is induced by the *theory of transportation*. Hence, the theoretical and the neurological studies of empathy using movies as stimuli allows for formulating and testing dynamic models to examine social interactions in diverse conditions.

In the experimental work reported in this thesis, we aim to answer the fundamental but complex questions: a) How does empathy neural networks evolve as a function of the narrative? b) Do empathy studies have higher ecological validity if the stimulus allows the viewer/reader to get all the contextual information required to understand the reason for the affective state of the other? That is, can a stimulus that explicitly presents the reason for the affective state of the other provide a deeper insight into the complex neural correlates, compared to activations for stimuli with little/no context. There has been no study conducted to date to address the second question. The findings from such a study will have large implications in the way empathy paradigms have been designed and on studies which have looked at empathy deficiency or efficacy of narratives/stories based intervention for empathy development.
2.5 The challenges of movie as stimuli to study empathy response

As can be inferred from the analysis of empathy research and the proposed models of the various schools of thought, there are many definitions for empathy and it is a challenge to ascertain which one defines the complex feelings one experiences in response to the affective state of the other. An account of empathy as defined by studies looking at pain infliction, moral judgment or altruism is limited when applied to the myriad combinations of experiences when one is viewing a movie or reading a story. For example, in a movie the sequence of events that lead to a young boy being dropped by parents in a boarding school, could evoke a sense of empathy and sympathy in a young viewer and anger plus empathy at the parents (even on own parents by experience of similar state as the protagonist). Adults and especially parents might feel negative emotion momentarily but analyze the cause and consequences of the action by the screen parents. Grandparents would feel empathic anger at the parents and society at large for putting a young child through a possible trauma. A complex combination of responses arises as they are influenced by the value system held by the self and as perceived from the state of the other (even if characters are fictional). Hence narrative empathy is much more complex as it also includes the paradox of fiction (Colin Radford, a reply to critics article in 1975), as emotional response to fictional events is irrational though familiar. The almost irrational state for fictional experiences, was further explained by Radford with two considerations: if the viewer/reader is convinced of the unreality, then the emotions that one frequently experience is not possible and second, the fact that we do not actually act to help the actor/character in the film/book, implies our awareness of the fictional status even if moved by the state of the actor. The third premise is that fictional characters can move us emotionally with the same intensity as living beings in real-life. The paradox proposed by Radford, of the irrational response has been debated by other film theorist and philosophers, though the reason for both the human response and the source for such a response still alludes researchers. A few theories proposed to explain this
paradox are: a) pretend theory: propounded by Kendall Walton (1978) explains the emotions as ‘quasi-emotions’, evoked due to the ‘make-believedly’ and b) thought theory: where rather than believing the fictionality all one needs to do is "mentally represent" (Peter Lamarque), "entertain in thought" (Noel Carroll), or "imaginatively propose" (Murray Smith) it to ourselves and c) Illusion theory where existence beliefs are generated in the course of engagement with works of fiction. The theories presented are nowhere close to explaining the effect of fiction. The work presented in this thesis is an attempt to address some of the questions by investigating the empathy response to fictional content.

Without getting into the debate of why a viewer/reader is able to feel a gamut of emotions even being aware of the fictionality of the presented stimuli, I list the following possible conditions of engagements, which might weigh the intensity but assures an empathy response:

• I don’t relate to the actors but can to the context.
• I relate to the actor but not to the context.
• I relate both to the actors and the context
• I relate to neither but willing to form a short-term relation.

In light of the above, cognitive empathy is the ability of the reader/viewer to understand the evolving state of the actor(s), place it in perspective with the events, make the self-other distinction constantly, place self in the other’s role even if for short periods, engage in moral judgment or a combination – which in game design language is switching between a ‘god’s perspective’ and a ‘first-person perspective’, all of which is possible if one understands the other’s feeling and internalizes it. Emotional empathy is when the viewer/reader takes on the emotional states of the other.
Hence, an operational definition for narrative empathy considered for this study is: *empathy for a fictional cinema narrative is the sharing or feeling or perspective-taking induced by viewing and comprehending the contextual factors for state of the 'other' by the power of transportation afforded by the cinematic narrative, while being aware of the self-other differentiation.* By this broad definition, an effort to address the individual variations in the empathic 'immersiveness' that one wishes to allow/inhibit as a function of the cinematographic differences in conveyance of the message is attempted.

### 2.6 The hypothesis of this study

A narrative is a method of conveying the reason for the state of the other by threaded events presented in a temporal sequence either in text, verbal or visual format and is an integral part of social communication. Readers or viewers experience a narrative by dissecting the events presented and taking the perspective of the agent(s). The short relationship the viewer builds with the other can be a state where he/she just understands the feelings expressed by the other by comprehending the context (Gallagher, 2012) and can also extend to actually reciprocating the feelings, both evaluations considered to be basis for empathy (Decety and Jackson, 2004).

Fleeting emotional expressions with no specific contextual information can rarely evoke empathy unless one has the experience or the imagination to make knowledgeable inferences. A photograph showing facial expressions depicting pain or that of someone being inflicted pain could evoke disgust or personal distress which is self-oriented than other-oriented, the latter being a fundamental element for empathy. Empathy requires the imagination or information for perspective-taking. That is, in addition to cognitive inference of 'what' the effective state of the other is, empathy response is aided by knowledge of 'why' the other is in a particular state and this defines the understanding required for sharing of the other's feelings.
In our study, the goal was to identify the empathy networks using a diverse set of movies, to look at the fidelity of the identified networks as a function of the narrative, viewer’s emotional and cognitive processes to the events. Our premise for using long narratives is: the context (‘informed’ condition) for the affective state of the other can stimulate basic subprocess like empathic concern (other-oriented response), personal distress (self-oriented) and thus empathy – cognitive, emotional, motor empathy as compared to responses for emotional images with little or no context to inform the reason for the state. From an image or a very short video clip, the viewer could make inferences by imagination or by knowledge constructs, but these are top-down and very subjective. Hence the goal of the second fMRI experiment was to identify and compare specifically empathy networks for 'informed' appraisal to that of ‘inferred’ state of the ‘other’ by comparing fMRI data collected from short movie clips to those from full-length movie. There has been no study which has examined neural correlates of empathy responses to visual narratives like fictional movies.

2.7 Data-analysis, the challenge from naturalistic stimuli

Most fMRI experimental designs use block-models, that is, a short (1s – 30 s) stimulus is presented at some frequency interspersed with no-stimuli baseline condition and comparison of activation during stimulus and baseline time points are undertaken. The short stimuli presentation model is considered robust as noise from subject movement in the scanner and/or magnetic field drift is minimal. To study real-life responses, an ecologically valid stimulus like naturalistic scenes presented for longer duration is required. Advances in fMRI equipment (field strengths of 3-7 Tesla), radio-frequency pulse sequence techniques and analysis methods have made it possible to project multimodal stimuli for longer duration with minimal signal degradation and acquisition of high-resolution functional images. This has opened experimentation with naturalistic stimuli to examine
functional connectivity networks as simultaneous activations of more brain areas are evident than for conventional block stimulus settings (Bartels and Zeki, 2004).

The fMRI data from a free-viewing naturalistic paradigm brings in analysis and interpretation challenges. In the Chapter 3, the basics of magnetic resonance imaging technique and the interpretation of the BOLD change signals will be covered in brief. The major focus relevant to the paradigm selected for the study will be on analyzing the various data analysis methods.