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Apparent Phi-Motion in Sequences of Eisenstein's *October*

1. Introduction

Dynamic visual media are today an integral part of our everyday lives (Beller, 2006; Charney & Schwartz, 1995; Doane, 2002; Pomerance, 2006). Film is based on the presentation of still images in a specific temporal sequence, a technique that began to be developed about 125 years ago with devices such as the Zoetrope and the motion experiments of Eadweard Muybridge (Abel, 2005; Hendricks, 1975; Herbert, 2000). The viewing of dynamic scenes refers to perceptual, attentional and cognitive processes that can generate the impression of real-world motion, a phenomenon called apparent motion (Koffka, 1935; Münsterberg, 1916; Wertheimer, 1912). Efforts to understand mechanisms of cinematic perception have increased over the past several decades (e.g. Allen, 1995; Anderson, 1996; de Lauretis & Heath, 1980; Deleuze, 1983, 1985; Hochberg, 1986; Hochberg & Brooks, 1978; Smith, 2006; Virilio, 1994; Williams, 1997). Recent technical advances, such as fMRI and video-based eye-tracking, not only allow us to investigate where people pay attention when watching movie sequences (e.g. Schrammel, Pannasch, Graupner, Mojzisch, & Velichkovsky, 2009), but also permit us to analyze brain activity while viewing films (Bartels, Zeki, & Logothetis, 2008; Hasson et al., 2008).

Although these techniques can be used to gain insight into the viewer's mind, filmmakers also need to understand how to manipulate both the viewer's perception and his or her attention through the shooting process. While directors have their individual compositional styles, which partially manipulate film viewing (cf. Bazin, 2003; Gidal, 2008; Henderson, 1980), different techniques in film editing also strongly influence where viewers look (Cutting, DeLong, & Nothelfer, 2010; Salt, 1992). Indeed, there has been a long-standing debate among film theoreticians regarding the virtues and limitations of montage (Bazin, 1967; Kracauer, 1973). The present research was inspired by the work of the Soviet filmmaker Sergei Eisenstein (1898–1948), who, following D. W. Griffith (1875-1948), is credited with perfecting film montage, that is, the purposeful planning and sequencing of specifically timed edits for greater emotional impact (Antoine-Dunne, 2003; Bernas, 2008; Bordwell, 2005; Nesbet, 2007). Classic examples of this technique can be found in *Strike* (1924), *Battleship Potemkin*

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(1925), *October* (1927)*, Old and New* (1929), as well as the Battle on the Ice in *Alexander Nevsky* (1938) (Aumont, 1979). Here we will focus only on *October* (see Eisenstein, 1975).

Commissioned by the Soviet government for the tenth anniversary of the Russian Revolution and released in 1927, *October* («Октябрь») constitutes a unique work of art aesthetically, as well as a technical milestone in the evolution of film editing (Harte, 2009; Rosenstone, 2001; Sorlin & Ropars, 1974; Sperber, 1977; Taylor, 2002). In order to examine Eisenstein's theories and techniques of montage (Eisenstein, 2010; Эйзенштейн, 1964), we selected a particular sequence from the movie. In this sequence, a machine gunner and his gun are presented in alternation. Individual shots of this sequence are aligned in a way that "the soldier becomes his machine" (Sperber, 1977). To achieve this impression, Eisenstein "cuts repeatedly from a frame of the machine gun pointing down to a frame of the gun pointing upward, followed immediately and several times by a dark close-up of the machine-gunman's face. This 'effect almost of double exposure with rattling montage' (Eisenstein's own description) continues in subsequent frame-by-frame cutting between the gun and the gunman [...] The montage has not only simulated the visual experience of bullets being fired but also replicates, through the swift and aggressive interchange of images, the firing sound of the bullets" (Harte, 2009, p. 206; cf. Selden, 1982).

Although the machine gun is perceived as firing, examination of the individual shots in the sequence revealed that only the face of the machinegunner and different views of the machine gun are displayed. Therefore, the gunfire seen in the sequence is an illusory perception. We propose that due to the rapid presentation of the shots, lasting between 33 and 700 ms, apparent motion is induced which generates the illusion of gunfire, although this is not shown.

Apparent motion or apparent movement has been thoroughly described by Max Wertheimer in 1912 in relation to his discovery of pure apparent movement, which Wertheimer called phi-motion (from *phenomenal* motion) in order to distinguish it from optimal apparent movement or beta-motion (Wertheimer, 1912). In its simplest form, Phi-motion consists of two identical stimuli flashing alternately at two different places and inducing the illusion of a single object moving from one place to another while continuously visible across the empty space in between. The timing of the two stimuli is critical, leading to an illusion called 'objectless motion' (for a recent review see Steinman, Pizlo, & Pizlo, 2000). Seeing motion without seeing a moving object is a puzzling experience for most subjects who often interpret it as a kind of 'tunnel effect' where the moving object is perceptually present but is optically hidden behind an occluder. Accordingly, the phi phenomenon can be considered as one of many examples of 'amodal completion' of perceptual structures not limited to vision or dynamic stimulation (Bregman, 1990; Michotte, Thinès, & Crabbé, 1964).

Both forms of visual illusory motion typically use simple stimuli such as dots or bars (see http://www1.psych.purdue.edu/Magniphi/MagniPhi.html for an example). However, there is reason to assume that Eisenstein experimented with this illusion to induce apparent motion by extending the phenomenon to complex and natural images. First of all, as evidenced in his films and his written work, Eisenstein was interested in psychological research and the discoveries from this field (Eisenstein, 1942, 1949, 2010). Most likely he was introduced to the ideas and concepts of Gestalt psychology by his friends Lev Vygotsky and Alexander Luria, renowned Soviet psychologists, who laid down the foundations for cultural-historical psychology and modern neuropsychology, respectively (Bulgakowa, 1988; Cole, Levitin, & Luria, 2006; Moll, 1990). Apart from the sequence we investigated here, there are further indications that Eisenstein knew about the phenomenon of phi-motion (c.f. for instance the sequence of the three sculpted lions in *Battleship Potemkin*, Eisenstein, 1949; fig. 8). Accordingly, his work can be understood as a cross-connection between psychology, aesthetics and visual art (Bulgakowa, 2001).

In the present work, we explore the nature of the illusion of gunfire in the machine-gunner sequence. We propose that apparent phi-motion is induced due to the sequence and duration of the pictures in the sequence (other motion in films relies on beta motion). The unit of investigation was the shot, which represents a single unbroken period of recording with a motion picture camera (Smith, 2006) and is generally understood as "the smallest film unit to which viewers can direct their attention" (Cutting, et al., 2010, p. 433; cf., however, Eisenstein, 2010). In contrast to simple stimuli, the key for the successful implementation of apparent motion in natural images (i.e. shots) seems to be the appropriate direction of covert visual attention (i.e. shifts of attention without eye movements). We think that covert visual attention is guided within single shots, sometimes only a single frame in duration, to a certain position which is characterized by particularly salient and informative features (or 'attractors'). Due to the combination of the shots in the sequence the viewer's visual attention is guided to different locations, inducing apparent motion and leading to the illusory perception of gunfire (see findings by Hikosaka, Miyauchi, & Shimojo, 1993, on the relationship between shifts of visual attention and the perception of motion).

To explore this hypothesis, we presented single shots from the machine-gunner sequence as still images and asked our subjects to indicate the most informative region. We assumed that the position of the most informative and salient region would systematically change from one shot (*n*) to the next (*n*+1). To investigate this hypothesis, we contrast our empirical observations with the theoretical assumption of an equiprobable arrangement of the most informative region between shots. Furthermore, apparent motion would require a particular strategy of back-and-forth position changes. Therefore we anticipated to find larger distances between the positions of shots *n* and *n*+1 than between positions of shots *n* and *n*+2.

2. Methods

2.1. Subjects

Five healthy volunteers took part in this experiment; 2 females and 3 males ranging in age from 22 to 63 years (mean age 34.4). All subjects had normal or corrected to normal vision. The study was conducted in conformity with the declaration of Helsinki.

2.2. Stimuli and Procedure

The machine-gunner sequence of Eisenstein's *October* consists of three sequential episodes[1]. From each episode individual shots were extracted, resulting in a total of 58 pictures (episode 1: 16 images; episode 2: 22 images and episode 3: 20 images). Images were extracted manually with a resolution of 720 x 480 pixels by using the freeware software VirtualDub-MPEG2. For the purpose of the study it was necessary to generate two different image sequences. From the original stream in the movie, images were alternately assigned to the two sequences (sequences 1 and 2 in Figure 1). Stimuli were presented in full screen mode on a 15.4 inch LCD display with a refresh rate of 60 Hz using a NVIDIA Quadro NVS 140M graphic card. Subjects inspected the images with a viewing distance of 70 cm; the screen subtended a visual angle of 34° horizontally and 22° vertically.

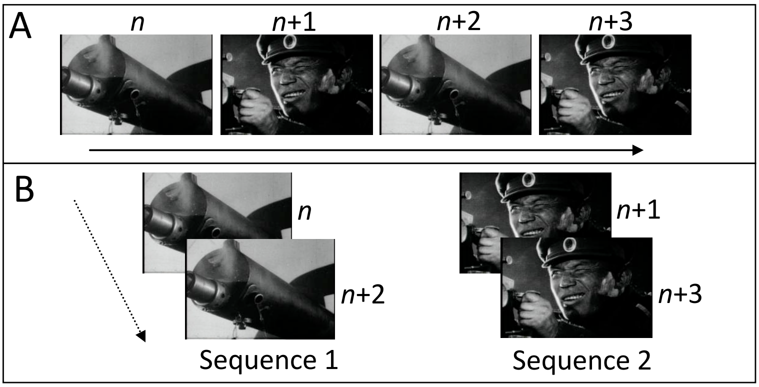

Fig. 1 Numbering (*n*…*n*+3) and sequence of four exemplary shots in the original movie (A) and as they were shown in the experiment (B). The temporal order of shots is indicated by the horizontal arrow in (A) and in (B) by the dotted arrow. Please note that the figure displays only a subsample of shots; the sequence contained more and different shots that are not shown here.

[1] Episodes were taken from the DVD *October: Ten days that shook the world.* released by Image Entertainment, Dec 29, 1998; running time 103 minutes (episode 1: frames 27725-27773, episode 2: 28387-28442, episode 3: 28685-28732).

Before the start of the experiment, subjects saw a sample image and were told to point with their index finger to the most informative and salient image region as soon as possible after the image onset. All answers were coded by the experimenter in regions according to a 3 x 3 matrix (see Figure 2). Within one session, one sequence was viewed. Each participant attended twice, with a minimum of two days in between. The order of sequence completion was counterbalanced across the participants. The total duration of one session was about 15 minutes per participant.

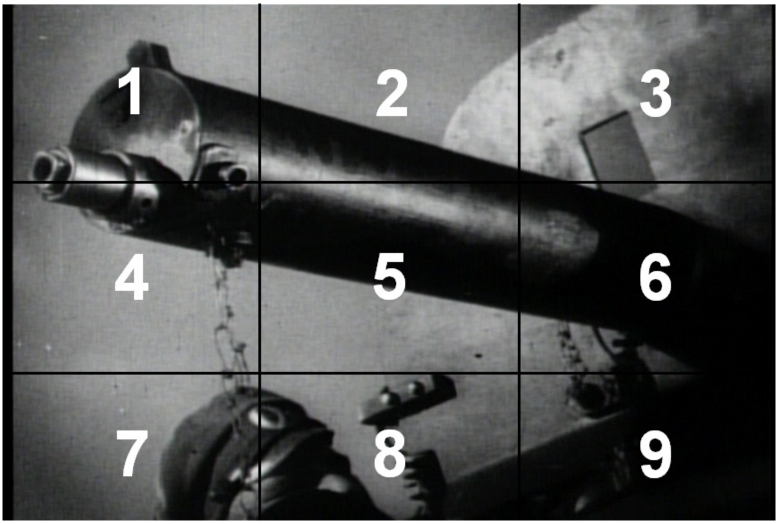

Fig. 2 Example shot showing the grid and numbering that was only used for the position categorization and not shown to the subjects.

3. Results

Figure 3 shows the frequencies of selected positions for each episode and reveals that regions 4 and 5 (middle left and central image region, see Figure 2) were most often selected. Position codes for each image were transformed into a substitution matrix to allow the calculation of distances between single images. Distance vectors were computed for the order of shots as shown in the experiment and the order of shots in the original movie. Furthermore, for the equiprobable distribution of attention, which assumes that there is no relation between successive shots, an average expected distance was computed for each single shot.

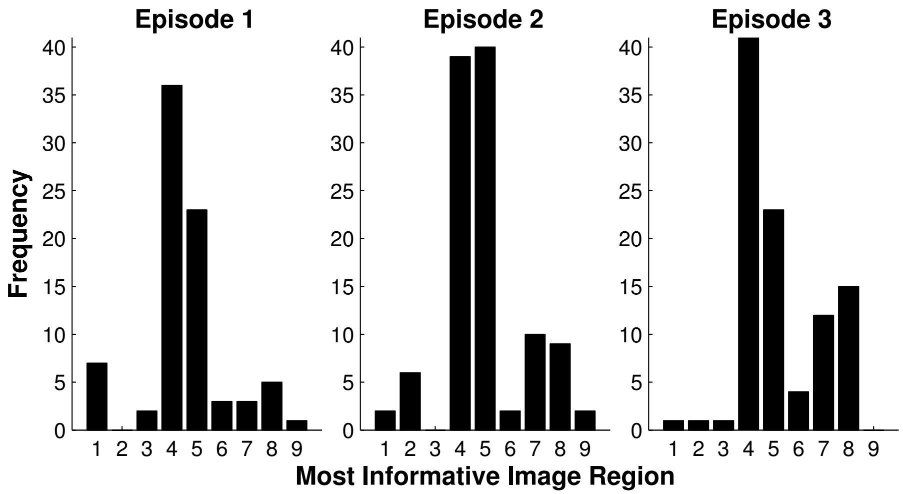

Fig. 3 Frequency of image regions that were selected as most informative across the different episodes.

First we compared spatial distances between the selected positions within successive shots of each sequence as it was used in the experiment. This was done in order to make sure that no bias in the distance values was generated as the result of the sampling of the shots. Averaged distance values for each subject and episode were subjected to a repeated measures analyses of variance (ANOVA) with sequence (S1, S2) as within-subjects factor and episode (1, 2, 3) as between-subjects factor. No differences were obtained neither for sequence, $F(1,12) = 1.62$, $p > .05$, nor for the sequence x episode interaction, $F(1,2) = 1.03$, $p > .05$. Since distances for both sequences are similar (*M*s = 0.76 and 0.64), we collapsed them and refer to them as the experimental distance vector.

To compare the distance values we computed a repeated measures ANOVA with shot order (experimental, movie, equiprobable) as within-subjects factor and episode (1, 2, 3) as between-subjects factor. Significant differences were obtained for shot order, $F(2,24) = 38.14$, $p < .001$, $\eta^2 = .66$, as well as for shot order x episode interaction, $F(4,24) = 3.76$, $p = .016$, $\eta^2 = .13$. Subsequent shots in the experimental arrangement were obviously more similar than in the original movie, as evidenced in smaller distance values for the experimental ($M = 0.69$) than for the original movie arrangement ($M = 1.02$). Furthermore, the obtained larger distance values for the equiprobable distribution arrangement ($M = 1.31$) support the idea that attention is guided in a specific manner. Bonferroni corrected pairwise post-hoc analyses were conducted and revealed that all distributions differed significantly from each other, all $p < .01$. Furthermore, Figure 4 shows a decrease in distance values across the episodes for the experimental arrangements, while distances in the original movie sequences increase. It indicates an amplification of the attention guidance across the episodes: Distances in the experimental arrangement become smaller, i.e. the attention between shots *n* and *n*+2 remain within similar regions, but those regions appear to be further apart from each other between shots *n* and *n*+1, as the distance values increase in the original movie sequence. This divergent behavior is reflected in the significant shot order x episode interaction. The Bonferroni corrected pairwise comparisons across the episodes, conducted separately for each shot order, were not significant, all $p > .05$.

Based on the assumption that the presentation time of individual shots also can contribute to the illusion, we assume a decrease in the duration of individual shots across the three episodes. Individual shot durations of each episode were applied to a one factorial ANOVA. While largest presentation times were found for the first episode (*M*s = 117 vs. 87 vs. 83 ms) this difference was not significant, $F < 1$. Accordingly we rejected the hypothesis that presentation time might contribute to the illusion of seeing gunfire.

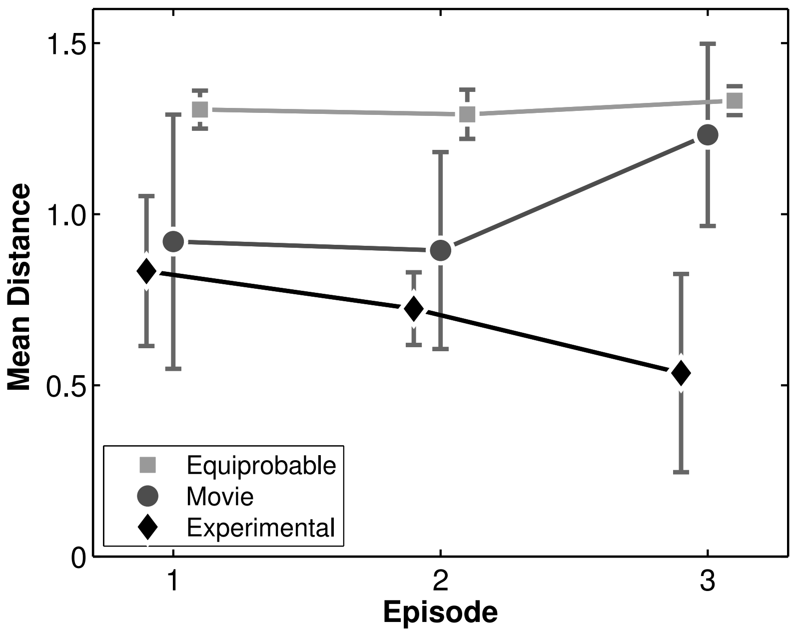

Fig. 4 Mean distance values between most informative regions for each episode.

4. Discussion

We wanted to shed light on the connection between psychology, aesthetics and cinema in the work by the Soviet filmmaker Sergei Eisenstein. From his movie *October*, we examined all three episodes of the famous machine gunner sequence. For each individual shot of the sequence the most informative region was determined. Our results reveal clear evidence for a systematic distribution of the region of highest information thereby ruling out an equiprobable distribution. Furthermore, position changes between two successive shots in the movie were larger than distances between shot *n* and *n*+2 as shown in the experiment. This finding supports our assumption that a special case of apparent motion, namely motion without perception of a moving object, or phi-phenomenon, is responsible for the illusory perception of gunfire although it is not shown in the footage.

While visual attention is guided to different positions in the image from one shot to the next with an average distance of 1, the mean distance between shots *n* and *n*+2 is around 0.7. These values suggest that for successive shots average attentional jumps are from one cell in the position matrix to the neighboring cell (see Figure 3). However, according to the averaged distance between shot *n* and shot *n*+2, attention often remains within the same cell. Taken together, the general pattern would be an alternation between two different locations, very similar to the usual apparent motion paradigm. According to our data, our hypothesis of seeing the illusion of gunfire seems to be very likely.

For the critical temporal interval, Wertheimer (1912) described the appearance of phi-motion in between the perception of two simultaneous stimuli (simultaneity) and the perception of two successive stimuli (successivity). Wertheimer reported simultaneity if the time interval between two stimuli was about 30 ms, whereas successivity was found for a temporal gap of about 200 ms. Apparent phi-motion occurs with intervals closer to simultaneity, more precisely with gaps of around 80-100 ms in between. This was replicated in a later demonstration by Steinman et al. (2000). The timing corresponds well to the average presentation time of the shots in the sequence (83-117 ms). Such short presentation times do not allow for eye movements in the sense of gaze shifts between the different regions, since saccade programming typically requires about 150-200 ms (e.g. Fischer & Ramsberger, 1984). Therefore mechanisms of fast relocation of covert attention are assumed to be involved in the generation of this phenomenon. For example, Cavanagh (1992) suggested two independent motion processes, a low-level automatic mechanism that can signal motion even in the absence of attention (i.e., by the way of 'pre-attentive mechanisms'), and another that is mediated by fast shifts of visual attention.

The present study is only a first step in the analysis of this phenomenon. A more in-depth analysis could include the experimental manipulating of certain features of the shots, for instance testing to what extent the modulation of contrast and timing of single shots is responsible for the effect. In future work, the most informative region within a shot as identified here by means of subjective evaluation could be compared with other methods, such as physical saliency-based search mechanisms (Itti & Koch, 2000; Scher, Gaunt, Bridgeman, Swaminarayan, & Davis, 2011, in press) or, as recently suggested

(Hwang, Wang, & Pomplun, in press), could involve psycholingustic measures and semantic scene analyses. In fact, the machine-gunner sequence presents us with another and especially strong form of attractor for observer's attention, namely social saliency (Hari & Kujala, 2009; Velichkovsky et al., in press). This form of saliency is briefly presented in the posture, facial expression and gaze of the gunner fixated on the invisible goal of his action. Even with the limited number of shots in this sequence, it would be hardly possible today to formally describe the cumulative influence of all the forms of attractors on the observer's attention. A final task for future research is to delineate the relative contributions of the hypothetical covert shifts of attention and pre-attentive mechanisms to the effect. It seems that in some displays demonstrating static phenomena of 'amodal completion', the role of pre-attentive mechanisms of perceptual integration can prevail (Reijnen et al., 2009). This is what the fathers of Gestalt theory would probably expect due to their skepsis of attention as a general explanation in psychology (see e.g. Koffka, 1935).

In conclusion, the results of the present study not only support the idea that Eisenstein intentionally manipulated the position of viewers' attentional focus leading to the vivid impression of gunfire, which is actually based on the perceptual illusion of phi-motion. They also empirically confirm Eisenstein's own claims—at least as regards his own filmmaking—that "[c]inematography is, first and foremost, montage" and that "montage is conflict" (Eisenstein, 1949, pp. 28 and 38). "Had I been more familiar with Ivan Pavlov's teaching," Eisenstein wrote in retrospect, "I would have called the 'theory of the montage of attractions' the 'theory of artistic stimulants'" (Eisenstein, 1970, p. 17). In this connection, however, it is interesting to note that although gunfire is not shown explicitly in the sequence from *October*, smoke was noted emerging from the barrel of the gun in a single frame. Although this does not detract from the findings of this study, nor in any way diminish the creative force of the sequence, it is tempting to speculate whether Eisenstein, at some point during the filming, was unsure of the full effectiveness of the technique he had used.

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Summary

To investigate the connections between psychology, aesthetics and film in the work of the Soviet director Sergei Eisenstein (1898-1948), the present work analyzes the famous machine gun sequence from *October* (1927). In this sequence, the viewer perceives the

illusion of gunfire. To investigate whether this illusion is based on apparent phi-motion, individual shots were shown as still images, while participants had to indicate the most informative region, in terms of saliency, within each shot. The systematic distribution of the regions of highest information together with the presentation time of the shots support the idea that Eisenstein intentionally guided the viewers' attentional focus to induce the impression of apparent phi-motion.
Keywords: Apparent motion, film editing, montage, visual attention, apparent phi-motion.

Zusammenfassung

Um Zusammenhänge zwischen Psychologie, Ästhetik und Kunst in der Arbeit des sowjetischen Filmregisseurs Sergei Eisenstein (1898-1948) zu untersuchen, wurde die berühmte Maschinengewehrszene aus seinem Film *Oktober* (1927) analysiert. In der Szene nimmt der Betrachter die Illusion eines Gewehrfeuers wahr. Um zu untersuchen, inwieweit es sich dabei um das Phi-Phänomen handelt, wurden die einzelnen Einstellungen der Szene als Standbilder gezeigt. Die Probanden sollten für jedes Standbild die Region mit dem höchsten subjektiven Informationsgehalt angeben. Die räumliche Verteilung dieser Regionen sowie die Präsentationsdauer der einzelnen Einstellungen unterstützen die Annahme, dass Eisenstein den Aufmerksamkeitsfokus der Betrachter gezielt führt und somit eine Scheinbewegung im Sinne des Phi-Phänomens induziert.
Schlüsselwörter: Scheinbewegung, Filmschnitt, Montage, visuelle Aufmerksamkeit, Phi-Phänomen.

References

Abel, R. (2005): *Encyclopedia of early cinema*. Oxford: Routledge.

Allen, R. (1995): *Projecting illusion: Film spectatorship and the impression of reality*. Cambridge: Cambridge University Press.

Anderson, J. D. (1996): *The reality of illusion: An ecological approach to cognitive film theory*. Carbondale: Southern Illinois University.

Antoine-Dunne, J. (2003): *The montage principle: Eisenstein in new cultural and critical contexts*. Amsterdam: Rodopi.

Aumont, J. (1979): *Montage Eisenstein*. Paris: Albatros.

Bartels, A., Zeki, S. & Logothetis, N. K. (2008): Natural vision reveals regional specialization to local motion and to contrast-invariant, global flow in the human brain. *Cerebral Cortex 18*(3), 705-717.

Bazin, A. (1967): *What is cinema?* (Vol. I). Berkeley: University of California Press.

Bazin, A. (2003): *Orson Welles*. Paris: Cahiers du cinéma.

Beller, J. (2006): *The cinematic mode of production: Attention economy and the society of the spectacle*. Hanover: Dartmouth College Press.

Bernas, S. (2008): *Montage créatif et processus esthétique d'Eisenstein*. Paris: L'Harmattan.

Bordwell, D. (2005): *The cinema of Eisenstein*. New York: Routledge.

Bregman, A. S. (1990): *Auditory scene analysis*. Cambridge, MA: MIT Press.

Bulgakowa, O. (1988): *Herausforderung Eisenstein [Challenge Eisenstein]*. Berlin: Akademie der Künste der DDR.

Bulgakowa, O. (2001): The evolving Eisenstein: Three theoretical constructs of Sergei Eisenstein. In A. LaValley & B. P. Scherr (Eds.), *Eisenstein at 100: A reconsideration* (pp. 38-51). New Brunswick: Rutgers University Press.

Cavanagh, P. (1992): Attention-based motion perception. *Science 257*(5076), 1563-1565.

Charney, L. & Schwartz, V. (1995): *Cinema and the invention of modern live*. Berkeley: California University Press.

Cole, M., Levitin, K. & Luria, A. L. (2006): *The autobiography of Alexander Luria: A dialogue with the making of mind*. Mahwah, N.J.: Lawrence Erlbaum Associates.

Cutting, J. E., DeLong, J. E. & Nothelfer, C. E. (2010): Attention and the evolution of Hollywood film. *Psychological Science 21*(3), 432-439.

de Lauretis, T. & Heath, S. (1980): *The Cinematic Apparatus*. New York: St. Martins.

Deleuze, G. (1983): *Cinéma 1*. Paris: Minuit.

Deleuze, G. (1985): *Cinéma 2*. Paris: Minuit.

Doane, M. A. (2002): *The emergence of cinematic time: Modernity, contingency, the archive*. Cambridge, MA: Harvard University Press.

Eisenstein, S. (1942): *The film sense* (J. Leyda, Trans.). New York: Hartcourt.

Eisenstein, S. (1949): *Film form: Essays in film theory* (J. Leyda, Trans.). New York: Hartcourt.

Eisenstein, S. (1970): *Notes of a film director*. New York: Dover.

Eisenstein, S. (1975): *Schriften 3. Oktober [Writings 3. October]*. Munich: Carl Hanser.

Eisenstein, S. (2010): *Selected writings* (W. Powell, Trans.). London: I. B. Tauris.

Fischer, B. & Ramsberger, B. (1984): Human express saccades: Extremely short reaction times of goal directed eye movements. *Experimental Brain Research 57*, 191-195.

Gidal, P. (2008): *Andy Warhol: Blow Job*. London: Afterall.

Hari, R. & Kujala, M. V. (2009): Brain basis of human social interaction: From concepts to brain imaging. *Physiological Reviews 89*(2), 453-479.

Harte, T. (2009): *Fast forward: The aesthetics and ideology of speed in Russian avant-garde culture, 1910-1930*. Wisconsin: University of Wisconsin Press.

Hasson, U., Landesman, O., Knappmeyer, B., Vallines, I., Rubin, N. & Heeger, D. J. (2008): Neurocinematics: The neuroscience of film. *Projections 2*, 1-26.

Henderson, B. (1980): *A critique of film theory*. New York: Dutton.

Hendricks, G. (1975): *Eadweard Muybridge: Father of the motion picture*. New York: Grossman.

Herbert, S. (2000): *A history of pre-cinema*. New York: Routledge.

Hikosaka, O., Miyauchi, S. & Shimojo, S. (1993): Focal visual attention produces illusory temporal order and motion sensation. *Vision Research 33*(9), 1219-1240.

Hochberg, J. (1986): Representation of motion and space in video and cinematic displays. In K. Boff, L. Lloyd & J. Thomas (Eds.), *Handbook of perception and visual performance* (Vol. I: Sensory processes and perception, 22-1--22-64): New York: Wiley.

Hochberg, J. & Brooks, V. (1978): The perception of motion pictures. In E. C. Carterette & M. P. Friedman (Eds.), *Handbook of perception* (Vol. X, pp. 259-304). New York: Academic Press.

Hwang, A. D., Wang, H. C. & Pomplun, M. (in press): Semantic guidance of eye movements in real-world scenes. *Vision Research*.

Itti, L. & Koch, C. (2000): A saliency-based search mechanism for overt and covert shifts of visual attention. *Vision Research 40*(10-12), 1489-1506.

Koffka, K. (1935): *Principles of Gestalt psychology*. New York: Harcourt.

Kracauer, S. (1973): *Theorie des Films: Die Errettung der äußeren Wirklichkeit [Theory of film: Rescuing the external reality]*. Frankfurt/M: Suhrkamp.

Michotte, A., Thinès, G. & Crabbé, G. (1964): Les complements amodaux des structures perceptives [Amodal completion of perceptual structures] *Studia psychologica*. Louvain, Belgium: Institut de Psychologie de l'Universite de Louvain.

Moll, L. C. (1990): *Vygotsky and education: Instructional implications and applications of sociohistorical psychology*. Cambridge: Cambridge University Press.

Münsterberg, H. (1916): *The Photoplay. A psychological study*. New York: Appleton.

Nesbet, A. (2007): *Savage junctures: Eisenstein and the shape of thinking*. London: I. B. Tauris.

Pomerance, M. (2006): *Cinema and modernity*. Piscataway, NJ: Rutgers University Press.

Reijnen, E., Pedersini, R., Pinto, Y., Horowitz, T., Kuzmova, Y. & Wolfe, J. M. (2009): Amodal completion does not require attention. *Journal of Vision 9*(8), article 1174.

Rosenstone, R. A. (2001): October as history. *Rethinking History 5*(2), 255-274.

Salt, B. (1992): *Film style and technology: History and analysis* (2 ed.). London: Starword.

Scher, S., Gaunt, J., Bridgeman, B., Swaminarayan, S. & Davis, J. (2011, in press): Eye tracking based saliency for automatic content aware image processing *ICIP Proceedings*.

Schrammel, F., Pannasch, S., Graupner, S.-T., Mojzisch, A. & Velichkovsky, B. M. (2009): Virtual friend or threat? The effects of facial expression and gaze interaction on psychophysiological responses and emotional experience. *Psychophysiology 46*(5), 922-931.

Selden, D. (1982): Vision and violence: The rhetoric of Potemkin. *Quarterly Review of Film Studies 7*, 309-329.
Smith, T. J. (2006): *An attentional theory of continuity editing.* Unpublished Doctoral thesis, University of Edinburgh, Edinburgh.
Sorlin, P. & Ropars, M.-C. (1974): *Octobre: Écriture et idéologie [October: Writing and ideology]*. Paris: Albatros.
Sperber, M. (1977): Eisenstein's October. *Jump Cut 14*, 15-22.
Steinman, R. M., Pizlo, Z. & Pizlo, F. J. (2000): Phi is not beta, and why Wertheimer's discovery launched the Gestalt revolution. *Vision Research 40*(17), 2257-2264.
Taylor, R. (2002): *October: Октябрь*. London: British Film Institute.
Velichkovsky, B. M., Geusebroek, J. M., Graupner, S. T., Hari, R., Marsman, J. B., Schevchik, S. A., et al. (in press): Measurement-related issues in the investigation of active vision. In B. Berglund, G. B. Rossi, J. T. Townsend & L. R. Pendrill (Eds.), *Measurements with persons: Theory, methods, and implementation areas*. London: Taylor and Francis.
Virilio, P. (1994): *The vision machine*. Bloomington: Indiana University Press.
Wertheimer, M. (1912): Experimentelle Studien über das Sehen von Bewegung [Experimental studies on seeing of motion]. *Zeitschrift für Psychologie 61*, 161-265.
Williams, L. (1997): *Viewing positions: Ways of seeing film*. New Brunswick, NJ: Rutgers University Press.
Эйзенштейн, С. (1964): Как я стал режиссером [How I became a filmmaker] *Избранные произведения Сергея Эйзенштейна в шести томах. Том 1* (pp. 97-106). Москва: издательство "Искусство".

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