Phenomenological Considerations on Time Consciousness under Neurocinematic Search Light

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Abstract

Film narratives are intrinsically time-dependent designs. This article proposes a model of narrative nowness, based on Husserl's concepts of retention and protention on one hand, and Francisco Varela's neurophenomenological exploration of time consciousness on the other, relating this further to narrative experience and its neural epiphenomena. Only recently has brain research been equipped with the possibility of dealing with temporal frames relevant for time consciousness in the scope of whole narratives. The study of cinema using neuroscientific methods and insights is referred to as *neurocinematics*. We promote neurocinematics as a complementary method of traditional film research, rather than an approach of brain sciences in general. Neurocinematic methods may provide film studies with new tools for re-evaluating established filmmaking conventions and developing new ways to study, for instance, the film viewer's experience and related aspects of time consciousness.

Introduction

The early phenomenologists William James and Edmund Husserl regularly applied scientific findings to support their phenomenological reflections. Particularly, psychology and physics provided metaphors and practical models for their philosophical inquiries. In psychology, Hugo Münsterberg was among the first to recognize the strong influence of film narratives on the audience. It was therefore natural for the early film theorists, such as Sergei Eisenstein, to apply the insights of their contemporary natural scientists, psychologists and brain scientists to lay the foundations of the discipline, as we know it today.[1] Against the historical background, it appears unproductive to isolate phenomenologically-

[1] Pia Tikka, *Enactive Cinema: Simulatorium Eisensteinense*, University of Art and Design Publication Series, Helsinki 2008.

oriented film studies from the sciences that reveal stunning insights to the epiphenomena of film experience.

We will base our approach on Francisco Varela's neurophenomenological studies and the broader paradigm referred to as the embodied mind approach.[2] In our article, the gradually accumulated scientific understanding of intersubjectively shared human experiences is extrapolated to the study of cinema narratives and the related viewer experiences. In the following article, we discuss the state-of-art in neurocinematics that has obvious benefits to the understanding of film experience, and propose a model of time consciousness that bridges phenomenology of narrative experience with empirical brain studies.

State-of-art in neurocinematics

The study of cinema using neuroscientific methods and insights is referred to as *neurocinematics.* The term was coined by the neuroscientist Uri Hasson and his team in an article targeted to the cognitive film research journal *Projections*.[3] However, today neuroscientists in general have to a great extent abandoned the term. For instance, Hasson has stated that his interest to use films focuses *not* on studying films, but on the human brain functions; for instance, memory encoding and retrieval.[4] His team has recently focused on questions regarding different scales of neural temporality, which Varela also discussed in his article *Specious Present* in the 1990s.[5] In relation to the topic of the present article, neuroscientific studies into temporal windows in the brain provide neurocinematic studies with highly valuable knowledge, in particular about how film viewers' holistic experience of filmic time might emerge from neural dynamics.

Neurophysiology intertwines with the social and cultural in an inseparable manner. In line with this argument by the embodied mind approach, neurocinematic research assumes that the viewers experience external phenomena in a relatively similar manner. The relativity claim does not reject idiosyncratic private experiences as such. However, it assumes the similarity of that experience – due to the biological and cultural evolution of humankind under certain particular environmental constraints – is far more extended than people in

[2] Francisco J. Varela, Evan Thompson, Eleanor Rosch, *Embodied mind: Cognitive science and human experience*, MIT Press, Cambridge (MA) 1991; Francisco J. Varela, "Neurophenomenology. A methodological remedy for the hard problem," in *Journal of Consciousness studies*, no. 4, 1996, pp. 330-349; Id., "The Specious Present: A Neurophenomenology of Time Consciousness," in Jean Petitot, Francisco J. Varela, Bernard Pacoud, Jean-Michel Roy (eds.), *Naturalizing Phenomenology: Issues in Contemporary Phenomenology and Cognitive Science*, Stanford University Press, Stanford 1999, pp. 266-329.

[3] Uri Hasson, Ohad Landesman, Barbara Knappmeyer, Ignacio Vallines, Nava Rubin, David J. Heeger, "Neurocinematics: The Neuroscience of Film," in *Projections. The Journal for Movies and Mind*, no. 2, 2008, pp. 1-26.

[4] Uri Hasson, personal communication.

[5] Francisco J. Varela, "The Specious Present: A Neurophenomenology of Time Consciousness," cit.

general are willing to admit. The art of filmmaking and storytelling relies on this intersubjectivity. And so does the art of neurocinematics in its endeavour to bridge the studies of film and the brain.

Only recently has brain research been equipped with the possibility of dealing with temporal frames relevant for time consciousness in the scope of whole narratives, such as full-length films, due to the rapid development of data collection and analysis methods. The use of the free-viewing method, as it is referred to, is increasing.[6] This signals a shift from traditional, more artificial studies, where, for instance, viewing dynamically changing images of faces has been taken as a sufficient experimental condition for studying the neural underpinnings of a range of human social behaviours.

Intersubjectivity

Neuroimaging experiments have revealed that viewer's brains "tick together" when they are viewing the same film.[7] The similarity of brain behaviour between viewers is likely due to the way their attention is trapped, guided, and tricked by the narrative design, which in turn builds on the shared foundations. Filmmaking, after all, relies on the mastery of manipulating the viewer's attention in time. The seminal neuroscientific observation of Hasson and colleagues showed significant intersubjective correlation between the brain responses of viewers of a Hitchcock film, but this did not hold for those watching a random surveillance video footage.[8] A quite reasonable interpretation is that well-designed storytelling engages viewers in predictable ways similar to most individuals, due to the built-in capabilities of the cognition, while a random series of events does not.

In film viewing situations we may assume the *narrative cognition* in play.[9] Based on their previous experience the viewers expect the narrative flow to be structured to guide their attention and anticipation. This may imply that unpredictable narratives require more intensive cognitive labour in terms of continuous updating of expectations than more strictly controlled narratives do. Indeed, in one of our recent neurocinematic studies, a group of individuals watched an

[6] Uri Hasson, Yuval Nir, Ifat Levy, Galit Fuhrmann, Rafael Malach, "Intersubject synchronization of cortical activity during natural vision," in *Science*, no. 303, 2004, pp. 1634-1640; Andreas Bartels, Semir Zeki, "The chronoarchitecture of the human brain – Natural viewing conditions reveal a time-based anatomy of the brain," in *NeuroImage*, no. 1, May 2004, pp. 419-433.

[7] Uri Hasson *et al.*, "Intersubject synchronization of cortical activity during natural vision," cit.; Iiro P. Jääskeläinen, Katri Koskentalo, Marja H. Balk, Taina Autti, Jaakko Kauramäki, Cajus Pomren, Mikko Sams, "Inter-subject synchronization of prefrontal cortex hemodynamic activity during natural viewing," in *Open Neuroimaging Journal*, no. 2, 2008, pp. 14-19.

[8] Uri Hasson *et al.*, "Neurocinematics: The Neuroscience of Film," cit.

[9] With the notion of narrative cognition we particularly refer to the sense-making processes that relate to cinematic structures. See Pia Tikka, *Cinema as externalization of consciousness*, in Robert Pepperell, Michael Punt (eds.), *Screen Consciousness: Mind, Cinema and World*, Rodopi, Amsterdam-New York 2006, pp. 139-162.

experimental silent short film, *At Land* by Maya Deren (1944). As explicitly pointed out by Deren herself, the film has been structured by other cinematic decisions, deliberately ignoring the story.[10] When we compared the intersubjective brain behaviour of the viewers with that of another group of viewers, who had watched a story-driven drama in similar conditions, we could detect differences between the groups.[11] Our preliminary interpretation assumes that *At Land* elicits stronger functional connections at the anterior parts of the brain that are associated with the management of higher cognitive tasks, such as decision making, evaluation of the consequences of the main characters actions, or grasping the "bigger picture," in contrast to the more consistent sensory-related posterior functional connectivity observed with the story-driven films.[12]

Annotation of film content

Annotation of content is the prerequisite of interpreting brain activity against cinematic content.[13] So far, it has been applied to mark up intersubjectively shareable situations, for instance, faces of other people or landscapes,[14] global or local movement,[15] and social vs. non-social actions.[16] Several overlapping methods are already in use, such as a) automated analysis methods: image, sound, and language analysis; b) subjective analysis methods: questionnaires, online annotation tools, and self-rating tools are used for collecting information of each viewer's subjective experiences; c) crowdsourcing methods: an online community including a large group of people may be invited to annotate narrative content (e.g., Mechanical Turk); d) expert annotation methods: discourse analysis methods; expert content analysis by dramaturgists, psychologists, social scientists.

[10] Maya Deren, *An Anagram of Ideas on Art, Form and Film*, Yonkers, The Alicat Book Shop Press, New York 1946, re-print in Bill Nichols (ed.), *Maya Deren and the American Avant-Garde*, University of California Press, London 2001, pp. 267-322.
[11] Janne Kauttonen, Yevhen Hlushchuk, Pia Tikka (unpublished data). Films are *At Land* by Maya Deren, USA, 1944, *Heartbeats* by Saara Cantell, Finland, 2009, and *The Match Factory Girl* by Aki Kaurismäki, Finland, 1990.
[12] Pia Tikka, Mauri Kaipainen, *Screendance as enactment in Maya Deren's* At Land*: Enactive, embodied, and neurocinematic considerations*, in Douglas Rosenberg (ed.), *The Oxford Handbook of Screendance Studies*, Oxford University Press (in press).
[13] Jelena Rosic, Pia Tikka, "Annotation of film content for a neurocinematic analysis: Implications for embodied approaches to filmmaking," an oral presentation at SCSMI2013, Society for Cognitive Studies of the Moving Image 2013 Conference, Berlin, 12 June 2013.
[14] Sanna Malinen, Yevhen Hlushchuk, Riitta Hari, "Towards natural stimulation in fMRI: issues of data analysis," in *Neuroimage*, no. 35, 2007, pp. 131-139.
[15] Andreas Bartels, Semir Zeki, Logothetis Nikos K., "Natural vision reveals regional specialization to local motion and to contrast-invariant, global flow in the human brain", in *Cereb Cortex*, no. 3, 2008, pp. 705-717.
[16] Juha Lahnakoski, Juha Salmi, Iiro P. Jääskeläinen, Jouko Lampinen, Enrico Glerean, Pia Tikka, Mikko Sams, "Stimulus-Related Independent Component and Voxel-Wise Analysis of Human Brain Activity during Free Viewing of a Feature Film," in *PLoS ONE* 7, 2012, e35215.

Annotation in itself is a broad field of methodological development that falls outside of the present topic. For the present discussion it suffices to assume that every meaningful event in the film is marked up with annotations that can be used to match the measured brain activity to it. However, the match of low-level content annotation with brain responses may not be sufficient in the long run as the focus of interest moves to the higher levels of cognitive functions.[17] To put it in another way, our point here is that annotation is not enough to describe the viewer's consciousness of the narrative time, and another layer of representing the narrative is needed to relate it to the neurocinematic data.

Time and narration in neurocinematics

The Russian film theorist Lev Kuleshov's famous montage experiment showed that a neutral face combined with images loaded with varying emotional context (a bowl of soup, a child's coffin, a woman) create different interpretations. Indeed, we tend to infer other people's situations based on the available contextual cues and information. In the unfolding of film narrative earlier images predetermine the interpretation of those that follow. Later Eisenstein proposed a more holistic idea by pointing out that sequentiality is not the main principle that defines the interpretation but rather the holistic simultaneity of different narrative elements in the viewer's mind, defined in terms of memory and anticipation. This conceptualization appears very similar to the Husserlian idea of nowness. All previous events condition the experience of nowness and the anticipation of the coming events along the narrative.

So far, naturalistic neuroscientific studies have analysed the relation between film content and brain data within isolated time frames. Yet, this method runs short of relating contextual conditions and the anticipations that filmic events trigger in time scales natural to film viewing, not to mention life itself. In our view, studies that do not take into account the viewer's temporal situatedness with respect to continuous narrative just fall short of meeting the attribute "naturalistic." For example, when in *The Match Factory Girl* by Aki Kaurismäki (1990) the main character Iris (Kati Outinen) rushes into the bathroom to vomit in the middle of her work shift, a current method that focuses on locally synchronized events would ignore the previous events that build the overall context. The interpretation of the corresponding brain data would be based on the assumption that the viewers are feeling disgusted because they are witnessing someone vomiting. However, the more correct interpretation that takes into account the context would be that the viewers feel shocked because they understand that Iris is pregnant with the child of a man that does not love her. This example shows

[17] This critical issue has also been recognized by neuroscientists, e.g., Uri Hasson *et al.*, "Intersubject synchronization of cortical activity during natural vision," cit.; Iiro P. Jääskeläinen *et al.*, "Inter-subject synchronization of prefrontal cortex hemodynamic activity during natural viewing," cit.

why we regard it crucial for neurocinematic interpretations to go beyond the currently applied methods of matching the film and the brain data, and move toward experimental paradigms that address time consciousness in a dynamical way with regard to the full scale of narrative contexts.

In order to gain further understanding of narrative *time consciousness*, we depart from the assumption that temporal and contextual situatedness constitute an intrinsic part of the human cognitive system and is likely to have been built into the neural dynamics in the course of evolution. Neuroscience studies have shown that cognitive segmentation of continuous narratives into meaningful sequences or shorter events appears to be a built-in cognitive mechanism related to intersubjectively shared sense-making.[18] In addition, the recent neuroscientific findings related to *temporal receptive windows* in the brain may guide neurocinematic mapping of the phenomenological, neural, and behavioural nowness into narrative structures on different time scales. Consequently, a hierarchy of cortical areas in terms of distinct temporal dynamics of neural population can be assumed.[19] To comprehend the idea of measured durations of the brain's temporal receptive windows we may consider them, for example, in terms of the spatial receptive fields in the visual cortex. Cortical hierarchy related to varying scales of temporal narrative coherence has been detected, for instance, in a study, where people were engaged in reading the same story content organized as a) "backward story," b) "word scram," c) "sentence scram," d) "paragraph scram," and e) intact "forward story."[20] The more coherent the story, the more extended the intersubjectively shared activation in the listener's brain.

In terms of narrative comprehension, the different temporally characterized functions could be assigned to different anatomical locations in the brain, and the temporal window of neural activity might even correlate with the level of abstraction of related neural representations.[21] Typically, for instance, the visual brain areas are responsive to "lower" level visual features (e.g., detecting line directions, contrasts) in a time scale of milliseconds. In turn, the "higher" level

[18] Jeffrey M. Zacks, Nicole K. Speer, Khena M. Swallow, Corey J. Maley, "The brain's cutting-room floor: segmentation of narrative cinema," in *Frontiers in Human Neuroscience*, no. 4, 2010, pp. 1-15; Jesse Q. Sargent, Jeffrey M. Zacks, David Z. Hambrick, Rose T. Zacks, Christopher A. Kurby, Heather R. Bailey, Michelle L. Eisenberg, Taylor M. Beck, "Event segmentation ability uniquely predicts event memory," in *Cognition*, no. 129, 2013, pp. 241-255.

[19] Uri Hasson, Eunice Yang, Ignacio Vallines, David J. Heeger, Nava Rubin, "Hierarchy of temporal receptive windows in human cortex," in *The Journal of Neuroscience*, no. 10, 5 March 2008, pp. 2539-2550; Jukka-Pekka Kauppi, Iiro P. Jääskeläinen, Mikko Sams, Jussi Tohka, "Inter-Subject Correlation of Brain Hemodynamic Responses During Watching a Movie: Localization in Space and Frequency," in *Frontiers in Neuroinformatics*, no. 4, 9 March 2010.

[20] Yulia Lerner, Christopher J. Honey, Lauren J. Silbert, Uri Hasson, "Topographic mapping of a hierarchy of temporal receptive windows using a narrated story," in *Journal of Neuroscience,* no. 31, 2011, pp. 2906-2915.

[21] Uri Hasson *et al.*, "Hierarchy of temporal receptive windows in human cortex," cit.; Iiro P. Jääskeläinen, Jyrki Ahveninen, Mark L. Andermann, John W. Belliveau, Tommi Raij, and Mikko Sams, "Short-term plasticity as a neural mechanism supporting memory and attentional functions," in *Brain Res*, no. 1422, 22 September 2011, pp. 66-81.

cognitive areas of the frontal lobe associated with, let us say, management of future tasks or evaluation of the moral consequences of film character's actions, may respond to information accumulated over longer temporal intervals up to tens of seconds. The direct implication of these findings is that temporal situatedness is to be conceived of in terms of multiple layers. In the following we propose a preliminary conceptual model of narrative time inspired by Francisco Varela's neurophenomenological approach to time consciousness.

Conceptualizing time consciousness

Varela's neurophenomenological interpretation of Husserl's model on temporality assumes moments of *nowness* embedded in broader temporal contexts in terms of *retention* and *protention* (fig. 1).[22] Retention refers to the temporally backwards-extended present, consisting of a long tail of past events that form a hierarchical system of mutually embedded contextual framings of the experience of the present, i.e. the nowness. From the point of view of psychology and neuropsychology, retention is entertained on multiple levels of gradually decaying memory traces. Protention, in turn, refers to the anticipation of the next moment implied by nowness.

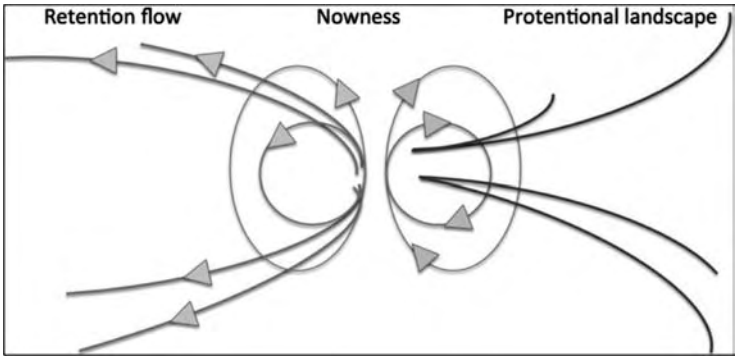

Fig. 1 – The fourfold structure of nowness constituted by retentional flow and protentional landscaping. Time can be seen to flow horizontally from left to right (static constitution) while vertically between the dynamical loops of retention and protention emerges the immanent affective disposition. The image can be seen to describe an experiential moment within the filmic flow. The image adapted from Varela's fourfold structure of nowness in "The Specious Present," p. 303.

[22] Francisco J. Varela, "The Specious Present: A Neurophenomenology of Time Consciousness," cit.; Edmund Husserl, *The Phenomenology of Internal Time Consciousness*, Indiana University Press, Bloomington 1964. Husserl's writings in German language *Zur Phänomenologie des Inneren Zeitbewusstseins* originate from 1893- 1917.

We suggest that a proper dynamic model of narrative nowness should allow mapping of retention (i.e. meaningful context conditions accumulated in time), and protention (i.e. the anticipation of immediate future) against the observed brain activity. Varela points out three aspects that should be considered as being elementarily intertwined in the neurophenomenological study of time consciousness: "(1) the neurobiological basis, (2) the formal descriptive tools mostly derived from nonlinear dynamics, and (3) the nature of lived temporal experience studied under reduction."[23]

In Husserlian terms, the experience of narrative nowness can be described as a kind of *temporal fringe*,[24] in terms of a spatial metaphor, an imaginary viewpoint from the centre to the periphery. The model allows holistic comprehension of nowness as that which simultaneously holds the *just passing past* with the still reachable memory of the gradually distancing past (retention), as well as the anticipation of the *nearest future* in terms of gradually approaching events (protention), all of these dynamically linked by means of feedback loops.

The duration of nowness can be intuitively defined in terms of on-going actions. We relate the notion of *protonarrative*[25] to the phenomenological idea of nowness, as a reference to the briefest possible meaningful event. For example, the moment when someone is rejected by another person exemplifies a socially meaningful protonarrative with a duration of a few seconds. The typical duration of a protonarrative might serve as a preliminary heuristics for the automated segmentation of film content into events, which in turn are necessary pointers to the neural phenomena of nowness. As observed in the brain activations, spectators seem to automatically recognize changes in the situations, for example, when an action or event ends and a new one begins.[26]

Quite obviously, the order of introducing narrative elements constitutes the fundamental aspect of narrative. What happened earlier will define the experience of nowness and by doing this, it will also condition the protention, the anticipation of immediate future events. In the next section, we propose a dynamical model that describes the narrative flow in terms of continuous updates of the retentive contexts.

[23] Francisco J. Varela, "The Specious Present: A Neurophenomenology of Time Consciousness," cit., p. 305.
[24] Edmund Husserl, *The Phenomenology of Internal Time Consciousness*, cit., pp. 27, 41; Francisco J. Varela, "The Specious Present: A Neurophenomenology of Time Consciousness,", cit., p. 278.
[25] The notion of protonarrative was applied in neurocinematic studies by Pia Tikka in 2010; see also Philip Lewin, "The Ethical Self in the Play of Affect and Voice," Conference on After Postmodernism, University of Chicago, 14-16 November 1997, http://www.focusing.org/apm_papers/Lewin.html, last visit 6 April 2014.
[26] Jesse Q. Sargent *et al.*, "Event segmentation ability uniquely predicts event memory," cit.

Narrative nowness model

The narrative nowness model determines to what extent each narrative event is considered meaningful for the experience of nowness for an individual viewer, constituting what can be consequently called the *narrative perspective*, following our conceptualization.[27] The narrative perspective of an individual movie viewer corresponds to their memory and attention varying from moment to moment. The assumed diminishing attention or decaying memory traces of past events can be described mathematically and algorithmically. Another factor is the one of context-refreshing associations induced by the storytelling at each moment of nowness, constituting a feedback loop that regulates the way the retentive memory traces are allowed to influence the interpretation of nowness (fig. 2).

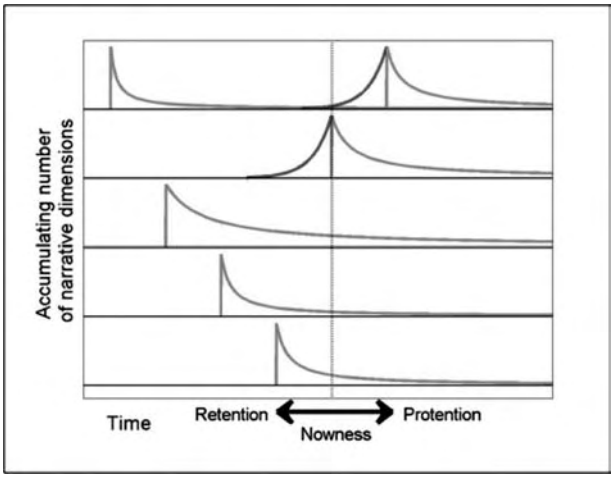

Fig. 2 – Schematic depiction of the evolution of the momentary nowness window and the weights on narrative dimensions that determine the corresponding perspective. The a) sharp peaks curve correspond to introduction of new dimensions through new narrative elements, b) the rising red curves to protentive expectations triggered by other events, while c) slowly decaying curves stand for narrative dimensions that gradually lose their prominence due to shift out from active working memory or attention.

We assume that once introduced, each meaningful event forms a *narrative context* for the following ones. It can be formally described as a narrative coordinate referring to a *dimension* of the narrative space, the value corresponding to its prominence in the experience of the nowness. The dimensions altogether define what can be termed a high-dimensional *narrative ontospace*, with reference to the

[27] Roberto Pugliese, Pia Tikka, Mauri Kaipainen, "Navigating story onto space: Perspective-relative drive and combinatory montage of cinematic content," in Raivo Kelomees, Chris Hales (eds.), *Expanding Practices in Audiovisual Narrative*, Cambridge Scholars Publishing, Newcastel (in press).

ontospace model of Kaipainen and colleagues.[28] The narrative ontospace corresponds to the whole system of potential experiences. An individual experience, in turn, is a *perspective* on that space, modelled as a set of weights, one for each narrative dimension. The coordinate value of a particular narrative dimension can be approximated by some decaying function of the temporal distance from the moment of when the memory was last refreshed.

The experience of nowness, as described above, while being based on the retentive perspective, is dynamically coupled to the protentive function, allowing a tension of anticipating coming events. It is, however, beyond the model to predict what the anticipated events are. It may suffice here to assume that anticipations involve the entire cognitive-perceptual and experiential apparatus, with its evolutionary hard-wired elements, such as emotions, logical inferences, as well as learned and culturally assimilated associations.

The suggested *narrative nowness model* potentially allows computational implementations, which can be calibrated to match measurements of memory and attention. Provided a level of validity with respect to these aspects of psychology, the model should be able to generate predictions for brain responses to cinematic events embedded in their full narrative contexts. This opens up several new avenues for the neurocinematic inquiry. It allows (1) evaluating effects of narrative context-dependency on the brain activity in the continuous movie viewing paradigm, (2) developing annotation methods to describe experience-determining narrative contexts in the scale of entire movies, and further, (3) combining these into a system that allows correlating large neuroimaging data (quantitative) and perspective-weighted annotations of content (qualitative), and (4) addressing issues of shared vs. individual narrative experience in terms of being able to describe and further compare varying perspectives.

Conclusions

We envision that the proposed nowness model, inspired by the phenomenological considerations, will contribute to the analysis of time- and context-dependency of film narratives. The model may also help anchoring the interpretation of the temporally unfolding contextually rich film content to that of viewers' brain data in a meaningful way. This would mean being more faithful to the holistic ways our narrative cognition functions as we experience the complexity of film characters' situatedness in the fictional world. The model allows for new ways for analysing and interpreting the neurocinematic data that have been collected during viewing of films. Further, the concept of narrative perspective associated to nowness accommodates even broader life contexts and other individual

[28] Mauri Kaipainen, Peter Normak, Katrin Niglas, Jaagup Kippar, Mart Laanpere, "Soft ontologies, spatial representations and multi-perspective explorability," in *Expert Systems*, no. 5, 2008, pp. 474-483.

determinants of experience, such as engagement in a film culture in such a way that allows the identification of cross-references between movies. In this respect, the proposed model should rather be regarded as the broad hypothesis that the experience of nowness can be modelled and mapped to its neural epiphenomena, implying a novel paradigm of film research.

Some sceptics with an implicit dualist attitude may argue that by introducing scientific methods into the film research the neurocinematic approach takes a collision course with humanist values. We believe the opposite, namely that insights to the physiological grounds of the embodied film experience will contribute to the holistic understanding of the art of film – right at the heart of humanity.

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